TYPOGRAPHICAL PRINTING-SURFACES

THE TECHNOLOGY AND MECHANISM OF THEIR PRODUCTION

BY

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INTRODUCTION

"Now of Introductions sooth be it Said that in them it behoveth to Speak fair, and with nice Tongue and Quaint upon the matter, yet not so far Removed therefrom that he that heareth be set Astray in his Expectations of things that be to Come."

Mirrour of Pryntyng.

Long primer ancient (Müller & Richard).

If we except the marks left by fossils such as those of leaves, shells, and other natural objects in the soft clay, hardened and turned to stone by the long-drawn action of ages, probably the first printing-surface in the world was the thumb or finger of some hunter ancestor of our race, producing its impress in blood on the blue-white surface of the skin freshly torn from his quarry.

Though the methods that produced this mark were similar, very different indeed was our antique hunter from our modern savages, regarded askance by society, whose thumb and finger prints present such interest to the Bertillons and to the Galtons and, incidentally, to the police of all civilized nations. It is indeed a far cry from the mark of prehistoric fingers on fresh-plucked skin to the marks the burglar leaves behind him on an incautiously handled beer-bottle, but the mechanical conditions which result in these marks are the same, and both are produced from a similar printing-surface.

In this work it is practically with printing-surfaces alone that the authors propose to deal, and not with the impressions produced; therefore, from their point of view, the thumb or the finger and its series of depressions and ridges which are the origin of the print, have for them more interest than the print itself. Within the same category fall all those processes which they are about to describe as contributing to the formation of a proper typographical printing-surface. Though ever striving to obtain perfection for the production of the printed page—to the printed page itself, except contingently, their subject will not take them.

Contrary to common opinion, the art of producing a printing-surface is a very old one indeed, and it was not so much the want of knowledge of how to print that retarded its development for so long, as the want of a proper fluid medium with which to print. It was ignorance of a proper ink and not of a proper type that kept this art almost unknown, and only led to its practical inception in the fifteenth century on the continent of Europe.

Printing on clay tablets or cylinders—in idea like the most approved modern methods—was practised in Babylon at least three or four thousand years ago. Printing on a plastic clay-surface with movable types was known in classic times, and the art was to a limited extent adopted among potters. Printing on tissues of various surface-qualities, continuous such as those of paper, or cellular, such as those of silk or other fabrics, was understood and used in China in remote ages. At all periods within civilization there have been printing-processes of some kind or other going on in the world, and therefore printing-surfaces have always been in use somewhere or other.

Interesting, however, as the matter may be from a philosophical or historic standpoint, it has but little importance so far as the scope of this present treatise is concerned, and therefore the brief remarks already made upon the subject must suffice in this introductory note. Reference, however, to the bibliography at the end of the volume will direct any, who may wish to investigate the matter at greater length, to works that contain information concerning a question full of interest.

The first really practical typographical printing-surface was an engraved block. Similar blocks are still in use to-day in certain parts of the world, for instance, in China and Japan, where the number and complexity of the ideographs, when this form of conveying ideas is employed, often render the use of movable type unremunerative and unpractical. The next improvement, useful only for languages possessing comparatively simple alphabets, was the separation of the characters, which composed the words engraved upon a block, into separate units.

This, about A.D. 1454, constituted the invention of Johann Gutenberg and Peter Schoeffer: "The Harlemers plead that Lawrence Jansz Koster of Harlem was the first inventor of printing in the year of Our Lord 1430." With the addition of this quaint sentence from Moxon, the first Englishman to write on the subject of the mechanical side of the printing art in 1683, is summed up what we know of the dawn of printing in Europe.

A word here, however, must be given to Moxon, whose "Mechanick Exercises" is the only English book that, so far as the authors know, has yet appeared on the subject of their treatise. Several chapters of the present work are headed by a quotation from this delightful old author, the study of whose volume has been a "pleasant drudgerie," and has never become, as has often been the case in wading through the works of some of his more ponderous contemporaries and followers, a "labour would make Hercules sweat."

In the initial stages of the art, printing was done from wooden types. The next step was the substitution of suitable metal types for the wooden ones, and this involved a much greater advance than is at first apparent, for it ultimately required the production of a steel punch from which to strike a matrix by means of which in turn, with proper appliances, to produce a type.

Hand-setting at this period, and for many years afterwards, was the means adopted for assembling the different units that went to form the page. In the early part of last century efforts were made to introduce mechanical composition, and probably to Church—whose patent, a British one, is dated 1822—the honour of this innovation must be allowed. This process of composing or creating the printing-surface by mechanical means was carried to a considerable state of perfection and real usefulness towards the end of the nineteenth century, and probably, had it commenced earlier, and had the production of cheap type been as far advanced then as it is to-day, it would have been one of the chief methods employed by the printer for the production of his printing-surface.

In the latter quarter of the last century, however, Ottmar Mergenthaler conceived the idea, along with many other fellow-workers of less note, of not only mechanically assembling type already cast, but of casting the type themselves, or their equivalent, from previously assembled matrices. Without going into details or referring to similar but unfruitful lines of invention, the advent and improvement of the Linotype on the one hand, and of the Monotype on the other, and of all their kith and kin, have carried things forward to the pitch of excellence marked by the closing years of the nineteenth century. A further advance seems likely to mark a new departure in these early years of the twentieth century, and what the next fifty years may show of yet further developments, it were hard to say.

In every instance, however, from the impress of the early hunter's finger upon the smooth white surface of the freshly separated skin to the most perfect example of modern letterpress work, the ultimate aim of the originator of the printing-surface is to produce a series of surfaces and depressions from which to reproduce the desired design. The end, unconsciously or consciously sought, has been the same, only the means for its realization have altered, changed and improved. It is with the more modern of these changes and alterations that the authors of this treatise have to deal.

THIS

JOSEPH MOXON

OF ENGLAND

1627–1700

"MECHANICK EXE

1683

THE ONLY TWO MEN WHO

IN

—FOR TH

BUT WITH THE B

TO GRAPPLE

THIS TREATISE IS DEDICATED

BY

THE AUTHORS

TO

THE MEMORY OF

JOSEPH MOXON AND PIERRE SIMON FOURNIER

OF ENGLAND 1627–1700 — OF FRANCE 1712–1768

WHO PUBLISHED THEIR

"MECHANICK EXERCISES" AND "MANUEL TYPOGRAPHIQUE"

IN THE YEARS

1683 AND 1764

RESPECTIVELY;

THE ONLY TWO MEN WHO HAVE, HITHERTO, SO FAR AS CAN BE ASCERTAINED,

ATTEMPTED,

IN COMPARATIVELY SMALL PART

—FOR THE MATTER THEN ITSELF WAS SMALL—

BUT WITH THE BEST CONTEMPORARY KNOWLEDGE AVAILABLE,

TO GRAPPLE WITH THE PROBLEMS OF THE SUBJECT.

"I hold every man a debtor to his profession, from the which, as men do of course seek to receive countenance and profit, so ought they of duty to endeavour themselves by way of amends to be a help and an ornament thereunto."

LORD BACON.

"Founders and senators of states and cities, lawgivers, extirpators of tyrants, fathers of the people, and other eminent persons in civil government, were honoured but with titles of *worthies* or demi-gods; whereas, such as were inventors and authors of new arts, endowments and commodities towards man's life, were ever consecrated amongst the gods themselves: and justly, for the merit of the former is confined within a circle of an age or a nation, and is like fruitful showers, which, though they be profitable and good, yet serve but for that season, and for a latitude of ground where they fall; but the other is, indeed, like the benefits of Heaven, which are permanent and universal, coming 'in aura leni,' without noise or agitation."

LORD BACON.

"Les grands services font les grands hommes, car la vraie gloire n'appartient qu'aux idées fécondes."

"C'est de Dieu que nous vient cet Art ingénieux
De peindre la parole et de parler aux yeux,
Et par des traits divers de figures tracées,
Donner de la couleur et du corps aux pensées."

PIERRE SIMON FOURNIER. *Preface to "Manuel Typographique."*

PREFACE.

"Never let it, then, be said, that a British Public have encouraged the introduction of that machinery, which can only tend to damp and destroy all the energy and talent of those who have hitherto upheld and exercised the Art. . . ."
Preface to Johnson's *Typographia* (1824).

" . . . mais nous avons changé tout cela."
Molière, *Le Médecin Malgré Lui.*

In dealing with typographical printing-surfaces and the processes and mechanisms of their production, one of the great difficulties experienced has been, not so much to know what to include in this treatise as to decide what to leave out; the aim having been not only to produce an interesting volume, but to make it also a standard text-book on the subject of which it treats.

The foundation of the present work is a paper read by one of the authors before the Institution of Mechanical Engineers and published by that body in their proceedings. The widespread interest it aroused, and the demand for copies of the excerpt as a work of reference, suggested the turning of a technical paper into a manual of technology; the one containing in all some hundred and fifty pages of illustrations and printed matter, and the other between six hundred and seven hundred pages of letterpress and over six hundred illustrations.

None can be so well aware as the writers themselves of their own deficiencies and of the skeleton fashion in which important sections of their thesis have been discussed, but the subject as a whole is so vast and so complex, and embraces so many fields of human activity, industry, and invention, that, if treated in a more prolix and less practical manner, the result would have rivalled the ponderous tomes of the old schoolmen themselves.

The time and trouble involved in the production of the book, even in its present form, have been very considerable, and the large amount of what may be called "dead work" is little apparent in the pages as they appear in their finished state.

To take the single instance of patents: thousands of these, both British and foreign, have had to be looked up, compared, abstracted, or considered, a task not rendered any the easier from the curious Patent Office classifications that confuse the multitudinous masses of typewriter detail with things that are more nearly pertinent to the printer.

The authors do not grudge their labour, for it has been a labour of love and one that has led to numerous friendships, but where thanks are due to so many, it would be invidious to particularize. The courtesy, however, of the Institution of Mechanical Engineers demands unique acknowledgment, for ready permission for the reproduction of parts of the original paper and kindly liberality in allowing the use of their blocks and drawings. Special help is referred to in the text as occasion demands, and all those, whose names are recorded in the following pages, and without whose friendly co-operation this work could never have come into being, are here very heartily thanked.

London, 1915.

Note.—The authors will be much obliged if any one consulting this book and discovering error, mis-statement, or omission, will communicate with them directly or through their publishers, with a view to having the matter rectified in a following edition.

HAEC OLIM MEMINISSE JUVABIT.

Subjoined is a list of the names of those who either in their individual or corporate capacity, or both, have been of assistance to the authors by advice or act, helpful material or confirmation of data. Some, of course, have done more than others, but where the goodwill of so many has been obvious, it would be invidious to particularize.

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CHAPTER

CONTENTS

APPENDICES

TABLES.

A LIST OF THE ILLUSTRATIONS IS GIVEN IN APPENDIX V.

GLOSSARY OF COMMON TECHNICAL TERMS.

". . . I do not exhibit this as a *Dictionary* so perfect, that all the obstruce Words and Phrases used among *Printers, Letter-cutters* and *Founders* are here exposed; for Words and Phrases offer themselves either as Discourse or Contemplation occurs . . ."
Moxon's Mechanick Exercises.

8-point De Vinne, roman and italic (American Type Founders Co.).

agate; an American size of type, see p. 59, table 3.
Alinement, see p. 24, par. 2; and p. 28, par. 2.
antique; a style of type, see p. 30, § 2; pp. 84–5, fig. 59; p. 86, § 5; and p. 87, § 12.
Ascenders; capital letters and lower-case b, d, f, h, i, j, k, l, t, which ascend above the small sorts.
atlas; a style of type, see p. 33, § 10.
a–z length (in ems); the overall length set-wise of the lower-case alphabet.
Bastard body, see p. 68, par. 3.
Beard or **neck,** see p. 11, fig. 3.
Beard or **kern** (at front or back), see p. 22, par. 1; p. 78, last par., and p. 80, par. 2.
Beard; the dimension line-to-front, see p. 14, par. 3.
Bill of fount or **scheme,** see p. 126, pars. 3 and 4.
black; a style of type, see p. 83, par. 6; and pp. 84–5, fig. 59, § 1.
Blacks; impressions of spaces, quads, furniture, etc., which have risen in the forme.
blackfriars; a style of type, see p. 82, § 3; pp. 84–7, figs. 59 and 60; and p. 86, §§ 7 and 16.
Body or **stem** or **shank**; part of a type, see p. 11, fig. 3.
Body-size (of type); now usually defined as a number of points, see p. 59, par. 1.
bold; a heavy face of type, see p. 31, last par.
booklet; a style of type, see p. 577, ex. 1.
Borders and **corners,** see p. 109, pars. 1 to 3 and figs. 95 to 97.
bourgeois; a size of type, see p. 59, table 3; and p. 60, par. 3.
Bowl; part of a letter, see p. 11, par. 2.
Braces, see p. 111, fig. 104.
Break, see pp. 12–14.
brevier; a size of type, see p. 59, table 3.
brilliant; a size of type, see p. 71, table 6.
broad face, see p. 89, fig. 61.
canon; a size of type, see p. 58, last line.
Capitals, see p. 35, table 3, line 3.
Cat's ears; part of a letter, see p. 11, par. 2.
Chase; an iron frame for holding a page or pages of composed type.
cheltenham; a family of type faces, see pp. 84–7, figs. 59 and 60; p. 86, §§ 8 and 17; and pp. 91 and 92.
clarendon; a style of type, see p. 30, § 2.
Clump; a thick lead, see p. 55, par. 4; and p. 114, par. 1.
Colophons, see p. 112, last par. and fig. 108.
columbian; an American size of type, see p. 70, table 6.
columbus; a style of type, see p. 91, ex. 13.
Composing; setting up matter in type or matrices with spaces between the words.
compressed face, see p. 89, par. 1.
condensed face, see p. 89, par. 1 and fig. 61.
Counter; part of a type, see p. 11, fig. 3.

Crotch; part of a letter, see p. 11, par. 2.
Dashes, see p. 112, pars. 1 and 2, and figs. 106 and 107.
Depth of strike, see p. 11, par. 1.
Descenders; letters or characters that descend below the line.
De Vinne; a family of type faces, see p. 32, § 8; pp. 84–7, figs. 59 and 60; p. 86, §§ 6 and 15; and p. 92.
diamond; a size of type, see p. 58, par. 4.
Distributing; putting back sorts of type or matrices, letters or spaces, into their boxes or compartments in the case or magazine.
doric; a style of type, see p. 30, § 1.
Dot; part of the type tang, see p. 11, fig. 2.
Dot; part of a letter, see p. 28, fig. 41; and p. 29, par. 1.
double english;——**great primer**;——**small pica**; American sizes of type, see p. 70, table 6.
double pica; a size of type, see pp. 70–1, table 6 (24-point in America, 22-point in England).
Dressing (type); see p. 20, pars. 2 and 3.
egyptian; a style of type, see p. 30, § 2; pp. 84–5, fig. 59; and p. 87, § 12.
em; a set-wise dimension equal to the body of the type; also used for defining widths of columns, the pica em being the unit; thus 15 ems = about $2\frac{1}{2}$ inches.
em quad, see p. 55, par. 1.
emerald; a size of type, see p. 58, par. 4.
em-set; the set width equal to the body of the type.
en; a set-wise dimension equal to half the body of the type.
en quad, see p. 55, par. 1.
english; a size of type, see p. 58, par. 4.
en-set; the set width equal to half the body of the type.
excelsior; an American size of type, see p. 58, par. 4.
expanded face, see p. 89, par. 1 and fig. 61.
extended face, see p. 89, par. 1.
extra-condensed face, see p. 89, fig. 61.
Face; a designation for styles of type, see p. 10, par. 4.
Face; the printing-surface of type, see p. 11, fig. 3.
Family (of type faces), see p. 122, par. 8.
fancy face, see p. 83, par. 4.
fat face, see p. 89, fig. 61.
Foot (of type), see p. 11, fig. 3.
Flong, see p. 473, par. 2.
Forme; a page or pages of type, secured in a chase, for printing from; see p. 689, par. 8.
Former, see p. 122, par. 3.
Fount scheme, see p. 126, pars. 3 and 4.
Fount of type, see p. 34, par. 3.
four-line pica or **canon**; a size of type, see p. 71, table 6.
french antique; a style of type, see p. 30, last ex.; and p. 31, par. 1.
french clarendon; a style of type, see p. 31, par. 1.
Full point or **period**; the full stop: **full point inverted**; the decimal point.
Furniture, see p. 55, par. 3.
Galley; an oblong tray with vertical sides, usually of metal, to which composed type or type-slugs are transferred.
Gauge (of type), see p. 11, fig. 4.
gothic; a style of type; the American name for sans, sans serif, sanserif, doric or grotesque.
great primer; a size of type, see p. 59, table 3.
Groove or **heel-nick**, see p. 11, fig. 3.
grotesque; a style of type, see p. 30, § 1.
Groundwork, see p. 110, par. 2 and fig. 100.

Hair-line, see p. 11, fig. 4.
Hair-space, see p. 55, par. 1.
hawarden; a style of type, see p. 91, ex. 5.
Heel-nick or **groove**, see p. 11, fig. 3.
Height-to-paper, high-to-paper, see p. 14, last par.
Inferiors, see p. 39, algebraical signs.
inclined sans serif,——gothic,——grotesque; a style of type, see p. 83, par. 9.
ionic; a style of type, see p. 31, § 4.
italian; a style of type, see p. 90, exs. 8 and 18.
italic, see p. 95, last par.
jenson; a style of type, see p. 31, § 5.
jobbing faces; fancy faces, see p. 83, par. 4.
Justifying, see p. 19, par. 3.
Kern, see p. 21, last par.; and p. 79, fig. 57.
latin; a style of type, see p. 31, § 6.
latin character; as contrasted with the german, greek, arabic, and other characters.
Lay of case; the arrangement adopted for the type in the compartments of the case.
Lead, leads, see p. 55, par. 4.
Leaders; dots or dashes placed at intervals in letterpress to guide the eye; two or more dots cast on the same type thus .. ..
lean face, see p. 89, fig. 61.
Ligatures, see p. 147, fig. 122; and p. 150, par. 1.
Line, alinement, see p. 11, fig. 4; p. 28, fig. 41 and last par.; and p. 122, last par. to p. 126.
Line-justification, see p. 77, par. 4.
Line-to-back, see p. 11, fig. 4; and p. 14, par. 3.
Lock-up (test), see p. 116, fig. 118.
Logotypes, see p. 108, par. 4.
long primer; a size of type, see p. 59, table 3; and p. 60, par. 3.
Lower-case letters; specifically those letters which are placed in the compartments of the lower case (p. 285, fig. 263); now often used for small letters as opposed to capitals.
Low-to-paper, see p. 14, last par.
Main-stroke, see p. 11, fig. 4.
Matrix, see p. 216, par. 1.
Matter; type set up; **dead** ——, no longer required for printing; **leaded** ——, with leads between the lines; **live** ——, ready and required for printing; **solid** ——, without leads.
meridian; an American size of type, see p. 58, last par.; and p. 70, table 6.
Middle space, see p. 55, par. 1.
minikin; a size of type, see p. 58, par. 4.
minion; a size of type, see p. 59, table 3.
minionette; an American size of type, see p. 70, table 6.
modern; a group of styles of type, see p. 33, § 9; pp. 84–7, figs. 59 and 60; and p. 87 §§ 11 and 19.
modernized old-style; a style of type, see pp. 84–7, figs. 59 and 60; and p. 87, §§ 10 and 18.
Monks and friars; heavy and light impressions of type, high or low to paper respectively.
morland; a style of type, see p. 91, ex. 14.
Mould, see p. 241, par. 1.
Neck or **beard**; part of a type, see p. 11, fig. 3.
Nick; part of a type, see p. 11, fig. 3.
nonpareil; a size of type, see p. 59, table 3.
old-face; a style of type, see p. 32, § 8; p. 83, last par.; and pp. 84–7, figs. 59 and 60, §§ 4 and 14.
old-style; a group of styles of type, see p. 32, pars. 1 and 2; and pp. 82–3, § 1.
Ornaments, see p. 109, last two pars.; and figs. 98–9.

Page (of type), see p. 144, par. 1.
paragon ; pearl ; sizes of type, see p. 59, table 3.
pica ; a size of type, see p. 58, table 2 ; and p. 59, table 3.
Pie ; type which has fallen down or become indiscriminately mixed.
Plate ; abbreviation for stereotype-plate.
Pocket, to work in ; to pool wages.
Point ; the unit for type body-sizes = 0·013837 inch, see p. 59, par. 1.
Point common line ; point title line, see p. 124, par. 3 and table 10.
Point system, see p. 60, par. 3.
Points ; punctuation marks, see p. 35, table 1.
Punch, see p. 194, par. 2.
Quad or **quadrat,** see p. 55, par. 1.
Quotations, see p. 55, par. 3.
Reglet, see p. 55, par. 4 ; and p. 113, last par.
roman ; type with vertical main strokes, as contrasted with italic, see p. 35, table 1.
ronaldson ; a style of type, see p. 91, ex. 8.
Rubbing, see p. 19, last par.
ruby ; a size of type, see p. 59, table 3.
Rules, see p. 110, last par. ; and p. 111, fig. 102.
sans or **sans serif** or **sanserif ;** a style of type, see p. 30, § 1.
Scheme or **bill of fount,** see p. 126, pars. 3 and 4.
script ; a style of type, see p. 96, par. 3 ; and p. 279, ex.
script ; a system of written or printed characters.
Scrolls, see p. 111, par. 2 and fig. 103.
Series (of type faces), see p. 121, par. 1.
Serif, see p. 11, fig. 4.
Set, see p. 11, fig. 4.
Shoulder ; part of a type, see p. 11, fig. 3.
Side-wall, see p. 11, fig. 4.
skeleton antique ; a style of type, see p. 90, last ex.
Slug or **clump,** see p. 689, par. 4.
Slug ; abbreviation for type-slug.
Small capitals, see p. 35, table 1, line 2.
small pica ; a size of type, see p. 59, table 3 ; and p. 60, par. 3.
Small sorts ; lower-case characters which neither ascend nor descend.
Sorts ; the general term for any particular letter or letters as distinguished from a fount.
Spaces ; hair —— ; middle —— ; thick —— ; thin ——, see p. 55, par. 1.
Stem or **shank,** see p. 11, fig. 3.
Strike (of matrix), see p. 218, par. 1.
Superiors, see p. 39, algebraical signs.
Tang, see p. 10, par. 1 ; and p. 11, fig. 2.
three-line pica or **two-line great primer ;** a size of type, see p. 71, table 6.
trafalgar or **two-line double pica ;** a size of type, see p. 58, last par.
tudor black ; a style of type face, see pp. 84–5, fig. 59.
two-em quad, see p. 55, par. 1.
two-line brevier ; a size of type, see p. 59, table 3.
two-line double pica ; —— english ; —— great primer ; —— paragon ; sizes of type, see p. 71, table 6.
two-line letter ; a type, usually of the same series, of twice the body-size of others.
two-line pica ; —— small pica ; sizes of type, see p. 59, table 3.
Type-high ; the same height as type = 0·918 inch.
Type-slug, see p. 689, par. 4.
typewriter ; a style of type, see p. 91, ex. 9.
venetian ; a style of type, see p. 31, par. 5.
winchell ; a style of type, see p. 91, ex. 6.
windsor ; a style of type, see p. 91, ex. 7.

TYPOGRAPHICAL PRINTING-SURFACES.

CHAPTER I.

PRINTING-SURFACES.

"Raised work of Metal engraved and eke of Wood, wherefrom Impressions may be wrought before Men's Eyes, outshooteth the Art of him that Prynteth Books; For they be Many and of Diverse wise, and out of our Knowledge and by us not to be treated. The Prynter hath Woes of his own enow: God knoweth!" Mirrour of Pryntyng.

Brevier old tudor black (Miller & Richard).

PRINTING-SURFACES may be divided into several classes, all of which are comprised under intaglio printing-surfaces, lithographic or what may be called smooth printing-surfaces, and relievo or typographical printing-surfaces.

1. *Intaglio printing-surfaces*, which may include the cylindrical as well as the plane surface.
    - (*a*) *Etching.*—An ink-containing depression produced by the localized action of an acid or other solvent on a smooth surface.
    - (*b*) *Engraving.*—An ink-containing depression produced by the action of a cutting tool or graver on a smooth surface.
    - (*c*) *Dry-point.*—An ink-containing depression produced by the scoring of a smooth surface by a pointed tool, ridges being thrown up by its action on one or both sides of the score.
    - (*d*) *Dry-point* ébarbée.—A process similar to the preceding, but in which the ridges on the sides of the ink-containing depression are removed.
    - (*e*) *Mezzotint.*—Cellular ink-containing depressions produced in (or removed from) a suitable smooth surface at more or less regular intervals.

(*f*) *Aquatint.*—An ink-containing surface interrupted by projecting portions of the original plane surface which are formed by the protection afforded from the mordant by a rosin solution which has granulated in drying on the plate.

The most usual materials in which these various forms of ink-containing depressions are produced are steel, zinc, or copper plates suitably prepared. These are generally inked by hand; the surplus ink is removed from the original smooth surfaces, and a damp sheet of paper is laid on the face of the plate. The plate and paper are then passed through a roller press in which a blanket is interposed between the roller and the paper, and the latter is forced into the depressions in the plate. All these intaglio processes are usually confined to the production of artists' original works, or reproductions of them. They are comparatively slow and costly on account of the very considerable skill required to carry them out successfully.

2. *Lithographic or smooth printing-surfaces*, also known as *planographic printing-surfaces* in America, which may include the plane, cylinder and cone, and in which there is little or no appreciable difference of elevation or depression.

   (*a*) *Lithography.*—All forms of lithography proper, which it is unnecessary to describe, save to say that the parts required to receive the ink are kept greasy by suitable means while the parts required to refuse it are kept wet.

   (*b*) *Anastatic printing.*—A form of lithography in which an existing print is used to effect a transfer to a metal plate by a somewhat complicated process in which the elements of lithography and etching are combined.

   (*c*) *Photographic printing*, which includes a large number of diverse processes, but which all practically come under the heading of printing from smooth surfaces.

   (*d*) *Photographic printing*, which includes a large number of diverse processes, some of which approximate to certain of the methods included under intaglio printing.

   (*e*) *Photographic printing*, which depends for its results upon a chemical reaction caused by the transmission of light through a negative on to prepared paper.

3. *Relievo or typographical printing-surfaces.*—Relievo or typographical printing-surfaces, which include the plane and cylinder, are those in which the printing-surface is in relief, and may be inked by means of an inking-roller.

   (*a*) *Various forms of relievo, or relief, printing-surfaces known as process blocks, and chiefly used for illustration*, which may be roughly grouped under the terms half-tone blocks, zincographs, etc., all of which can be used in conjunction with the more common typographical surfaces.

(*b*) *Typographical printing-surfaces*, which are produced directly by means of movable type or indirectly by means of movable matrices which mechanically compose the desired characters, combinations, or groups of suitable length correctly dimensioned, or consist of relief surfaces embossed in thin sheet metal.

(*c*) *Typographical etching* is akin to the various forms of relief printing just mentioned. One notable use of this method of producing the printing-surface is in the production of the shorthand pages of "Pitman's Shorthand Weekly." In this process a metal plate is covered with a wax etching-ground through which the characters are engraved by means of tools of appropriate shape. When the engraving is completed an electrotype is taken from the plate, from which impressions can be printed. The printing-surface is formed by that portion of the electrotype which was in contact with the metal plate and the whites occur where the wax was left.

(*d*) *Graphotype*.—In this process a layer of prepared chalk is compressed on a suitable backing so as to present a smooth outer surface. The drawing is made with a glutinous ink on this surface, and after drying, the adjacent non-treated material is removed with a pad of velvet or a brush to a depth of about 0·01 inch; suitable tools are used to obtain increased depth in the whites. The block is then treated with a solution of alkaline silicate, and, when dry, a mould is taken from it, from which an electrotype or stereo-plate can be made.

The extent and complexity of the subject of printing-surfaces may easily be realized when it is considered that this entire work will be limited to the consideration of the technology of the production of typographical printing-surfaces, and that not only one, but many volumes could be written about this branch of the subject.

Strictly speaking, under this head should also be included various methods employed for the transference of the capabilities of the original printing-surfaces in metal to plaster, paper, flong or *papier mâché*, and all the mechanical and other processes connected therewith. These, however, are treated more briefly, for, though cognate and presenting features of great interest, they do not come under the strict definition of typographical printing-surfaces, but are rather to be regarded as secondary processes or a means for multiplying and rendering available the original metal surfaces for the more rapid production on the press of printed matter, or as a means for preserving a typographical surface by a more economical method than that of keeping the actual type masses.

CHAPTER II.

TYPOGRAPHY.

> "The setting of Type to Type, each Mannikin beside his Brother, duly and as beseemeth his quality, is an Art not to be lightly Learned, and, being apprehended, one that is to be honoured in the Act, as, sooth it is of both high and low in the Result; For it is a very Prince, nay, the mightiest of Monarchs among the Arts, having in it the power of Man his Brayne, nay, also of the Tongue, as Saint Paul saith."
>
> Mirrour of Pryntyng.

Long primer black No. 1 (Figgins).

Typography, or, literally, the art of writing by means of movable types, now includes the art of printing on paper or any similar surface not only from movable types, but from printing-surfaces produced as a secondary product from movable types or their equivalent. In this treatise printing-surfaces only are dealt with, or, to speak more accurately, only printing-surfaces such as are produced by the methods specified above. The consideration of this matter, however, presents to-day the peculiar difficulty that, whereas the records of all other callings and industries are effected by means of typography, yet the records of that art itself are singularly deficient, and, for a trade of such antiquity as that of printing, the data available are very meagre.

Before, however, entering into the more particular history of this subject, it may be as well to give a brief recital of some salient points in the art generally.

Apart from those forms of printing on clay or other plastic surfaces already alluded to in a paragraph of the introduction, the earliest attempts at printing are believed to have been made in China about the commencement of the Christian era. It is said that in the year A.D. 175 the text of the Chinese classics was cut into tables which were erected outside the national university, and that impressions—probably rubbings—were taken of them. It is stated that some of these are still in existence.

Printing from engraved wood-blocks was almost contemporaneous with the Christian era, and printing from movable types seems to have been practised in China many centuries before the invention of the art in Europe.

In reply to a query addressed to the authorities at the British Museum, the authors are informed that "Chinese writers state that a certain Pi Shêng in the eleventh century invented movable type. This Department [the Department of Oriental Printed Books and Manuscripts] possesses a copy of the Wen hsien túng Káo, a Chinese encyclopædia printed in Korea from movable type in 1337. Further information on the subject will be found in the 'Chinese Repository,' volume xix., p. 247 foll. The British

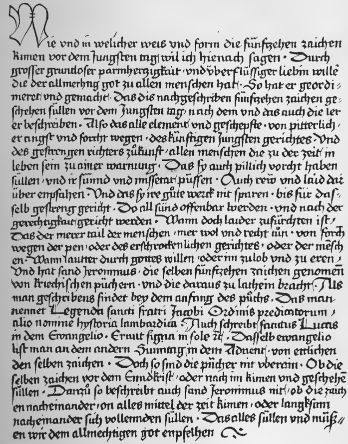

Wie vnd in welicher weis vnd form die fünfzehen zaichen
kimen vor dem iungsten tag/ wil ich hienach sagen · Durch
grosser grundloser parmhertzigkait · vnd vberflüssiger liebin wille
die der allmechtig got zu allen menschen hat · So hat er geordi-
meret vnd gemacht · Das dis nachgeschriben fünfzehen zaichen ge-
schehen sullen vor dem Jungsten tag/ nach dem vnd das auch die ler
er beschreiben · Also das alle element vnd geschepfte · von pitterlich/
er angst vnd forcht wegen · des künftigen iungsten gerichtes · Vnd
des gestrengen richters zůkunft/ allen menschen die zu der zeit in
leben sein zu ainer warnung · Das sy auch pillich vorcht haben
sullen / vnd ir sünd vnd missetat püssen · Auch rew vnd laid dar
über empfahen · Vnd das sy ire güte werck mit sparen · bis für das-
selb gestreng gericht · Do all sünd offenbar werden · vnd nach der
gerechtigkait gericht werden · Wann doch lauder zufürchten ist/
Das der merer tail der menschen / mer wol vnd recht tün · von forch
wegen der pen / oder des erschrockenlichen gerichtes / oder der mēsch
en · Wann lautter durch gottes willen / oder im zulob vnd zu eren /
Vnd hat sand Jeronimus · die selben fünfzehen zaichen genomē
von kriechischen püchern · vnd die daraus zu lathein bracht · Als
man geschribens findet bey dem anfang des pŭchs · Das man
nennet Legenda sancti fratri Jacobi Ordinis predicatorum /
alio nomine hystoria lambardica · Auch schreibt sanctus Lucas
in dem Ewangelio · Erunt signa in sole &c · Dasselb ewangelio
list man an dem andern Sumtag in dem Advent · von etlichen
den selben zaichen · Doch so sind die pücher nit vberain · Ob die
selben zaichen vor dem Endkrist / oder nach im kimen vnd geschehē
süllen · Dartzŭ so beschreibt auch sand Jeronimus nit / ob die zaich
en nacheinander / on alles mittel der zeit kimen / oder langksam
nacheinander sich vollenden süllen · Das alles süllen vnd müss-
en wir dem allmechtigen got empfelhen

FIG. 1.—*Reproduction of xylographic printing.*

Museum possesses no books printed, or supposed to have been printed, from type made by Pi Shêng."

In Europe xylography, or printing from wood-blocks on paper, does not seem to have been practised before the latter half of the fourteenth century, though this art was certainly applied to the printing of designs, patterns and decorations on woven fabrics, skins, and vellum, and also to the imprinting of single initials and like characters in manuscript works for subsequent filling and illumination by hand. The example from a block-book given in the text, fig. 1—a page reproduced on a slightly reduced scale from a facsimile of a page of the original German work, "Der Entkrist" (The Antichrist), *circa* 1450, appearing in the work of Drs. Lippmann and Dohme—will show to what a pitch of practical excellence the art had been carried prior to the advent of individual types.

Engraved wood-blocks were formerly used by kings and other important personages for signing documents. Engraved seals are still used in this way in the East as relief printing-surfaces, with the advantage that the prints can be identified with certainty by the illiterate, whereas a written signature, which varies, cannot. A modern revival of this method of attestation is exemplified by the rubber signature stamps used by many of those engaged in the cycle, automobile, and other industries.

Without going into the vexed question as to who the original inventor of printing by movable types was, it is sufficient to say that the first authentic European printing-surface composed of movable types, from which we have any recorded impression, was that from which two different editions of Letters of Indulgence issued in the year 1454 by Pope Nicholas V in behalf of the kingdom of Cyprus were produced. This, though the earliest authentic specimen of printing from movable types, was certainly not the earliest specimen that had been produced in this way in Europe, for it is certain that at that date there were at least two rival firms of printers at work, and earlier impressions from movable types must have been taken, though none of them has come down to us, so far as is known.

From this date on, the history of printing from movable types is simply part of the general history of human civilization, and does not require further comment here.

Though movable types were, in the first instance, possibly made from engraved blocks sawn into rectangular prisms, so roughly fashioned that they were incapable of being locked up, and required other devices to hold them in position, such, for instance, as being bored through or pierced and threaded on wires, or possibly nicked in one or both sides and held in position with strips, the art must have rapidly progressed, for wooden types of fairly good form are stated to have been made. This wooden type, however, must have proved weak and short-lived, and the obvious step was the substitution of some harder material.

After various experiments, an alloy of the metals lead and tin was adopted, with, subsequently, the addition of varying quantities of antimony, and occasionally of other metals such as copper and bismuth. These metal types may at first have been produced by engraving, but if so the process was too slow and costly, and ended in types being cast from matrices which, in the first instance, were made of wood and later on of lead. Here, again, the inferior hardness of the material demanded the use of a harder matrix. After various attempts to engrave metal matrices, the tedious repetition involved in this process led to the production of engraved steel punches which were struck into copper. Having arrived at this stage, the art of producing a printing-surface had made a fair start.

The early types, however formed, were not very accurate, and probably could not be secured by locking up as they are to-day. To enable them to be handled when set up, their shanks, as mentioned, may have sometimes been pierced and the types strung together with thread or wire, or otherwise secured. As the individual types required much handwork in their making, the printer could not carry a large stock, and in this pristine period in the history of typography, books were often printed page by page, and, after the requisite number of impressions had been struck off, the types were distributed, and the composition of the next page was commenced.

The paper used by the early printers was hand-made, much tougher and better capable of adapting itself to the inequalities of the printing surface than the highly-glazed, machine-made papers of to-day. This old paper, owing to its power of adaptation to inequalities, has been much sought after by artists for printing etchings. Hand-made paper of long fibre, used damp and with an elastic back, gave an impression in which the breadth of the actual lines forming the face of the type was uniformly widened, and consequently the hair-lines and serifs were broadened out of proportion to the main-strokes, the external corners at the same time becoming rounded. One has only to examine old prints with the microscope to see this; under a suitable power the circumjacent surplus ink appears as a band, almost detached from the edge of the actual impression of the type itself. This defect contributed in a rather marked degree to legibility, for it tended, as has been said, to thicken the hair-lines and thus render more pronounced the difference between the less dissimilar letters. The highly-glazed papers of to-day, of short fibre, containing much sizing and mineral matter, are not adapted for printing from such irregular surfaces; their want of flexibility requires a hard and true backing, and hence increased accuracy in the printing-surface in order to obtain a uniformly sharp impression. Modern calendered paper has, however, rendered possible the reproduction of the admirable process blocks with which the current high-class papers and periodicals are illustrated. The depth of the grain in process blocks is so small that the old paper can not be used effectively for direct printing from this small height of relief.

From the earliest days of printing to the present day the thickness of paper used for ordinary book-work, however, has kept approximately between the same limits.

What, moreover, we term paper, did not exist, except in China and Japan, before the eighth century; it is stated not to have been manufactured in Europe before the twelfth century. According to the Italian professor, Jos. La Mantia, as quoted by the "Inland Printer," the earliest known piece of [European] paper in existence is a letter from Adelaide, third wife of Roger I, Count of Sicily, written about A.D. 1109. It measures eleven inches by thirteen inches, is of a strong texture, and has a pinkish white tinge. According to the "Deutscher Buch- und Steindrucker," the oldest piece of paper known is one which dates to A.D. 399, and was found near the Turfan Oasis, in Asia. The papyrus generally used as a writing-surface prior to the dates given could not be folded like ordinary rag-paper, and would probably have been torn to pieces under the action of the printing-press. Being built up of separate portions of the papyrus reed, it could not be rolled up in the same way as a sheet of paper can be rolled, but had to be wound round a wooden cylinder or roller. Parchment, the earliest common medium for carrying writing, is greasy, resists ink, and is comparatively troublesome to handle, being regarded even at the present day as a most undesirable printing, or even writing, material; moreover, as a rule its surface is not a plane.

Combined with the paper difficulty, there was another difficulty. The ancients, as has been said, lacked a suitable printing-ink, and, trifling as this fact may seem, it was one of the chief obstacles in the way of successful progress; for even had types been invented, printing from them would have been an impossibility without the contemporaneous invention of a suitable printing-ink.

The Chinese, thanks to the highly absorbent nature of their paper, were never confronted with this difficulty; so that although, strictly speaking, they were printers even at that remote period, yet they were not printers in the special sense in which the term has from the commencement been understood in Europe.

The writing-ink of European classical antiquity was made of a thin wash of soot, thickened with gum, with an acid sometimes added to make it bite into the surface of the parchment or papyrus. Later, oak galls and sulphate of iron were also used in the early writing-inks. These thin watery inks would have collected in blotches on a smooth metal surface, and if stamped on ordinary paper or parchment, the impressions would have been of irregular blackness and illegible in many places. The discovery which proved a kind and helpful godfather to the invention of printing was the invention of the mixing of colours with oil—a step which wrought a revolution in the art, or rather, really made the art a practical possibility. It is generally, but erroneously, attributed to Jan van Eyck, of Holland, or to his brother Hubert, who lived during the early part of the fifteenth century. The printers, it is said, finding that they could not use the ink of the copyists, took a hint from the painters, and, mixing their lamp-black with oil, succeeded in making an ink which answered their purpose admirably, and enabled them to give to the world books, which, after more than four centuries, are still beautifully legible.

Since the foregoing paragraph was written, the authors' attention has been called to William A. Shaw's remarkable article in the "Connoisseur," of October, 1911. Apart from the vindication of the latent artistic nature of Englishmen and of our grand old school of painting and its masters, who in their age were second to none, the fact that the use of oil-painting was known in England possibly more than a century before it was independently discovered—which it is difficult to suppose—or borrowed by the van Eycks, is a matter of singular interest. Had the need for printing been pressing in this country in the fourteenth century, doubtless necessity, the mother of invention, would have given Englishmen the pride of place in that art owing to the power which they would then unquestionably have had of producing a proper printer's ink with materials ready to hand and with the help of methods well known and in common use.

Further research while these pages were going through the press has carried the knowledge of the discovery of the method of painting in oils back by at least a couple of centuries, and probably a wider sweep of investigation would take the date of its invention yet deeper into the past.

The work of the monk Theophilus, "Diversarum artium Schædula," a translation of which was published in 1843 by Count Charles de l'Escalopier, should give its quietus to the widespread error that credited Jan van Eyck with the invention of oil-painting about the year 1410. Theophilus noted its use, and himself employed this method between the end of the eleventh and the beginning of the twelfth century. Jan van Eyck was probably the inventor of drying or siccative varnish for pictures, and it is not unlikely that this fact gave rise to the general misconception.

Possibly, moreover, the retardation of the invention of printing, though doubtless largely due to ignorance as to the potentialities that lay latent in a proper printer's ink, was due quite as much to the fact that no real necessity for the invention existed; for it must never be forgotten in connexion with printing, that cheapness of production of manuscript works, at any rate in the days of ancient Rome, actually to a certain extent rivalled the productions of the present-day printing-press when the limited editions and the limited number of readers are considered. The press of the day consisted of scribes who were educated slaves; their food and clothing cost but little, and they could produce books faster than the books could be sold. A large number of these slaves would be assembled in a great hall and write from the dictation of a reader selected for his accuracy and clearness of enunciation, with the result that an edition of a poet's latest work or the latest declamation of an orator, or the commentary of a jurist on some edict or current law, was produced at a price which rendered all thought of the invention of any further labour-saving methods unnecessary.

It is stated that a roll of Martial's "First Book of Epigrams" in plain binding or casing was sold for six sesterces, or about one shilling, by the Roman booksellers. It is only in the last few years, indeed, that this price has been approached in the twelve-penny volumes and cheap editions of the day.

CHAPTER III.

DESCRIPTION OF TYPE.

"Types to they that be of the Craft are as things that be Alive. He is an ill Worker that handleth them not gently and with Reverence. In them is the power of Thought contained, and all that cometh therefrom."

Mirrour of Pryntyng.

Long primer augustan black (Stephenson, Blake & Co.).

As usually cast, a type has attached to it a tang or gate which carries with it a small plug, generally the frustum of a cone, known as the *dot.* This dot consists of the metal which remains in a piece intermediate between the mould and the nozzle of the metal-pot from which the supply of liquid metal for casting the types is ejected. The tang, of course, has to be removed, and the lower surface or foot of the type dressed or grooved so as to get rid of the projecting irregularities resulting from the fracture of the tang. This operation has usually been carried out by hand, and the types, after the removal of the tang, are set up, also by hand, on sticks preparatory to their transfer to the dressing-bench, where they have the irregularities at the break removed by the passage of a hand-plane along the inverted line of type, the plane at the same time producing what is known as the heel-nick.

Hitherto this groove in the foot has been considered as essential in good type, but modern practice, supported by the experience gained from several machines which cast and trim the type by other methods, or cast the type perfect as regards its foot bearing, has shown that the mere removal of projecting metal is all that is really necessary, and that the provision of the heel-nick as a distinct depression is unnecessary.

The names for the various parts of a type are shown in figs. 2 and 3.

The term *face* is also generally applied to any fount of type when describing its features, for instance broad face, narrow face, etc.

The names of the various parts of the face and of the dimensions are given in fig. 4.

The dimension given as *side-wall* does not appear to have had a name till recently, when it was thus named in the matrices of the Wicks machine.

The distance from the face to the shoulder is known as the depth of strike.

In addition to the names given to the various parts shown in figs. 2, 3, and 4, certain parts of characters have names of their own, for example, the round portion of the letters b **d** **p** **q** surrounding the counter is known as the *bowl*, the bulb at the end of the tail of the letters *f* j y is the *tail-dot*, the lugs at the top of the capital letters **C** **G** are *cat's ears*, and the sharp extremities of the counters of the letters **K M N V W** and many other sorts are styled *crotches*.

Various devices, at present by no means universally adopted, have been designed with a view to eliminating the work of breaking off the tang, setting up the type and planing the heel-nick; all of

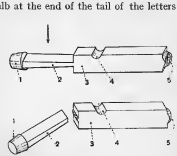


FIG. 2.—*Isometric view of type as usually cast before and after breaking off the tang.*

1. The dot.
2. The tang.
3. The body.
4. The nick.
5. The face.

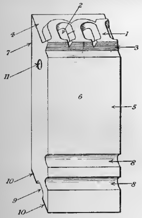


FIG. 3.—*Isometric view of type.* ($2\frac{1}{2}$ times full size.)

1. The face.
2. The counter.
3. The neck (or beard).
4. The shoulder.
5. The stem or shank.
6. The front.
7. The back.
8. The nicks.
9. The heel-nick or groove.
10. The feet.
11. The pin-mark or drag.

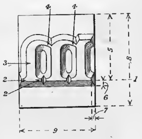


FIG. 4.—*Plan of type.* ($2\frac{1}{2}$ times full size.)

1. The line.
2. Serifs.
3. Main-stroke.
4. Hair-line.
5. Line-to-back.
6. Beard.
7. Side-wall.
8. Body.
9. Set.

The body-wise dimension of the face is called the gauge.

these operations were formerly performed by hand. A few typical examples of breaks may now be considered:—

1. *Mason's break*, fig. 5, which has been adopted in type-moulds prior to the introduction of self-dressing matrices. Two inclined recesses are formed in the breaks of the mould which produce projecting shoulders on the tang; these are caught by the inclined faces of the breaks and the upward movement of the top break causes a greater rotational movement of the tang than the movement of the mould-faces permits to the type-body, thus causing the tang to be twisted away from the body of the type.

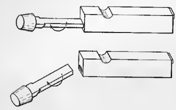


FIG. 5.—*Mason's break.*

2. *Non-dressing break*, fig. 6. An improvement made in moulds fitted with Mason's breaking arrangement, consisted in fitting two semicylindrical wires, each containing one-half of a cylindrical hole having its axis at right angles to the axes of the wires, which are coincident. The tang-wire requires to be set to position for each alteration in set width of the matrix which is in use. By the introduction of self-dressing matrices, the type were ejected finished from the mould, the break being effected in the small cylindrical portion of the tang contained between the wires and occurring below the surface of the foot.

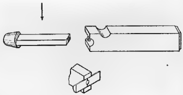


FIG. 6.—*Non-dressing break.*

3. *The Davis break*, fig. 7. In this a triangular wire having a short slot at one end is fitted to the lower half of the mould. The type is broken away from the tang by the action of the drag fitted to the upper half of the mould, when the mould commences to open, and the tang is subsequently ejected from the wire by means of a pusher.

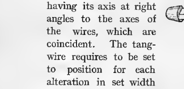


FIG. 7.—*Davis break.*

4. *The Nuernberger-Rettig break*, fig. 8. In this break two sections of cylindrical surfaces are formed in the top and bottom halves

of the mould into which they project from the tang-blocks; these are guided by plates in, and are spring-operated from, the carriages. After the cast is completed and when the pressure against the tang-blocks has been removed, these retire under the action of the springs, dragging the tang with them and subsequently ejecting it. The break takes place within the depression at the foot of the type, but the method evidently requires the use of springs of considerable strength when the set width of the type is large.

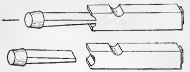


Fig. 8.—*Nuernberger-Rettig break.*

5 *The Stringer break*, fig. 9. Two **V**-shaped nicks are formed one on each side of the tang by means of inset pieces working in conjunction with the mould. The type, after ejection from the mould by the action of the body-slide, is automatically passed into a raceway, and the tang fractured by a blow or thrust.

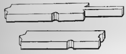


Fig. 9.—*Stringer break.*

6. *The Typograph break*, fig. 10. In this form, which is applied to a slug-casting machine, the jet does not run the whole length of the slug, and a portion of the base of the slug is depressed over a slightly greater length. The jet is sheared off within the boundary of this depressed surface, the fractured metal coming below the foot which surrounds it on three sides.

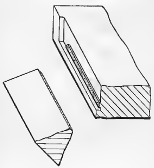


Fig. 10.—*Typograph break.*

7. *The Monotype break*, fig. 11. In the Monotype mould, which casts single type, no provision is made for ensuring that fracture takes place below the surface of the foot, but the tang which joins the body at one edge is sheared off by the movement of the mould, leaving a surface which has been found to be sufficiently true for all practical purposes.

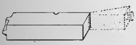


Fig. 11.—*Monotype break.*

8. *The Grantype break*, fig. 12. In the Grantype—which casts a line of single or loose type in one

operation—by designing the foot of the type and the tang-blocks of appropriate form, the fracture below the surface of the foot of the break, which is confined to one side of the stem or body of the type, is mechanically ensured; and this method also is found to be perfectly adequate to all the requirements of the modern printer.

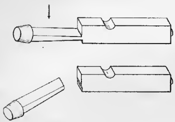


Fig. 12.—*Grantype break.*

Efforts have been made to cast type from other portions than the foot, but they have not met with success in practice hitherto, as far as the authors know.

Dimension 5, fig. 4 (*line-to-back*), is the datum for all measurements of a *fount*—pronounced *font*, and so spelt in America—of type, and that of the lower-case **m** or capital **H** is usually taken as the standard, but the difference between the body-size and this dimension is also frequently referred to as a dimension, and called the *beard*. In actually measuring type, dimension 5 is that which is measured.

The nick is in the front of the type in England, America, Germany, and most other countries, but in France and Belgium it is placed at the back. A supplementary nick is cut, usually just below the shoulder, in the small capitals **O S V W X Z** to enable these characters to be distinguished from the lower-case. In old-style the small capital **I** is also marked to enable it to be distinguished from the figure 1.

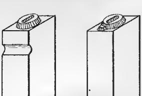


Fig. 13.—*Small capital types showing means of identification.*
Supplementary nick. *Identification mark.*

When finished type is produced direct from the casting machine, as in the case of Wicks type, a different method of identification is required. This can be effected by the provision of a projection on the beard having its upper surface a sufficient distance below the face of the character to avoid producing an impression on the paper. This is shown in fig. 13. The *pin-mark*, or *drag*, shown in fig. 3, only occurs in certain machine-made type. The dimension from the foot to the face is called the *height-to-paper;* the standard for this in England is now 0·918 inch. The term *high-to-paper* is used to express a deviation in excess of the standard; thus type 0·920 inch high is described as being 0·002 inch high-to-paper. The converse is expressed by the term *low-to-paper*.

CHAPTER IV.

TYPEFOUNDING.

"Now (according to Custom) is Half a Pint of Sack mingled with Sallad Oyl provided for each Workman to drink, . . ." **Moxon's Mechanick Exercises.**

Long primer old-style antique No. 2 (Shanks & Sons).

In the early days of printing, the typefounder was not only a founder pure and simple, but also to some extent a metallurgist and mixer of metals, and that some of his experiences in the pursuit of his art were not altogether pleasant is evidenced by the quaint quotation from Moxon's famous work, which is given at the head of this chapter.

Sir Henry Bessemer, whose father was originally the engraver to the French Mint, and afterwards in England became a punch-cutter and typefounder, also alludes in his autobiography to the trouble arising from the dust of the crude antimony when it was being broken up for the melting-pot, this work often seriously affecting the workmen engaged in it. He adds that his father also used tin and copper, which made his type superior in hardness to that of his contemporaries.

Moxon says, "What the metal founders make printing letters of is lead hardened with iron: thus, they choose stub nails for the best iron to melt. . . ." Nearly a century later iron was still used, but it was subsequently shown that its utility in the making of type-metal was due to its combining with the sulphur contained in the crude antimony then available; when purer forms of the latter metal were commercially obtainable, iron was no longer used.

Type-metal at the present day consists chiefly of lead, antimony and tin, with, in some cases, the addition of a small percentage of copper. Experiment has demonstrated that from 1·8 to 2 per cent of copper is the maximum which it is possible to alloy with typefounders' metal.

Line-casting machine type-metal undergoes a wastage or depreciation; this depreciation amounts often to an average of 2 per cent each time the metal passes through one complete cycle of making and using. The proportions, in which the metals are combined, are usually varied according to the size of type to be cast. Type of small size requires a hard alloy which also must flow very freely; it usually contains a much higher percentage of tin and antimony. The percentage of tin falls more rapidly than does the percentage of antimony as the size of type to be cast increases; in fact, in the case of furniture and leads, no tin at all need be used. The proportions in which the metals are mixed vary considerably with different founders, but a general idea of the proportions generally

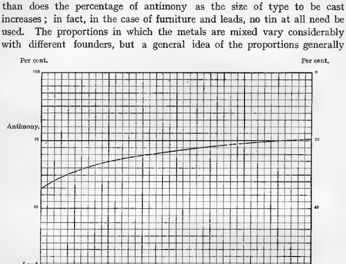


FIG. 14.—*Composition of type-metal for different body-sizes.*

used may be obtained from the diagram, fig. 14, which shows the percentages and their variation for different sizes of type. In general, only three or four alloys are used in any particular foundry, as these are found sufficient to cover the requirements of practice.

Casting.—In the early days of typefounding the metal was first melted in a pot from which it was taken in a ladle and poured by hand into the mould. This was jerked upwards by the founder with a peculiar and dexterous motion, so as to cause the liquid metal to reach the matrix at its end and so obtain a cast of the impression previously made by the punch.

Furniture and leads, which are usually of too great and too variable length to be conveniently produced in casting machines, are still being cast by this method.

Early in the nineteenth century a pump, partially immersed in the metal-pot, was brought into use, so that the molten metal was injected into the mould under considerable pressure, and the cast effected with greater certainty and speed.

The United States patent of M. D. Mann and S. Sturdevant, of 7 January, 1831, shows a pump with a spring-propelled plunger. This appears to the authors to forestall both the patents of Sir Henry Bessemer, No. 7585, of 8 March, 1838, and the United States patent of D. Bruce, jun., No. 632, of 17 March, 1838, which cover a pump with a spring-propelled piston and an opening and closing mould.

The improvement resulting from the use of such a pump in the process of typecasting, being such an interesting and important one, the authors make no apology for inserting here an extract from that extremely interesting book, "The Autobiography of Sir Henry Bessemer," which practically covers the whole question of the change of typefounding from a purely manual to a mechanical art; for though forestalled in actual date by the patent of Mann and Sturdevant of 1831, as has been pointed out, Sir Henry's patent carried out and virtually made use of improved methods, certain of which, as far as the authors are aware, have been brought into practical use by no other inventor up to the present day. Sir Henry, so far as can be ascertained, has nowhere left an exact description of how he carried out his invention of exhausting the air from the mould at a moment prior to the injection of the molten metal.

It is within the authors' knowledge that, about the year 1899, a patent was applied for, or proposed to be applied for, for producing a vacuum in moulds and that a sum of money was paid for the patent or the suggestion, which, had the interested parties known of Sir Henry Bessemer's work, would not have been done. The authors are also aware that the idea has been revived and its application suggested as a novelty in connexion with another patent of quite recent date.

Sir Henry writes, in his "Autobiography," as follows:

"When I was experimenting with plumbago (about 1838) I was engaged in designing a new system of casting types by machinery, some features of which are of sufficient interest to be recorded. The moulds in this machine were entirely composed of hardened and tempered steel, shaped by laps, as the metal could be neither planed nor filed. From fifty-five to sixty types were cast per minute in each of the two compartments of the mould; and in order that the solidification of the metal should take place in the extremely small interval of time allowed for that purpose, the moulds were cooled by a constant flow of cold water through suitable passages made in them, in close proximity to those parts where the fluid metal came in contact. Another special feature of this mode of casting was the employment of a force-pump placed within the bath of melted metal, by means of which the latter was injected into the mould at the proper moment, the pressure of the injected fluid being under the perfect control of a loaded valve. It will be readily understood that a sharp jet of fluid metal would propel with it an induced current of air, and consequently produce a bubbly and spongy casting, which would have been wholly valueless. The short space of time occupied in its solidification afforded no opportunity for the escape of air in the usual way by floating in bubbles upward, as in the case of castings where the metal is retained in its molten state in the mould for several minutes.

"I found an absolute cure for this apparently insuperable difficulty, by forming a vacuum in the mould at the very instant at which the injection of metal took place; and so successful was this system of exhausting the moulds, that one might break a hundred types in succession without finding a single blowhole in any one of them.

"The iron or brass founder, whose slow and tedious operations are performed by quietly pouring his molten metal into the mould with a ladle, will at once see what a new departure in the art of founding this machine presented. Firstly, there was the same mould producing fifty-five to sixty castings per minute, instead of being broken up and destroyed after one cast: then pouring the metal from a ladle was replaced by injecting it with a force-pump, the mould itself having a continuous stream of cold water running through suitable passages formed in it so as to cool every part of its surface in contact with the fluid metal; and, finally, instead of the mould being composed of porous materials through which the confined air gradually escaped, there was an almost indestructible mould, wholly free from pores, from which all the contained air was withdrawn in the fraction of a second by its sudden connection with an exhausted vessel at the moment when the metal was injected.

"The valve through which the metal was injected into the mould, being extremely small, required to be fitted very closely to prevent its leaking; it was found that after it had been opened and closed some six or seven thousand times, a portion of the fluid metal would, by friction against the sides of the valve, be rubbed into powder, and more or less obstruct its action. Otherwise, the really beautiful mechanism of this casting machine performed all its functions with perfect precision, and formed the bodies of the type so parallel and so perfect in other respects, that it soon began to create much jealous feeling and opposition among the type-founders, whose occupation was threatened by it. For this reason, Messrs. Wilson, the well-known type-founders, of Edinburgh, to whom I had sold my invention, preferred to make no further efforts to improve the valve arrangements, and allowed the whole matter to sink quietly into oblivion rather than face the storm they saw was brewing."

The gate through which the metal passes into the mould becomes also filled with type-metal, and forms the projecting tang which must be removed subsequently from the type, which in itself is either cast finished from the mould or has to go through various other operations already alluded to before the foot is finished.

The *face* of the type is obtained from an impression, usually made by a punch, in a piece of soft copper, of bronze, or of nickel called a *matrix*. The sides of the mould are formed of steel, ground and lapped. As the mould goes through the various stages of opening and closing at each cast, the surfaces must be so true that the molten type-metal will not flow between them under the pressure at which it is injected into the mould, as otherwise a fin or fringe would be formed at the joints of the mould. The position of the matrix relatively to the sides of the mould must be very accurately determined, so that the face may be cast in the proper position on the shoulder. This work requires careful positioning of the matrix to bring the strike into its proper place relatively to the mould cavity. This may be effected by stops or registers attached to the mould or by mechanical constraint of the matrix independently of the mould. In any case, the strike must be accurately placed relatively to some portions of the external surfaces of the matrix.

FIG. 15.—*Type before rubbing.*

FIG. 16.—*Type after rubbing.*

The work of shaping by hand or machining the exterior of the matrix so as to be true and correctly placed relatively to the shank of the type to be cast from it, is known as justifying; it is very highly-skilled work, and is performed by casting a type from the mould, and comparing it with a standard lower-case m and correcting the matrix till the face of the trial type agrees with the standard for alinement, and occupies its correct position on the shoulder, so that the proper amount of side-wall is given on each side.

When type are cast in matrices which are not of the non-rubbing kind, that portion which projects beyond the stem of the type, fig. 15, is usually removed by rubbing on the sides and occasionally at the top and bottom also. This operation is performed by hand on a rubbing-file, which is a large flat piece of steel cut with teeth like a file over the whole of its surface, or more usually on a rubbing-stone, which is similar to an ordinary grindstone, but is used lying on a bench on one of its flat sides; it is usually of sufficient area to allow of its use by two or more workmen at the same time. After the sides of the type have been rubbed sufficiently to remove these projections, as is shown in fig. 16, it is set up by boys or girls upon a stick, fig. 17, in line, in the first operation, face outwards.

The sticks of type are then passed to a workman known as a dresser, who at the dressing-bench, fig. 18, transfers the lines individually to the dressing-rod, fig. 19, in which each of them in turn is supported on the face of the type by a brass strip and clamped for length by an adjustable jaw operated by a screw. In order that the line may be securely held and supported, the dressing-rod is then placed in the dressing-bench, which is practically a vice with jaws of sufficient length to clamp the whole line of type. A piece of hardwood is rubbed to and fro over the length of the line, now occupying a position with the face downwards, with sufficient pressure to ensure the faces coming down evenly on to the brass supporting-surfaces of the dressing-rod.

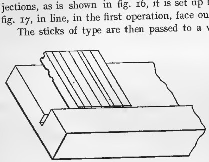


FIG. 17.—*Setting-up stick.*

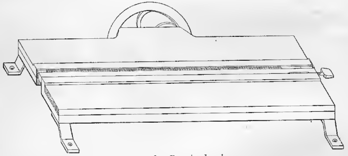


FIG. 18.—*Dressing-bench.*

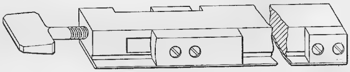


FIG. 19.—*Dressing-rod.*

The dressing-plane, fig. 20, now comes into operation, and is used by the dresser to plough out the groove between the feet, frequently known as the heel-nick. The manner in which the dressing-rod is held between the jaws of the dressing-bench and in which the dressing-plane is guided by the line of type while the nick is being cut, is shown in fig. 21.

In some cases, and particularly for the purpose of enabling certain small-capital sorts to be readily distinguished from lower-case or other sorts of the same fount so closely resembling them that there is the risk of confusing them, for example, the **o s v w x z**, and **I** in old-style, it is necessary to cut a supplementary nick, usually placed high on the stem,

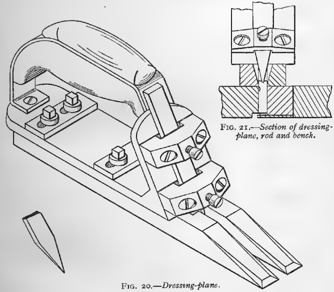


Fig. 21.—*Section of dressing-plane, rod and bench.*

Fig. 20.—*Dressing-plane.*

for identification purposes in these small capitals. This operation is also performed by the dresser, who uses a somewhat different plane, fig. 22.

When the actual printing-face of the character projects set-wise beyond the stem of the type, it is said to kern, and the projecting portion, which in this case cannot be removed by rubbing, must be trimmed so that it does not, when set up, foul the bevel of any type to which it may be adjacent. This operation also comes within the province of the dresser, who uses the same plane as that used for cutting the supplementary nick, or one somewhat similar. The type are set up body-wise on the stick instead of set-wise, as in the former operations of cutting the heel-nick or the supplementary nick, and the planing operation bevels the overhanging portion down from the face to meet the body, as shown in figs. 56 and 57, p. 79.

When the actual printing-face of the character projects body-wise beyond the stem of the type, it is said to beard, and the projecting portion must be treated as in the case of a kerned sort. Bearding was a troublesome peculiarity not unusual in early printed works, where, especially in the capital letters, ornamental flourishes were liberally added, while, in

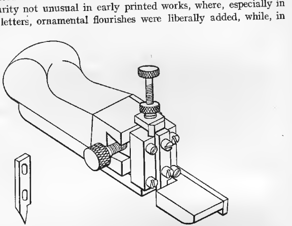


FIG. 22.—*Nicking, kerning, and bearding plane.*

the lower-case those abbreviations (a relic of the days of manuscript books) which represented omitted letters or syllables, made this peculiar feature quite common. Bearding is becoming rare because of the obvious

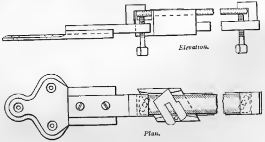


FIG. 23.—*Kerning file.*

risk of fouling between ascenders and descenders in consecutive lines of printed matter when set without leading.

In the case of type of large body and where the amount of kern is very great, as in some oriental founts—such as Arabic, Sanskrit, Gujarati, the members of the Dravidian group, namely Tamil, Malayalim, Telugu and

Kanarese, and to go further east Burmese, Javanese and various neighbour scripts—a different method is applied, because the overhanging portion is of such length that it must be reduced on its flat lower surface so as

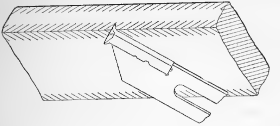


FIG. 24.—*Detail of kerning file.*

just to clear the shoulder of the adjacent type. Such type, of course, is much more liable to damage and breakage. The operation of dressing the kern is in this case effected by rubbing the type singly over a kerning file held in an apparatus shown in fig. 23; this contrivance is fitted with a sliding guide for the type, shown full size in fig. 24.

CHAPTER V.

TYPE DESIGN.

"God hath given us Eyes, but herein is Mystery, for the Devil of his Malice hath them marred that they see not at all Times aright."
Mirrour of Pryntyng.

10-point cheltenham bold condensed (American Type Founders Co.).

PROBABLY not one reader in a thousand appreciates the degree to which he is critical about size and alinement of type; the ease with which the eye detects want of alinement in two adjacent lines, used by the engineer in the vernier for obtaining accuracy, here acts conversely in requiring it. A difference of 0·001 or 0·002 inch in alinement is readily apparent, and a difference of 0·002 or 0·003 inch in the size of a character is easily noticeable; not only must the characters be of the correct size and truly placed, but the proper proportions of thickness of stroke,

FIG. 25.—*Brick ornamentation; Gloucester Road tube station.*

length of serif, and other variable dimensions must be maintained throughout the fount.

In justifying and in punch-cutting it is necessary to remember that type faces must not be made so as actually to be in alinement, or so that the characters are of equal size, but they must be made *to appear so*.

To show the very great importance of adopting what may be styled *accurate inaccuracies* by the use of which the human eye is deceived, or deceives itself, inaccuracies which are necessary in the designing of type owing to the failure of the eye to differentiate realities from illusions, a few examples are given which show in accentuated form the difficulties that have to be considered and overcome by the punch-cutter or the designer of type faces.

Included among the specimens illustrated are two, the effect of which on a large scale can be observed in certain of the London tube railway stations, where the patterns set out in coloured tiles on some of the station walls produce curious and not infrequently startling effects.

FIG. 26.—*Brick ornamentation ; Down Street tube station.*

These are shown in figs. 25 and 26, which should be viewed from a distance of about four feet.

In fig. 27 the lines AB, CD, EF, and GH are all strictly parallel, but

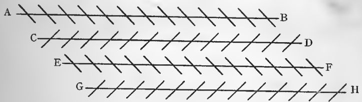


FIG. 27.—*Combined parallel and diagonal lines.*

the diagonal lines drawn across them produce the illusion of their being convergent and divergent. If, however, they are viewed from a sufficient distance, the illusion is destroyed.

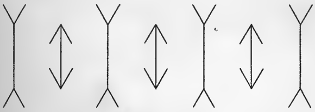
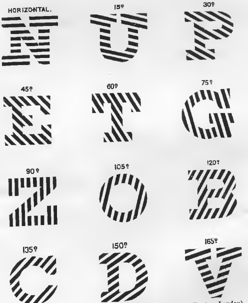


FIG. 28.—*Combined arrow-heads and vertical lines.*

The vertical lines in fig. 28 are of equal length, though the 2nd, 4th, and 6th appear shorter than the 1st, 3rd, 5th, and 7th.

If the eyesight is perfect, the letters in fig. 29, from a block supplied by the courtesy of Curry & Paxton, should all appear of the same shade in any position through which the page may be turned. But perfect eyesight is very rare.

Before coming to a definite conclusion about the nature of some of these errors, it is necessary to turn the book through 360°, and notice whether the apparent errors remain uniform for all changes of position. Any noticeable difference is probably due to astigmatism, which should be corrected by proper glasses before the comparison of characters and the estimation of their errors are undertaken.



Hatched letters (Curry & Paxton, London).

FIG. 29.—*Block letters with white hatched lines.*

Nearly all the illusions given are traceable to two factors shown in figs. 27 and 28 respectively; that is to say, firstly, the difficulty which the eye finds in correctly defining the direction of a line crossed by a series of oblique lines; and secondly, the difficulty the eye finds in estimating the length of a line, especially when its limits are defined by arrow points or similar converging lines. The authors, however, in this as in other similar matters do not profess to be able to give a satisfactory explanation of these phenomena, but must leave them to the specialist.

The example shown in fig. 30, in which the circular dots appear

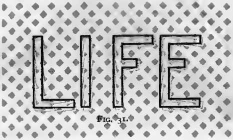


FIG. 31.

FIG. 31.—*Inclined strokes on background of square black dots.*

FIG. 32.

FIG. 32.—*Inclined strokes and black dots intersected.*

FIG. 33.

FIG. 33.—*Inclined strokes overlapping.*

FIG. 34.

FIG. 34.—*Short inclined strokes not overlapping.*

FIG. 35.

FIG. 35.—[illegible] *strokes.*

[*To face page 26.*

To face page 26.

FIG. 31.

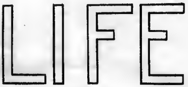


FIG. 32.

FIG. 33.

FIG. 34.

FIG. 35.

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PLATE I.

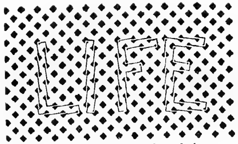


FIG. 31.—*Inclined strokes on background of square black dots.*

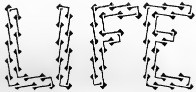


FIG. 32.—*Inclined strokes and black dots intersected.*

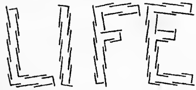


FIG. 33.—*Inclined strokes overlapping.*

FIG. 34.—*Short inclined strokes not overlapping.*

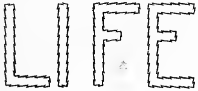


FIG. 35.—*Zig-zag strokes.*

[*To face page* 26.

PLATE II.

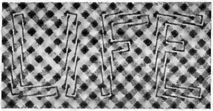


FIG. 36.—*Inclined strokes on chequered background.*

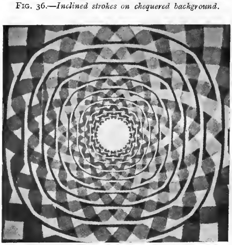


FIG. 37.—*Circles appearing flattened in two directions each, at right angles.*

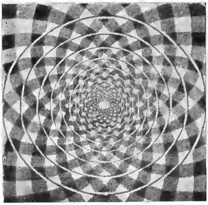


FIG. 40.—*Distorted figures appearing to be of circular form.*

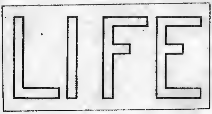


FIG. 36.

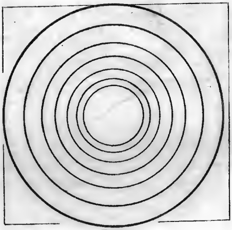


FIG 37.

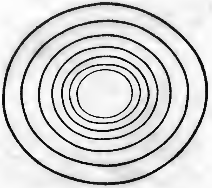
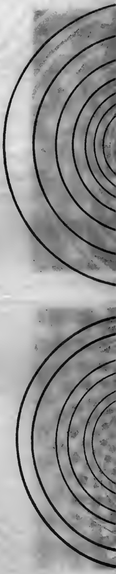


FIG. 40.

To follow plate I.



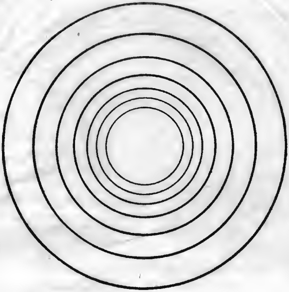


FIG. 38.

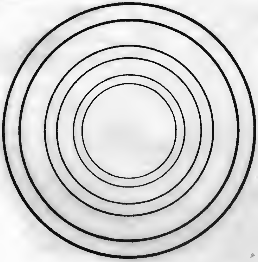


FIG. 39.

[To follow plate II.

PLATE III.

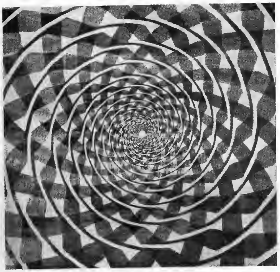


FIG. 38.—*Circles appearing as logarithmic spirals.*

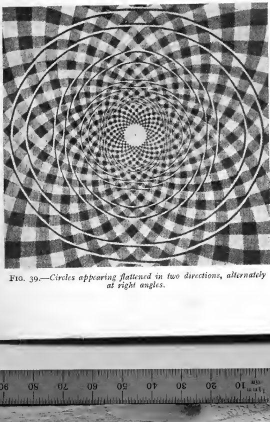


FIG. 39.—*Circles appearing flattened in two directions, alternately at right angles.*

PROPERTY OF THE
MINNEAPOLIS
ATHENAEUM

hexagonal, has a curious history: in many insects the eye consists of a group of *ocelli* or small circular eyes arranged as in the figure; these *ocelli* were for many years believed to be hexagonal, an error which for some time even appeared in text-books.

The authors are indebted to a very interesting article by Dr. James Fraser, which appeared in the "British Journal of Psychology" for January, 1908, for several of the suggestions and illustrations here given, in which the illusion of extreme distortion is brought about by comparatively simple

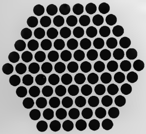


FIG. 30.—*Circular dots appearing hexagonal.*

means; see figs. 31 to 40, plates I to III. The subject has quite a literature of its own, as curious as it is voluminous.

In figs. 31 to 36, plates I and II, the ends of the short lines composing the strokes of the characters lie actually on vertical and horizontal lines respectively, but the effect of the inclination of the strokes causes the letters to appear out of the vertical in figs. 31 to 35, and the effacement of part of the chequered background by means of white lines causes still further exaggeration of this effect in the case of fig. 36, and in figs. 37 to 39, plates II and III, it is carried still further by showing a series of circles built up of white and black sections of spirals and superimposed on a chequered background. The result produced is one of symmetrical irregularity in the case of fig. 37, of a system of logarithmic spirals in fig. 38, and of two forms of distortion at 90° to each other in fig. 39. It can be easily confirmed, by applying the circles given on tracing paper, that these apparent distortions are merely optical illusions, and that the boundary lines are in every instance actually placed in the form of true circles.

Still more interesting as affording direct evidence on the subject of errors intentionally introduced in order to obtain apparent truth are the curves shown in fig. 40, plate II. These appear to be truly circular, but their outlines as printed on the transparent sheet covering the plate show that they are in fact much distorted, and that the appearance of truth has been obtained by the introduction of a real error of opposite sign to the apparent error visible in a diagram constructed with true circles. The actual amount of distortion is apparent when the lines on the tracing are examined apart from the figure.

THE INFLUENCE OF ILLUSION ON THE FORM OF CHARACTERS.

Accurate inaccuracies.—If the characters used on the printed page were all made equal in their dimensions and true to line, they would

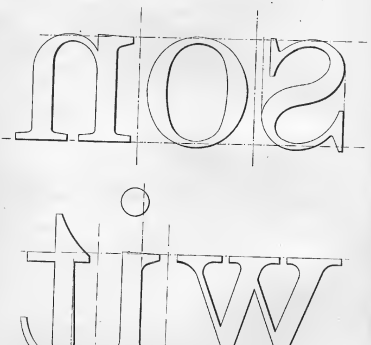


FIG. 41.—*Alinement and peculiarities of type*, 20 times full size.

appear unequal. Fig. 41 shows the relative magnitude of the errors which must be introduced in order to make the characters of uniform appearance. Almost all the characters in a fount have some peculiarity which must be retained if they are to appear true; thus the round sorts must be larger than the square sorts and come above the square small sorts, and to a greater extent below the line, in order that they may seem to be of the same size. The upper part of the lower-case **s** must be smaller than the lower part; the lower-case **t** must not be vertical or of uniform thickness in the main-stroke, or it will seem to lean back; the dot must not be placed centrally over the main-stroke of the lower-case **i**, or it will seem to be on one side; the strokes of the **w** must be slightly curved at the lower extremities in order that they may seem to be straight; the **o** projects more below the line than it does above the upper line; and other characters have their own peculiarities.

THE INFLUENCE OF THE SERIF.

The serif.—There are few who, when they look at the characters of a fount of type, consider the extreme accuracy that it is necessary to observe in their design and production, and fewer still, perhaps, are those who have considered the influence of the serif on the style, durability, and legibility of the character that they see before them.

It has even been stated that the serif makes the character, and although the authors cannot endorse this somewhat sweeping statement, in a modified sense it certainly has in it a good deal of truth.

All European faces whose origin can be traced back to inscriptions on stone or to inscriptions formed as continuous lines on some hard material, were first produced, so far as the authors are aware, with strokes of approximately uniform width. As a matter of fact, the ordinary sans serif of to-day reproduces almost exactly the characteristic features of the early Roman incised lettering.

Possibly, as has been lately stated, the effect of shadow in obscuring the terminations of incisions in stone-carved characters had some influence in bringing the serif into being, but the authors are inclined to the belief that the serif also had in great part a simpler origin, namely, the desire of the scribe or penman to define accurately the ends of the strokes which, in the form of writing now developed into print, required accurate demarcation at the top ends, and often even more so at the bottom ends, as well as at some horizontal terminations. If this was not done, the natural tendency for the stroke to finish with a somewhat rounded, if not ragged end, giving the appearance of irregular and uneven alinement, forced upon the scribe the necessity for obviating this defect, and hence, in his efforts to define the stroke-ends, the most natural trend of development resulted in the evolution of the serif. Once the advantages due to the serif, however crude and rudimentary its form, made themselves apparent, its advance and differentiation became only a question of time. This matter, however, does not call for historic treatment: it is rather the aim of the authors to show how the modern use of serifs tends to separate into a comparatively few different groups the whole range of type faces.

Faces of type may be classified, according to the shapes of their serifs (if any), as follows :—

1. Characters devoid of serif.

John Day, 1546

Canon condensed sans (Miller & Richard).

JOHN GRISMAND

30-point condensed sans serif.

Thomas Wright

2-line great primer grotesque No. 4 (Miller & Richard).

Characters devoid of serif, as shown by the examples given above from the catalogues of two leading British typefounders, are known by various names, and, save for the absence of serif, vary within the same limits as any other form of face. These faces are generally called sans serif, more correctly sanserif, sometimes abbreviated as sans, but occasionally they bear the quite irrelevant titles of grotesque and doric; in the United States of America they are known as gothic.

2. Characters in which the upper and lower bounding lines of the serif are horizontal, and in which the depth of the serif is less than, or approximately equal to the width of the main-stroke.

Arthur Nichols

30-point antique No. 3 (Shanks).

This face is frequently known in England, and usually in France, as egyptian; in England it is sometimes styled clarendon, and occasionally antique.

3. Characters in which the upper and lower bounding lines of the serif are horizontal, and in which the depth of the serif is greater than the thickness of the main-stroke.

Wynkyn de Worde

2-line english (27-point) french antique (Miller & Richard)

This last face and its derivatives are widely used in France for display and advertisement purposes. In England it is frequently called french clarendon or french antique, whereas in France, judging from its name *italien*, a different origin is implied.

4. Characters in which the upper and lower bounding lines of the serif, as in class 2, are horizontal over a portion of their length, but in which the serif is connected to the main-stroke by a fillet or radius.

John James

36-point ionic.

In some examples of this style, commonly known as ionic, the radius or fillet is so extremely small, that it is hard to differentiate it from the style called antique.

5. Characters in which the upper and lower bounding lines of the serif are horizontal, except that the upper serif of the lower-case sorts has its bounding lines parallel and inclined to the main-stroke of the letter.

Nicholas Jenson

36-point venetian old-style (Shanks).

The characteristic features of this style follow those of the face originated by Jenson, whose name it generally bears, though it is sometimes known as venetian.

6. Characters in which the respective upper and lower external bounding lines of the serifs are horizontal, and the two internal bounding lines of the serifs are inclined to the horizontal, forming pointed serifs with their extremities on the respective upper or lower lines of the type.

DOCTOR FELL

2-line great primer antique No. 8 (Miller & Richard).

Faces having this peculiarity are usually known as latin, or, when heavy, as bold latin, though they are occasionally and ambiguously styled antique.

7. Characters in which the serifs have the outer bounding lines usually horizontal and the inner bounding lines inclined, also a short vertical bounding line terminating the serifs and a small fillet or radius connecting the serif to the main-stroke, except that in those lower-case letters which have vertical stems the upper serif has its upper bounding line inclined and the lower bounding line horizontal.

John Bagford

36-point old-style (Miller & Richard).

Robert Andrews

36-point Haddonian (Haddon).

Henry Bessemer

2-line english (27-point) old-style antique No. 7 (Miller & Richard).

These are the characteristic features of the old-style group. By a system of hybridization between various forms of capitals and lower-case letters having these peculiarities, derivative old-styles are formed, such as old-style ionic, old-style antique, etc.

8. Characters in which the serifs have the outer bounding lines usually horizontal and the inner bounding lines formed entirely by a radius or fillet, and also have a short vertical bounding line terminating the serifs. In the lower-case the upper serifs generally have their upper bounding lines inclined.

Joseph Moxon

2-line great primer old-face.

Rowe Mores

3-line pica De Vinne (Stephenson & Blake).

This style is termed old-face, and perhaps the finest example of it known to the authors is that cut in Glasgow by Wilson, about 1768, and used for a notable edition of Virgil published by Fowler in 1778.

9. Characters in which the serifs are reduced to a simple horizontal hair-line, connected by a small fillet or radius to the main-stroke.

John Baskerville

2-line great primer No. 4.

This form of serif is that common to the great group of faces known as modern, one of the most extensively-used styles, whether in some of its extreme forms as a book face, or in its somewhat heavier form with shortened and thickened serifs as a news fount. It is in this style that the punch-cutters of the nineteenth century manifested the greatest technical skill on the steel of the punch and the least kindly consideration for the eyes of the unfortunate readers of the ultimate product of their inconsiderate ingenuity.

10. Characters in which the serif is rudimentary and indistinguishable from the gradual thickening of the main-stroke towards the ends in following a curved outline.

Alexander Wilson

24-point atlas.

The term generally used to describe this style of character is atlas.

A curious instance of the small effect that the serif alone may have in differentiating a type face is shown in example 8, where two founts, ordinary old-face and De Vinne, differ very widely and yet possess serifs that are practically identical.

In addition to the various forms of serif which have been classified among the foregoing typical examples, there are numerous varieties of serif, developed and undeveloped, exaggerated and minified, angular, bulbous, vermiform, undulating, many apparently suffering from strange and distressing maladies such as elephantiasis, rheumatic arthritis, and phagedænic ulcerations, to mention nothing worse. In all seriousness, some of the incongruous serif forms which the authors have met with, fully merit the names attached to them above, though such nomenclatures may appear foreign to a technical work on typographical printing-surfaces. Applied knowledge is always to be respected ; applied ignorance is not so worthy, but, perhaps unfortunately, these curious serifs are not so much examples of failing or ignorance on the part of type producers, as they are evidence of a depraved taste on the part of what is happily but a minority of their public.

It is a great pity that no standard nomenclature exists for the various styles of type face, but those names to which the authors give priority in their descriptions are those which they would suggest ought to be adopted for general convenience.

CHAPTER VI.

FOUNTS OF TYPE.

"Imps of Hell are busy but in Mischief; Whereto work also Symbols and Abbreviations which ever have wise men held to be Imps of the Case; For of them alack the Printer maketh use but to his own woe seeing that Memory worketh not ever alike to him that Readeth and in him that Buildeth his Bookes."

Mirrour of Pryntyng.

8-point condensed clarendon (Shanks & Sons).

According to Moxon, a fount is the whole number of letters that are cast of the same body and face at one time. Possibly this restriction to "one time" was due to the fact that with earlier and cruder methods than those at present in use, a fount produced at one time never exactly corresponded with a fount produced at another. He derives the word "fount" from the same source as to found or cast, and says that the word should be properly called "fund," the product of a type fundry, or foundry.

In the early days of printing there were, strictly speaking, no founts. In Caxton's time, for instance, the character itself, according to Hansard, was a rude old gothic, mixed with secretary, designed on purpose to imitate the handwriting of those times; the words were printed so closely to each other that the result was difficult and tedious to be read, even by those who were used to manuscripts, and often led the inattentive reader into mistakes. Even after the introduction of roman, founts were still very incomplete, and italic, which forms part of every full fount to-day, and which is said to be based upon the handwriting of the poet Petrarch, was not introduced till 1501.

A fount of type to-day comprises all the characters which commonly occur in books and papers. A fount adapted to ordinary purposes is given in table 1.

It would be an interesting line of inquiry to follow out and classify the shapes common to the largest number of alphabets—an esperanto of letters as it were—for there may be some law that governs the genesis of character shapes and the authors are not aware of any attempt to discover it, nor even do they remember seeing anywhere a suggestion that such exists. Accents would naturally fall into the scope of the investigation, for an accented letter is virtually only a new letter or one with a different outline from its fellows.

TABLE I.

Ordinary fount of type.

Kind.	Characters.	Number.
Roman lower-case . .	a to z and æ œ ﬀ ﬁ ﬂ ﬃ ﬄ	33
Roman small capitals .	A to Z and Æ Œ &	29
Roman capitals . .	A to Z and Æ Œ &	29
Roman figures . .	1 2 3 4 5 6 7 8 9 0	10
Fractions . . .	½ ¼ ¾ ⅓ ⅔ ⅛ ⅜ ⅝ ⅞	9
Roman points . .	. , ; : - ' ! ? ([	10
Roman accents . .	{ á à â ä ã é è ê ë í ì î ï ó ò ô ö ú ù û ü ẃ ŵ ç ñ Ç }	26
Peculiars . . .	* † ‡ § ‖ ¶ ⁀ ‸ ¬ - — . .	12
Commercial signs . .	@ ℔ lb / £ $ % + − × ÷ =	12
Italic lower-case . .	*a* to *z* and *æ œ ﬀ ﬁ ﬂ ﬃ ﬄ*	33
Italic capitals . .	*A* to *Z* and *Æ Œ & £*	30
Italic figures . . .	*1 2 3 4 5 6 7 8 9 0*	10
Italic points . . .	*; : ! ? ( ]*	6
Italic accents . .	{ *á à â ä ã é è ê ë í ì î ï* *ó ò ô ö ú ù û ü ẃ ŵ ç ñ Ç* }	26
Total	. . . .	275

The fount given in the preceding table comprises all the accents and accented sorts used in the principal languages of the Latin, Anglo-Saxon, and Teutonic groups; other languages and dialects require some special accents or characters. Those shown on the next page may be taken as typical of the large number of examples which might be quoted. The border line between letters bearing accents and special letters cannot easily be defined, a further variety being introduced when small letters are themselves used as accents in conjunction with ordinary characters of the body fount. Only languages employing generally, or occasionally, the latin character are here considered. Any analysis of the vowel signs, tonal marks and other variations (usually termed accents by the printer) of character, in languages still making use of their own alphabet (such as the Semitic group, the Indian groups, the languages of the near and far East, of Melanesia, of Polynesia, and the native languages of North and South America), would be quite outside the scope of this brief reference. In a later chapter, however, a classification is given of languages using the accents peculiar to various European and other groups of languages for which the latin character is the basic script.

Albanian ḱ ȩ ɵ	Icelandic Ꝥ ð þ	Norwegian ø
Amoy ȯ ȧ	Jaunsari ṉ̰ ḍ	Nupe ũ ọ ẹ ǒ
Annamite Đ đ ẻ	Kienning ă ậ ō ē ī	Polish ł ą ż ń ś
Ashanti e̱ ẘ ṅ o̱	Latin ă ŏ ŭ ā ō ū	Roumanian ş ḑ ţ
Bohemian ů ž ě ř č	Magyar ő	Slovenian č ǯ
Cree ế ấ	Maltese Ħ ħ	Swedish å
Guarani û ỹ	Micmac ạ ɯ ɛ ŏ ɚ	Urdu ḳ ṭ ṉ
Ibo Ọ ọ́ ẹ	Nkondi ů e̱ i̊	Yahgan ų ų́ q̄ ɯ ɨ ɛ

All these varieties of accents, however, fade into insignificance when contrasted with some of the proposed universal international systems. The "Standard Alphabet" of C. R. Lepsius (2nd ed. 1863) bristles with accents both above and below the line, and a single vowel may be accented in more than thirty different ways, while the consonants also are freely marked. The Berlin Academy of Oriental Languages applies a very elaborate system of accents. In one of its recent volumes, dealing with a single language, forty-five vowels are thus distinguished, the **a** appearing in no fewer than thirteen different guises. Even under the best conditions, with new type, the best paper, the blackest ink, and the brightest light, it is very difficult to differentiate between several of these accented sorts, while in less favourable circumstances to do so becomes a virtual impossibility.

The task which confronts the designer of a totally new letter is twofold. In the first place the new letter must be sufficiently distinct from any of the old ones, so that its impression can be read even under unfavourable conditions; and in the second place it must be sufficiently strong to enable it to withstand the same treatment as the rest of the fount. For nearly half a century Isaac Pitman strove to find the best working compromise between these two claims, but only some half-dozen of his inventions met with his unqualified approval.

Several of these new forms have been adopted by the International Phonetic Association, which, however, avoids many difficulties by eliminating all the capital letters. Its system of phonetic printing is now widely diffused, one single publisher having employed it in upwards of seventy books. The following is an example of the system as applied to the English language:—

ðə nɔːθ wind ənd ðə sʌn wəː dis'pjuːtiŋ witʃ wəz ðə strɔŋgə, wɛn ə trævlə keim ə'lɔŋ ræpt in ə wɔːm klouk. ðei ə'griːd ðət ðə wʌn huː fəːst meid ðə trævlə teik ɔːf (h)iz klouk ʃud bi kən'sidəd strɔŋgə ðən ði ʌðə. ðɛn ðə nɔːθ wind bluː wið ɔːl hiz mait, bət ðə mɔː hiː bluː, ðə mɔː klousli did ðə trævlə fould (h)iz klouk ə'raund him; ənd ət lɑːst ðə nɔːθ wind geiv ʌp ði ə'tɛm(p)t. ðɛn ðə sʌn ʃɔn aut wɔːmli, ənd i'miːdjətli ðə trævlə tuk ɔːf (h)iz klouk; ənd sou ðə nɔːθ wind wəz ə'blaidʒd tə kən'fɛs ðət ðə sʌn wəz ðə strɔŋgər əv ðə tuː.

FIG. 42.—*International Phonetic Association type.*
From page 20 of "The Principles of the International Phonetic Association," London, 1912.

CONVENTIONAL AND IDEOGRAPHIC SIGNS.

Conventional signs.—In addition to the characters in common use which, taken together, make up what is called a fount of type, there are numerous other characters and signs of special meaning. Their use has greatly extended in these last few years, owing to the increase in the number of guide-books, route-books, hotel, hydro and health-resort announcements, and works of a similar nature that are now published in response to the desire for general knowledge, and the vastly-increased restlessness of the human race.

Never was truer prophecy uttered by any seer than that made by Daniel, more than twenty-five centuries ago, that a particular epoch of one of the future stages of our world's life-history would be characterized by the words: "Many shall run to and fro, and knowledge shall be increased." There is no arguing with the Prophet! Even in a technical book like this, his statement is full of relevance and truth, and a brief consideration of the enormous modern increase of signs bears testimony to it, if nothing else does. In some ways it is a curious reversion to an earlier state of things; it is the old sign-board thrusting itself upon mine host's customers once more, but in another form, the old representation of a natural object announcing what was to be had within the shop or workshop, when we come across in a modern guide-book a neat little representation of an hotel for the traveller, a garage for the car, a well-limned can of petrol, gasolene or essence for the motor, a well-drawn spanner to notify the existence of a repair shop. Truly "Time sweeps on in cycles, with changing, yet changeless wing."

The signs shown below are placed more or less in chronological order, the astronomical being given priority, as being probably among the oldest conventional signs that can be properly credited with that name; at any rate, they were undoubtedly the first that were brought into general use by the educated.

ASTRONOMICAL SIGNS.

SOLAR SYSTEM, INCLUDING SUN AND GREATER PLANETS.

☉ Sun	☾ or ☽ Moon	♄ Saturn
☿ Mercury	♁ Earth and moon	♅ or ⛢ Uranus
♀ Venus	♂ Mars	♆ or Ψ Neptune
⊖ or ⊕ Earth	♃ Jupiter	

ASTEROIDS, OR TELESCOPIC PLANETS.

⚳ or ⚳ Ceres	⚖ Astræa	(9) Metis
⚴ or ⚴ Pallas	Hebe	(10) Hygeia
⚵ Juno	Iris	(11) Parthenope
⚶ Vesta	Flora	(12) Victoria

and some 700 others, all of which are now denoted by numerical signs.

LUNATIONS.

● New moon	○ Full moon
☽ First quarter	☾ Last quarter

and many other forms.

ASPECTS.

☊ Ascending node	☌ Conjunction	☍ Opposition
☋ Descending node	△ Trine	□ Quadrature
⊙ Quintile	⚹ Sextile	

and many other forms.

SIGNS OF THE ZODIAC.

♈ Aries	♌ Leo	♐ Sagittarius
♉ Taurus	♍ Virgo	♑ Capricornus
♊ Gemini	♎ Libra	♒ Aquarius
♋ Cancer	♏ Scorpio	♓ Pisces

and many other forms.

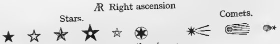
ALMANAC SIGNS.

Hours of light and darkness; weekdays.

MISCELLANEOUS.

℞ Right ascension

Stars. Comets.



and many other forms.

Pseudo-scientific signs.—In addition to the astronomical signs already given, there are numerous other signs and symbols which have been invented by pseudo-astronomers and astrologers, apparently for the purpose of hiding their own ignorance from the ignorant and of filling up with pretentious-looking symbolism the pages of their almanacs. These signs are too numerous to give here, and are hardly of sufficient importance at this date. Among them, it may be stated, to mention only a few, are signs giving notice on what day it is proper to let blood, to bathe, and to cup, to sow and to plant, to take physic, to have the hair cut, to have the nails cut, to have children weaned, together with endless other absurdities, as well as symbols that serve to indicate the approach of hail, of thunderstorms, of lightning; and, in addition to these natural phenomena, symbols that have reference to many occult marvels. Those interested in these symbols, which have no technical importance, will probably discover them in old almanacs and even in the present astrological and prophetic almanacs that are still on sale, and, what is more extraordinary, still find believers.

MATHEMATICAL SIGNS.

GEOMETRICAL.

$>$ is greater than	$\veebar$ equiangular	⬠ pentagon
$<$ is less than	○ circle	⬡ hexagon
$\gtrless$ is greater or less than	⊽ sector	$\therefore$ therefore
$\lessgtr$ is less or greater than	⌓ segment	$\because$ because
$\ngtr$ is not greater than	⌒ arc	$^\circ$ degree
$\nless$ is not less than	Δ triangle	$'$ minute
$\angle$ angle	□ square	$''$ second
∟ right angle	▭ rectangle	$\backsim$ similar to
$\perp$ perpendicular to	▱ rhombus	: is to, or divided by
$\parallel$ parallel	⊞ cube	∻ or :: as, or is equal to
# equal and parallel		

and many others.

ALGEBRAICAL.

$+$ plus	$\surd$ square root, radix	$\lfloor n$ or $n!$ factorial
$-$ minus	$^{123 . n}$ exponents or powers	$n\rfloor$ or $n¡$ subfactorial
$\pm$ plus or minus	$_{123 . n}$ suffixes	Δ finite difference
$=$ equal to	$\times$ multiplied by	$\sim$ difference
$\neq$ not equal to	$\div$ divided by	δ used for partial differential coefficients
$\propto$ varies as	$\equiv$ congruent	
∞ infinity	$\int$ integral	

and many others.

Exponents and suffixes are known in printing as superiors and inferiors.

MISCELLANEOUS.

All those characters of the greek lower-case and capitals which differ from the roman. α, β, γ, δ, ϵ. ζ, η, θ, ι, κ, λ, μ, ν, ξ, π, ρ, σ, τ, ϕ, χ, ψ, ω, Γ, Δ, Θ, Λ, Ξ, Π, Σ, Φ, Ψ, Ω.

Đ ꝗ Crossed letters and scratched figures
$\overline{S}$ $\overline{4}$ Overscored letters and figures
$\frac{1}{1}$ $\frac{2}{2}$ $\frac{3}{3}$ $\frac{4}{4}$ $\frac{5}{5}$ $\frac{6}{6}$ $\frac{7}{7}$ $\frac{8}{8}$ $\frac{9}{9}$ $\frac{0}{0}$ Split fractions
· Decimal point (full point inverted)
$\dot{7}$ Dotted figures
$\ddot{7}$ Double-dotted figures
$\sqrt[3]{}$ $\sqrt[4]{}$ Root signs
$\overline{\quad}$ Vinculum
/ Bar or solidus

and many other signs.

The interrelation between typesetting and mathematical notation.—The difficulty which the printer encounters in the composition of even simple arithmetical work has long since been recognized, and has resulted in the placing of the figures upon the en-set. With the advent of the decimal system this influence has become extended to the points, the full point and some other points now being cast on the quarter-em or middle-space set to facilitate the composition of tabular work. In the composition of mathematical formulæ this influence has already made itself felt to such an extent that changes have been brought about in mathematical notation with a view to facilitating the work of the compositor. First among such changes may be mentioned that made some thirty years ago in the expression for factorials. These quantities, which occur so frequently in all matters relating to permutations, combinations, probability, etc., were formerly represented thus, $\lfloor\underline{n}$, and expressions of the form $\dfrac{\lfloor\underline{n}}{\lfloor\underline{m}\;\lfloor\underline{(n-m)}}$ gave rise to a very large amount of work in composition, the short rules requiring much time and skill for their justification. The introduction of the exclamation sign (!) in place of the combination of rules formerly used reduces this expression to $\dfrac{n!}{m!\,(n-m)!}$ and eliminates much of the labour of composition. Similarly subfactorial n, $(\underline{n}|)$, is now written n¡.

The progress of machine-composition has already begun to make itself felt in the simplification of fractions from the compositor's point of view. It is now quite usual to arrange in one line fractions which previously required at least two lines of type separated by a rule; by this method what the French term *le parangonnage*, or the building up of a line out of several bodies, is avoided. It is true that the point system has greatly simplified such work when set by hand, but with machine-composition, whether the machine produces lines of loose type, or slugs, further simplification is desirable in order that formulæ may, as far as possible, be capable of composition in single lines. The fraction has been the commonest and one of the greatest stumbling-blocks, but its horizontal division line or bar is now, in many cases, replaced by the solidus or diagonal stroke; thus the formula quoted above can now be written on one line, $n!/[m!\,(n-m)!]$, without the least danger of misunderstanding.

The above, however, shows that at present the application of the method is somewhat restricted for want of other appropriate symbols for such additional brackets as may be required. It is to be noted that the brace {} also might be cut on a small body, and that it is an already familiar sign; furthermore, it would be easy and would in no way interfere with legibility to make use of parentheses and brackets of much-increased thickness of main-stroke, and by so doing to retain the familiar form while obtaining the requisite difference essential to accurate interpretation.

Another sign which could easily be dispensed with is the radix $\sqrt{\ }$. This has frequently to be made of ⌐-section to allow for the insertion of the index of the root, thus, $\sqrt[3]{\ }$, $\sqrt[3]{(A + B)^2}$. This can be equally well expressed by a fractional index and the expression set up in the form $(A + B)^{\frac{2}{3}}$. The use of the small index fraction, however, produces results the reverse of legible, besides involving, in many cases, the difficulty of composing with split fractions of minute body. Increased legibility can be obtained by the use of ordinary superiors in combination with a solidus cast as a superior, the expression then becoming $(A + B)^{2/3}$ and ceasing to present any difficulty to the compositor. The size of the figures forming the fraction can thus be increased by about one-half beyond that necessary in the case of the horizontal bar. If the powers are cast as superiors on a half-body of the size used for the matter being composed, it is possible to use inferiors also on a half-body for suffixes, and an expression of the form $M(\epsilon_1^2) + M(\epsilon_2^2) + M(\epsilon_3^2) + \ldots$ presents no difficulty in setting up; in fact, as it is here set up, it could be composed and cast on the Linotype or any other composing and casting machine. It is to be recommended that the solidus should be put on the same set-width as the figures and that the characters used for superiors and inferiors should, whenever possible, be cast on the en-set or the em-set, as this would make the work of composition much simpler. Moreover, the solidus should be made heavier, to render it more visible.

The long $\int$ used for integration offers similar difficulty in many formulæ, and the loss of time which it occasions in a printing-office where mathematical works are composed is sufficiently great to warrant mathematicians permitting the adoption of some more convenient substitute for this familiar sign, such, for instance, as a greatly expanded doric italic ***S***, in which case an expression now written and printed

$$B\sqrt{29}\int_0^H \frac{H - h}{H} h^{\frac{1}{2}} dh$$

would become $B(29)^{1/2}\boldsymbol{S}_0^H[(H - h)/H]h^{1/2}dh$.

This question, as well as the many others involved in that of a universal notation for mathematical and physical constants, is worthy of the very careful and serious consideration of an international commission. The commission engaged on this work should have the advice not only of publishers and authors whose province is the use of type faces, not only of typefounders and printers who deal with the production and manipulation of type, but should be especially advised by those who know the limitations imposed by machine-composition and appreciate the constant change and advance in methods of typesetting. The leading mathematicians and physicists have in the Oxford, the Cambridge, and the other university presses large stores of material for hand-composition; the difficulties of converting old methods to meet the exigencies of the modern press-room are as unknown to those who have such access, as they are to their confreres of continental countries like France, where the influence of machine-composition has yet scarcely made itself felt. The professor and the editor of technical proceedings have difficulty to-day in finding in London a greek alpha, α, which can be distinguished from an italic latin a; the physicist and the electrical engineer are endeavouring to find a type face which will provide many symbols they require; *Fraktur*, script, heavy-face and other special type have been proposed, but each of these is either troublesome to write or to distinguish from others on the blackboard or in manuscript; and the difficulties of those engaged in other branches of science may be estimated from the fact that it has taken nearly two years to collect from the foundries of England, America, and various European countries a small percentage only of the signs given in the preceding and following lists.

The whole of the lower-case and capital letters of the roman alphabet, the lower-case italic, and those letters of the greek alphabet which differ from the roman or italic, have almost all found familiar uses, many of them for several different purposes. There are an ample number of signs in existence for covering the range of expressions used or required for mathematical work and physical research without drawing upon the very illegible gothic or german characters or even upon the more legible of those Russian characters which differ from the greek or roman, though these would be far preferable to the gothic. Moreover, there are available among the lesser-known languages of Europe and the near East many simpler but beautiful and easily-written characters which would readily amplify the list of universal notation characters should this be found necessary.

In many cases fractions may be avoided by the use of negative indices, for example, $\frac{m^2}{n}$ can be written on one line, thus, m^2n^{-1}, though in so simple a case the solidus is to be preferred.

$$\bar{x} = \frac{\int_0^a x\,dx \int_0^{\sqrt{a^2 - x^2}} r\sqrt{x^2 + r^2}\,dr}{\int_0^a dx \int_0^{\sqrt{a^2 - x^2}} r\sqrt{x^2 + r^2}\,dr} = \frac{2a}{5}$$

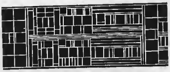


FIG. 43.—*Example of mathematical composition and cross-section through the component type.*

A difficulty which is met with by the compositor in setting up complex mathematical formulæ is illustrated in fig. 43, in which a formula is shown as set up, and below it a horizontal section of the type of which it is composed. The total number of leads, rules, spaces, quads and type shown here, apart from quotations and furniture to make up the measure of the page, amounts to 159 pieces of which only 58 form the actual typographical printing-surface.

The difficulties of mathematical composition are increasing to such an extent that in the future, unless a simplified notation is adopted, it will be necessary for the mathematician to obtain the reproduction of his formulæ in the shape of zinco-blocks instead of having them set up from loose type of many bodies and founts, made up with leads and rules of various thicknesses, cut specially to length for the individual formula and laboriously packed with the necessary spaces and quads.

ECCLESIASTICAL SIGNS.

+ Greek cross
† Latin cross
X St. Andrew's cross
T Tau cross
St. Anthony's cross
✝ Calvary cross
‡ Triple cross of the Pope
☦ Double cross of Archbishops and Cardinals
✠ Double Jerusalem cross

† Ornamental cross
✠ Miscellaneous crosses
卐 Buddhist cross
Mitres
Ave Marias
Sacred Heart and Crown
Tears
℟ Response
℣ Versicle
☧ Monograms
Crowned M

and many others.

MEDICAL SIGNS.

♃ or ℞ Recipe
℥ Ounce
ʒ Drachm
℈ Scruple
♏ or ♏ Minim, or drop
O. *Octarius*, or pint
C. *Congius*, or gallon
℔ or ℔ *Libra*, or pound
gr or gr. Grain
ss or ss. Semi, or half
j, ij, iij One, two, three, etc.
P. Particular

P. æq. *Partes æquales*, or equal parts
āā *Ana*, or of each
q.s. *Quantum sufficit*, or as much as is sufficient
q.p. *Quantum placit*, or as much as you please
M *Misce*, or mix
s.a. *Secundum artem*, or according to art
p.r.n. *Pro re nata*, or occasionally

and many others.

ARCHÆOLOGICAL SIGNS.

AD Æ AL M N AP AR AW N © HE

MP MV ND NE NP NR PV TV VA VE

AI A Ȧ AI AV ET E F G IS B D F L M M N N Þ

R ME NE N N H R R E H Ṫ Ṫ L R T

V V VL VM VR WT X X XV YH

and many others.

SCRIBAL ABBREVIATIONS.

ã ā ƀƀ ƀ ƀ c̃ c̄ cᷓ c̃o đ đ ẽ ē e͠ f f f g̃ gᷓ ħ ħ

ĩ ī j̃ ꝁ ł ł ŧŧ ŧŧ m̃ m̄ (m̃) mᷓ ñ n̄ nᷓ õ ō

p̃ ꝑ ꝑ ꝑ pᷓ q̃ ꝗ ꝙ qq r̃ s̃ sᷓ t̄ t̃ ꝛ tᷓ

ũ ū uᷓ ṽ vᷓ w̃ x̃ xᷓ ỹ ȳ z̃ ꝣ

&̃ ꝭ ⁊ ꝰ ꝰ ʃ ʒ ʒ ꝰ ÷ ꝭ ꝯ

Ā Ꝺ Ē Ī Ō M̄ Ꝑ Ꝑ Pᷓ ℞ V̄

CARTOGRAPHICAL SIGNS.

✂ Battle	○ Town	⛪ Church
⊙ County town	++++ Railway	═ Road
▬▬ Canal	■ Castle or abbey	✳ Lighthouse

and many others.

CARTOGRAPHICAL SIGNS INDICATING ARCHÆOLOGICAL REMAINS.

Colour.	Pre-Roman.	Colour.	Roman.
Black	Ⓔ Earthworks and *oppida*	Red	◘ Walled towns
Blue	π Megalithic remains	,,	■ *Castra*
,,	✱ Coins and miscellaneous finds	,,	● Interments
,,	△ Settlements	,,	▲ Foundations of buildings
,,	✕ Torques, etc., also bronze weapons	,,	◆ Potteries
,,	● Interments	,,	▬ Roman roads
,,	▬ Drift implements	,,	▪▪▪ Probable Roman roads
		,,	✱ Coins and miscellaneous finds

Colour.	Anglo-Saxon.
Green	● Interments
	✱ Coins and miscellaneous finds

NATU

♂ Male

○ Plants capable of but
fructescence
① Monocarpic annual
② Monocarpic biennial
♾ Hardy monocarpic pla
only flowers after a
of years and dies
doing
♃ Rhizocarpic plant; t
say, a plant whose
hardy and throw u
bearing stems each y
♄ Caulocarpic plant as
whose stalk survi
fructifies many time
♃ Perennial herb
♄ Suffrutex, an undershr
♄ Frutex, a shrub
♄ Arbuscula, a bush or s
♄ Arbor, a tree more tha
high
⌒ Climbing plant
↺ Right-handed climbing
↻ Left-handed climbing p

Some of these signs a
meanings in a few cases. M

£ Pounds sterling (rom
£ Pounds sterling (ital
₤ Pound sign (Italian)
₧ *Pesetas* (roman)
₧ *Pesetas* (italic)

NATURAL HISTORY SIGNS.

♂ Male ⚥ Hermaphrodite ♀ Female

and others.

BOTANICAL SIGNS.

○ Plants capable of but a single fructescence

① Monocarpic annual

② Monocarpic biennial

⊛ Hardy monocarpic plant which only flowers after a number of years and dies after so doing

♃ Rhizocarpic plant; that is to say, a plant whose roots are hardy and throw up flower-bearing stems each year

♄ Caulocarpic plant as a rule, whose stalk survives and fructifies many times

♃ Perennial herb

ħ Suffrutex, an undershrub

ħ Frutex, a shrub

ħ Arbuscula, a bush or small tree

ħ Arbor, a tree more than 25 feet high

⌒ Climbing plant

↺ Right-handed climbing plant

↻ Left-handed climbing plant

△ Evergreen

♂ Male plant

♀ Female plant

☿ Hermaphroditic plant

○= Cotyledons accumbent to the radicle

○‖ Cotyledons incumbent on the radicle

∞ Indefinite number of petals, stamens, etc.

? Casts doubt upon a preceding word or phrase

! Indicates certainty

+ Following a name, signifies that the object is not well-known

– Between two figures, as in 5–10, indicates the extremes of difference, as the stamens are from 5 to 10

✕ After a synonym, indicates that a description from nature will be found in the work of the author cited

Some of these signs are also used by Linnæus, but with different meanings in a few cases. Many other signs are used by various authorities.

MONEY SIGNS.

£ Pounds sterling (roman)	¢ Cents	$ *Reis*
£ Pounds sterling (italic)	₰ Deniers	$ Dollars (roman)
₤ Pound sign (Italian)	B *Bolivars*	*$* Dollars (italic)
₧ *Pesetas* (roman)	∥ *Schellings*	Ł Pound (Roman)
₧ Pesetas (italic)	*ʃ Sous*	# Pound (Tournoi)

and many others.

COMMERCIAL SIGNS.

℔ Per
% Per cent
‰ Per mil
@ At
a/c Account
c/o Care of
\# Number (used in America)
and others.

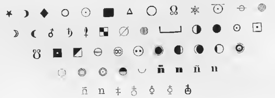
METEOROLOGICAL SIGNS.

INTERNATIONAL SYMBOLS USED FOR RECORDING WEATHER PHENOMENA.

≡ Fog
≡° Mist
≡⁝ Wet fog, from which moisture is deposited copiously on exposed surfaces
∞ Dust-haze, or smoke
⊤ Thunder
< Lightning
⊤< Thunder-storm
● Rain
✻ Snow
↑→ Snow-drift
⊠ Snow lying *
← Ice crystals
▲ Hail
△ Soft hail
⌓ Dew
⌴ Hoar-frost
V Rime
∼ Glazed frost
⁋ Gale
⦶ Solar *corona*
⊕ Solar halo
Ⓤ Lunar *corona*
Ⓣ Lunar halo
⌒ Rainbow
♕ Aurora
◥ Zodiacal light

Exponents 0 or 2 applied to symbols indicate respectively light and heavy. Thus ▲² indicates heavy hail, ●⁰ light rain, ≡⁰ light fog or mist.

OTHER METEOROLOGICAL SIGNS.



* More than half the country covered with snow.

WEIGHTS AND MEASURES SIGNS.

℔ Pound

℔ Pound

@ *Arrobas* (roman)

@ *Arrobas* (italic)

and many others.

ENGINEERING SIGNS.

HP Horse-power

∿ Alternation

PEDIGREE SIGNS.

┬ ╤ ╤ ┐ ┌ ═ ─ ━ ┬ ╤ ┬ ┬ ┬

CROWNS, CORONETS, WREATHS, HELMETS, AND HERALDIC SIGNS.

BRITISH.	FOREIGN.	VARIOUS.
Imperial crown	Imperial crown	Knights
Royal crown	Royal crown	Knights Bachelor
Ducal coronet	Ducal coronet	Red hand of Ulster
Marquis's coronet	Marquis's coronet	Scotland or Nova Scotia
Earl's coronet	Count's coronet	Fleur-de-Lys
Viscount's coronet	Viscount's coronet	Ermine
Baron's coronet	Baron's coronet	‡ Double cross of Lorraine
Antique crown	Naval crown	Archbishop's mitre
Civic crown	Military crown	Bishop's mitre
	Laurel wreaths	

and many others.

ORDERS.

BRITISH.	FOREIGN.
Order of the Garter	*Saint-Esprit*
Order of the Thistle	*Saint-Michel*
Order of Saint Patrick	*Saint-Louis*
Distinguished Service Order	*Saint-Georges*
Imperial Service Order	*Saint-Sépulcre*
Saint John of Jerusalem	Legion of Honour: white
(Military) Order of Merit	Legion of Honour: white with ribbon
(Civil) Order of Merit	Legion of Honour: with ring
	Mérite militaire
	Mérite militaire; with ring
	Mérite agricole

and many others.

MEDALS.

Victoria Cross — Iron Cross

New Zealand Cross — Mentana Cross

and many others.

MASONIC AND OTHER SECRET AND PHILANTHROPIC ASSOCIATION SIGNS.

and many others.

POLITICAL SIGNS.

Phrygian cap — Primrose League

and others

TING-SURFACES.

FOREIGN.

- Saint-Esprit
- *Saint-Michel*
- *Saint-Louis*
- *Saint-Georges*
- *Saint-Sépulcre*
- Legion of Honour: white
- Legion of Honour: white with ribbon
- Legion of Honour: with ring
- *Mérite militaire*
- *Mérite militaire;* with ring
- *Mérite agricole*

thers.

S.

- Iron Cross
- Mentana Cross

thers.

T AND PHILANTHROPIC
 SIGNS.

thers.

SIGNS.

- Primrose League

rs

METAL SIGNS.

(Au) or (O) Gold	(Ch) or (B) Bronze
(Ag) or (A) Silver	(Fe) or (F) Iron

and others.

TRAVEL SIGNS.

- Country
- Mountain
- Range of mountains
- Fortress
- Town
- CT County town
- UD Urban district
- RB Royal borough
- CB County borough
- MB Municipal borough
- PB Police borough
- (P) Police station
- Ch.S Syndical room
- Monument
- Cathedral
- Church
- Cemetery
- Castle
- Country-seat
- *Château*
- House
- Hotel (first class)
- Hotel (second class)
- Hotel (third class)
- Hotel (fourth class)
- Hotel (fifth class)
- Hotel (sixth class)
- CH Central heating
- Lift
- Meat-market
- Poultry-market
- Fish-market
- Fruit-market
- Flower-market
- Grain-market
- Wine stores
- Wine-shop
- Music-shop
- Pawnshop
- Dark-room
- Photographic stores
- Central post, telegraph, and telephone office
- Post office
- PP Parcel post
- Redirection
- Telegraph office
- Telephone office
- 357 Telephone and number
- Railway station
- Level crossing
- RDC Railway delivery company
- Electric tramway
- Voit Horse and carriage
- Veterinary
- Farrier
- & Forge
- Motor-car
- Recharging accumulators
- Air cylinders
- Repair shop
- G Garage, and number of cars it will hold
- Box 2 Private lock-up compartments, and number

Curling
Lawn-tennis
Ice hockey
Croquet
Golf
Ski-ing
Fishing
Tobogganing
Ice-run
Rowing
Guides
Skating
Bob-sleighing
Steamer excursions
Theatre
Concert-hall
Ambulance
Hospital
Doctor
Apothecary
Chemist

Inspection-pit
Benzene
Naphtha
Lubricating oil
Motor-car works
Velodrome
Bicycle hire
Bicycle repair
Balloon station
Aeroplanes
Aeroplane repair shop
Admiralty
Harbour
Anchorage
Ship
Steamer
Motor-boat
Arrows
Fist
Curved fist
Golf-links
Race-course

and very many others.

DIRECTION SIGNS.

Keep straight on. Turn to left. Turn to right.	When three roads, diverging from the same point, are met with, one going straight ahead, one turning to the left, and one to the right (whatever may be their angle of intersection).
Keep straight on. Turn to left.	When two roads, diverging from the same point, are met with, one going straight ahead, and the other turning to the left (whatever may be their angle of intersection).
Keep straight on. Turn to right.	When, of two roads diverging from the same point, one goes straight ahead, and the other turns to the right (whatever may be their angle of intersection).
Turn to left. Turn to right.	When two roads are met with, one turning to the left, the other to the right (at any angle of intersection).

CAUTION SIGNS.

ENGLISH.

Prohibition; red disk — Caution; red triangle

Speed limit; white ring with limit in figures — Cross-roads

and others, usually of diamond shape.

FRENCH.

Dangerous descent — Steep rise

Turn to right — Turn to left

Hump or bridge — Gulley

Level crossing — Low bridge

Rails projecting upwards — Bad *pavé*

Dangerous cross-roads — Winding descent with bad corners

Village

and others.

SPORT SIGNS.

Bicycling — Coursing

Cricket — Hunting

Football — Horse-racing

Lawn-tennis

and many others.

MISCELLANEOUS SIGNS.

Caduceus — Trefoil

Heart and cross — Hearts

Heart — Diamonds

Bretons — Clubs

Siphons — Spades

and many others.

SYMBOLIC SIGNS.

These symbols are used as substitutes not only for the substantives they represent, but also for adjectives, thus, for example, while stands for "drama" or "actor," stands for "dramatic author"; similarly ⚓ signifies "naval engineer," and signifies "military engineer." One example given at the end of this section, taken from an actual work, shows the practical usefulness of these signs, and another given in the form of a guide-book page illustrates their power of conveying meaning while saving at the same time a very great amount of print.

- ★ Was born in
- † Died in
- ✢ Theologian
- or ⁂ Philosopher
- Lawyer
- Surgeon
- Physician
- ⚓ Naval officer
- Military officer
- Musician
- Musical composer
- Painter
- ○ Picture
- Sculptor
- ○ Statue
- Drama or actor
- Writer
- Agriculturist
- Geographer
- Engineer
- or ⚒ Geologist
- Mineralogist
- Historian
- Chemist
- Botanist
- Astronomer
- Architect
- Archæologist
- A literary work
- Philologist
- Mythologist
- Physicist
- Poet
- Trader
- Commerce
- Prophet
- Ornithologist
- Entomologist
- Philatelist
- Miner
- ⚖ Apothecary
- Battle

and many others.

EXAMPLE OF USE OF SYMBOLIC SIGNS IN CONTEMPORARY WORK.

Fothergill, John & , ★ 1712 Carr End, † 1780 London .

From Cassell's "Miniature Cyclopædia."

NOTE.—The signs here used are similar to but not identical with those used in Messrs. Cassell's work, which itself is based on the "Taschen-Konversations-Lexikon" of Dr. Kürschner of Stuttgart.

EXAMPLE OF GUIDE-BOOK MATTER SET UP IDEOGRAPHICALLY.

Here ★ 1760 who † 1810 in † circumstances in ◎ ⊙ of Tretz; ◎ once admirably defended against ☾ by the heroic , who finally vanquished his adversary in the great at near at the foot of ▲ in of the Carpathians. It is a spot well known to and . ✠ and ⁂ have moralized over it even as , and have each exercised their art in connection with its beauties, while and other have laid within its district the scene of their . and on early have disputed with Ψ, and over the meaning of its ruins and even over the very stones disinterred by chance by the plough of . and have studied its rocks, and , assisted by , have given products to distribute through every known to . In this district are to be found , every convenience for and ; , , , , , ○ are held weekly; every facility in the shape of ✉, , , , , , and , and facilities on river and ; S on the land are there, with , and even , and of course and .

THE PRECEDING EXAMPLE IN ORDINARY LETTERPRESS.

Here the poet was born in 1760, who died in 1810 in tragic circumstances in the cathedral fortress town of Tretz; a fortress once admirably defended against the Turkish Sultan by the heroic King-Emperor, who finally vanquished his adversary in the great battle at the cross-road near the ford at the foot of the highest mountain in the range of the Carpathians. It is a spot well known to botanists and ornithologists. Theologians and philosophers have moralized over it even as musicians, painters and sculptors have each exercised their art in connexion with its beauties, while dramatic and other authors have laid within its district the scene of their works. The historian and the writer on early law have disputed with the archæologist, philologist and mythologist over the meaning of its ruins and even over the very stones disinterred by chance by the plough of the agriculturist. The geologist and mineralogist have studied its rocks, and the mining engineer, assisted by the chemist, have given commerce products to distribute through every country known to the geographer. In this district are to be found hotels of every class, every convenience exists for the horse and motor; fish, flesh, fowl, flower, fruit, honey markets are held weekly; every facility in the shape of posts, telegraphs, telephones, post-horses, steamboats, rowing-boats, motor-boats and sailing-boats and facilities on the river and railways; electric and steam tramways on the land are there, with garages, and even aeroplane establishments, and of course bicycle repair shops and the necessary outfit for pneumatic tyres.

It is obvious that the foregoing guide-book or Baedeker example could be extended, page after page, through ecclesiasticism, chivalry, heraldry, etc., but even the matter given above shows that it is possible to effect a saving on the ordinary letter-press of nearly one-third, or say 30 per cent, when the matter is set up with symbols and abbreviations, or as it may be truly called ideographically, though the saving in space is reduced in the actual example given owing to the extra leading made necessary by the large sorts used in it for many of the symbols.

The spoken words which directly represent thought are called ideophones, and the written symbols which directly represent thought are called ideograms. It is probable that for some considerable time after its introduction writing was ideographic, but at length it was extended so as to represent the sounds of the ideophones, and the symbols which perform this function are called phonograms. The crucial distinction between ideograms and phonograms lies in the fact that the former, since they represent nothing but soundless thought, cannot have any fixed sound of their own; whereas the latter represent sound and nothing else. Yet, since every language, for the sake of convenience, bestows names on most ideograms, and since these names are usually reduced again to writing —which is then only the great-grandchild of thought—we find that speech and writing are so closely interwoven in actual practice that it is rarely necessary to remember that they really constitute two totally different methods of expressing thought.

All pictures, maps, and diagrams, when they convey any meaning at all, may be regarded as ideograms, since the meaning they convey to the eye is independent of the language spoken by the owner of the eye. They address one in a language that practically no one has to learn, a language that is international and that stands in its ready simplicity in the same relationship to Esperanto as Esperanto itself may be said to stand in relationship to any human language of ordinary complexity. The method, in its proper sphere, is perfectly legitimate, logical, legible, and instantly comprehensible, and its use is ever widening and increasing. Furthermore the method of appealing to the eye (and not to the ear as is done in the case of all other written speech, with one great exception), links it to the only living human language—Chinese—that like itself in its recorded expression has practically no sound, no grammar, and no troubles save the trouble of memorizing an enormous number of signs which convey every shade of meaning, and, in practice, of automatically and instantaneously allotting the correct meaning to each individual symbol.

CHAPTER VII.

UNITS AND DIMENSIONS.

"And by complicating the Letters and Points, as aforesaid, you will have any Thickness, either to make a Gage by, or to use otherwise."

Moxon's Mechanick Exercises.

Minion on brevier, antique (Clowes).

Spaces and quads.—In addition to the letter characters, *spaces* and *quadrats*, or *quads*, must be provided for separating the words and spacing out the lines. These usually have the following set widths: hair-space = $\frac{1}{8}$ body, thin space = $\frac{1}{6}$ body, middle space = $\frac{1}{4}$ body, thick space = $\frac{1}{3}$ body, en quad = $\frac{1}{2}$ body, em quad = the body, two-em quad = $2 \times$ body, three-em quad = $3 \times$ body and four-em quad = $4 \times$ body. It might be inferred that the en and em quads are of the same set as the **n** and **m** characters, but this only occurs in exceptional circumstances. Owing to modern conditions of noise in printing-works, and to make orders clear on the telephone, these are better called "nut" and "mutton" quads respectively.

In most cases where typecasting machines are concerned it is not necessary to consider the quads larger than the em, as they are usually of softer and cheaper metal and cast separately.

When quads are of 18-point or larger body they are frequently cast hollow, in which form they are known as *quotations* when they do not exceed 8 ems in length. Quotations of 8 ems and upwards in these bodies are known as *furniture*; this is generally cast hollow and cored from both sides instead of from only one side, as is usual with quotations. Quotations and furniture are used for making up the blank spaces on pages having a considerable area of white.

In order to separate lines of type and increase the amount of white between them, *leads* are used; these are thin strips of metal of thicknesses varying up to 4-point, generally expressed as fractions of a pica thus: a 3-to-pica lead, that is a lead $\frac{1}{3}$ pica in thickness. Above the thickness of 4 points, leads are usually called *clumps*, and this term covers the size from 4 points to 18 points, above which the term *furniture* is generally adopted. A *reglet* is a strip of hard-wood sometimes used in place of a clump, and is made of the same thickness as a clump.

Height-to-paper.—In the "British Printer," Hermann Smalian, of

Berlin, with whom the study of type standards is a hobby, controverts some statements made in a lecture by Wightman regarding the heights of types in use on the Continent. On collating the quotation (given by Smalian below) with the original in De Vinne's work, the authors find that it is incorrectly termed a quotation, being really more in the nature of a paraphrase; for though the sense is correctly rendered the wording differs in several places from that of the author quoted.

Smalian says, "These particulars appear to have been taken from Mr. Th. L. De Vinne's book, 'The Practice of Typography.' (New York, 1900.)

"They read as follows:—

"'Variations in the height of types have not been as marked as variations in body. British and American founders came to a practical agreement at the beginning of this century that the standard of height should be eleven-twelfths of an English inch. In France the height of type has been fixed by law at ten and a half geometric lines. Modern French types are higher than American types; the two heights cannot be used together. German types were still higher, but are now made to the French standard. This reform was made by H. Berthold. He modelled and had constructed several standards of steel, and sent one gratuitously to every German typefounder. The types of Russia and Poland, once more than one inch in height, are now made to conform to the Berthold system.'

"These particulars are altogether incorrect. The correct height of types is as follows:—

"1. *Frankfort height of type.*—Nearly 68 Didot points in height. This was the height of the typefoundries at Frankfort-on-the-Main. Very old printing establishments have this height up to the present day.

"2. *Russian height of type.*—Nearly $66\frac{3}{4}$ Didot points in height. This is the only height of type in Russia proper.

"3. *Leipzig height of type.*—Nearly 66 Didot points in height. This was the height of the typefoundries at Berlin, Leipzig, Hamburg, and so forth. Same is still to be found in many old printing establishments in Germany, Switzerland, Denmark, Norway, Sweden, in the Russian Baltic Provinces and in Russian Poland. In addition that is the standard of the typefounders in Holland.

"4. *Haase height.*—Nearly $63\frac{1}{2}$ Didot points in height. This is the height of type of the typefounder Gottlieb Haase of Prague. Same is still in existence in very old printing establishments in Austria-Hungary.

"5. *Fournier height of type.*—Nearly 63 Didot points in height ($10\frac{1}{2}$ lines of the French foot). This height was laid down in 1723 by the French law. This is still to-day the standard height for typefoundries in Belgium and Austria.

"6. *French height of type.*—Nearly $62\frac{2}{3}$ Didot points in height. This is the height of the typefoundries in Paris. All typefoundries on the Continent desirous of having a uniform height of type now introduce this

French height, *i.e.* all typefoundries in France, Spain, Italy, Greece, Germany, Switzerland, &c. In Germany, ever since 1879 all new printing establishments have been set up on the basis of this French height of type. Ever since 1840 individual German typefoundries have fitted out new printing establishments with this height of type. It is evident from this that Berthold did not require to create this height of type.

"Th. L. De Vinne has confounded body of type with height of type. Hermann Berthold's great service to typefounding consisted in the scientific adaptation of the Didot system based upon the Paris foot. In 1879 he adapted same to the metric scale, and prepared about forty steel typometers of 300 mm. = 133 Nonpareil (798 Didot points), and handed one copy to each foundry without charge. (*Vide*, "British Printer," No. 69, 1899, p. 130).

"In Germany an effort was made to gradually supersede the old heights of types by the French height. In order that this height might not suffer any modification, the combined German typefounders deposited a standard of this height of type with the authorities in 1905: $62\frac{5}{8}$ points = 23·566 mm.

"The British height of type is nearly 62 Didot points in height.

"Hermann Smalian."

The height-to-paper of type in America and England is now standardized at 0·918 inch, or 23·317 mm. Certain typefounders still cast the points and dots of the i and j about 0·001 inch high-to-paper, that is of a height of 0·919 inch, while in the case of some composing and casting machines the height-to-paper is made as much as 0·920 inch, or 0·002 inch high-to-paper, when new, to allow for the wear which takes place in the matrices.

The *trade* height-to-paper of spaces, quads, quotations, furniture, leads and clumps is usually 0·75 inch, but where stereotypes are to be taken, the height-to-paper is frequently made as much as 0·88 inch so that the top of the spaces, quads, leads or clumps comes to the height of the shoulder of the type: quotations and furniture are but rarely made of this *stereo* height. Some special furniture is also made cored from one side only with a flat surface on the other; this is known as table-top furniture, and is used extensively for mounting the metal plates of process blocks in place of the mahogany backing generally used for that purpose.

UNITS, LIMITS OF ACCURACY, AND SPACING.

Units.—In order to appreciate fully the difficulties to be contended with in typecasting and composing machines, the degree of accuracy required must first be considered.

The unit for measurement in this country and in America is the pica which is approximately one-sixth of an inch; until quite recently the size of the pica varied from 0·1678 inch to 0·1664 inch, but now most founders are in agreement and the size 0·16604 inch adopted in America has become standard.

The size of pica as made by the leading English typefounders recently varied as follows :—

TABLE 2.—*Pica sizes.*

Maker.	Pica ems per foot.	Size of pica. In.
Standard size	72·272	0·16604
Stephenson and Blake	72·125	0·16638
P. M. Shanks and Sons	72·000	0·16667
Caslon	71·875	0·16696
Figgins	71·708	0·16735
Sir Chas. Reed and Sons	71·667	0·16744
Miller and Richard	71·500	0·16783

The Monotype moulds and matrices used in England do not cast type of standard-point bodies, the size of the 12-point being 0·1668 inch. Not only does this differ from standard practice, but the height-to-paper is also slightly different from standard, being 0·920 inch.

Not only was there a difference between the sizes of pica cast by different firms, but other sizes, such as english, varied, one being 14-point and another $13\frac{1}{2}$-point. Further, some other sizes such as emerald, the half of $13\frac{1}{2}$-point english, or $6\frac{3}{4}$-point; diamond, the half of $8\frac{1}{2}$-point bourgeois, or $4\frac{1}{4}$-point; and minikin, the half of nonpareil or 3-point, were made by some founders and not by others. Of these, minikin, or excelsior, by which name it is known in America, is used for split fractions in mathematical work and also occasionally in the setting up of musical matter.

The sizes above paragon were formerly known by names which were in some cases confusing, thus, double pica was the size intermediate between paragon and 2-line pica, being equal to 2-line small pica or 22-point. The five sizes above double pica were—

2-line pica	24-point.
2-line english	~~27~~-point to 28-point.
2-line great primer ..	36-point.
trafalgar (known in America as meridian)	44-point.
canon	48-point.

The pica (0·166044 inch) is divided into twelve points (1 point = 0·013837 inch). The sizes of the various bodies are measured by points, and are as follows :—

TABLE 3.—*Body-sizes of type.*

Name.	Example.	Used in	Points.	Body. In.
2-line pica [1]	Typecas	These larger sizes are mainly used for display purposes.	24	0·33209
2-line small pica [1]	Typecasti		22	0·30441
Paragon	Typecastin		20	0·27674
Great primer [2]	Typecasting		18	0·24907
2-line brevier [4]	Typecasting a		16	0·22139
English	Typecasting an	Scotland for legal reports.	14	0·19372
Pica [1]	Typecasting and c	Parliamentary reports.	12	0·16604
Small pica [1]	Typecasting and co	Text-books and novels.	11	0·15221
	Typecasting and com	Patent specifications.	10½	0·14529
Long primer [2]	Typecasting and comp	Text-books and novels.	10	0·13837
	Typecasting and comp	"Proc. Inst. Mech. Eng."	9½	0·13145
Bourgeois [3]	Typecasting and compo	"Times" leaders.	9	0·12453
	Typecasting and composi		8½	0·11761
Brevier [4]	Typecasting and composi	"Punch."	8	0·11070
Minion	Typecasting and composing	"Times."	7	0·09686
Nonpareil [5]	Typecasting and composing m	"Engineering" ads.	6	0·08302
Agate	Typecasting and composing mac	Used in America.	5½	0·07610
Ruby	Typecasting and composing mach	"Times" ads.	5¼	0·07264
Five-point	Typecasting and composing machin	Devotional works.	5	0·06919
Pearl		"Bradshaw."	4¾	0·06573

[1] Pronounced *Pie'ca*. [2] Pronounced *Prim'er*. [3] Pronounced *Bur-joice'*. [4] Pronounced *Bre-veer'*. [5] Pronounced *Non'parel*.

NOTE.—Since the above table was compiled, some of the examples given have changed the body-size of the type used.

The relative importance of the various body-sizes may to some extent be gauged by the following table, which shows how many different faces of each body the American Type Founders Company supply according to one of their specimen books :—

TABLE 4.—*Faces and body-sizes.*

Body.	Faces.	Body.	Faces.	Body.	Faces.	Body.	Faces.
3-pt.	. 1	6-pt.	. 27	9-pt.	. 22	12-pt.	. 19
4-pt.	. 2	7-pt.	. 19	10-pt.	. 28	14-pt.	. 5
5-pt.	. 5	8-pt.	. 28	11-pt.	. 17	15-pt.	. 1
$5\frac{1}{2}$-pt.	. 9						

From this table it will appear that the even-point bodies are most in demand. Of these 183 faces, 99 are modern and 84 are old-style.

Point System.—Much confusion and trouble has been caused in the past through want of adherence to a definite unit, and some evidences of this remain in the half-point sizes, for example small pica ($10\frac{1}{2}$), long primer ($9\frac{1}{2}$), and bourgeois ($8\frac{1}{2}$), still in use in England.

In the United States of America the point system has for nearly twenty years been in universal use. It may be said also that its use is now practically universal throughout Great Britain and her colonies and dependencies. The system has for its basis the point or unit of 0·013837 inch. It has been stated that it was originally intended to make the unit one seventy-second of an inch, and the nearness of the measurements gives some colour to the statement, for, as a matter of fact, 72 points are nearly equal to an inch. It was found, however, more convenient, as the result of a careful discussion and a report following on the meeting of the United States Type Founders' Association held at Niagara in 1886, to adopt the pica of the MacKellar, Smiths & Jordan Company as the standard basis, the subdivision of which into twelve equal parts gave the unit or point of 0·013837 inch (0·3515 mm.).

Incidentally it may be mentioned that 996 points are very nearly equal to 35 centimetres, the difference in the length being only about one five-hundredth of an inch. In this connexion it may also be as well to state here that the British and the United States inches are not absolutely identical, one British inch being equal to 0·999997 United States inch. There is, roughly speaking, a difference of one three-hundred-thousandth of an inch between the standard inches of the two countries.

The French point system is of much earlier date, and was originated about the year 1737. Its author was Fournier, le jeune, by whose name it is still known, and in this system the unit or point is equivalent to

0·34875 mm. The following is a careful translation of the chapter in his famous work in which its originator explains his point system, and the illustrations that accompany it, figs. 44 to 49, are reproductions in facsimile from the copy of his book, in the possession of the authors of this treatise. The figures are interesting, for they exhibit not only the names and distinguishing numerals of his type and their equivalent in his points, but also show a scale. They are further remarkable from the fact that the illustration given in De Vinne's work is apparently from a later edition of the "Manuel Typographique," for the page, given in De Vinne's book as the page of Fournier's work which carries the illustration, is not the same as the page which carries it in the authors' own copy of his work: the type also appears somewhat battered and the scale not so correct. In the case of such a careful author as De Vinne, these differences must have some good reason and cannot be mere clerical errors or errors of reproduction.

"DETAIL AS TO DIFFERENT COMPONENTS OF A FOUNT OF CHARACTERS.

OF TYPOGRAPHIC POINTS.

"This chapter demands particular explanation, for the subject of which it treats is novel and unknown. I introduce it here to make known the new proportions that I have given to *Letter-Bodies* by fixed dimensions which I have named *Typographic Points.*

"The latest Government Regulation ('Réglement de la Librairie') issued in 1723 has fixed the *height-to-paper* at ten and a half geometric lines: this rule is as easy to give out as it is easy to put into practice, but the same was not the case when the Regulation sought to establish laws to settle the *body-sizes* of the said Letters. At the time when this rule was made, there was apparently nobody to be found sufficiently informed to furnish true ideas on the matter, which was of great importance, since the endeavour was to correct abuses and put into order and standardization that which had hitherto had neither the one nor the other. Through lack of enlightenment on this point a certain Master-Printer gave with all their defects, as a standard, such Letters as he found in his own printing establishment. The law which was promulgated, not being founded on any principle, remained unenforced; for this reason the body-sizes of Type have never had fixed and rational dimensions, and so the result is that this want of system is at the present time as great as it has ever been.

"It is stated, in Article LIX of this Regulation, that, of *bodies proper, the Petit-canon is equal to two Saint-augustins; the Gros-parangon to a Cicero and a Petit-romain, etc.*, but it is not stated what size this Saint-augustin, this Cicero and this Petit-romain should have that their sum may equal the Petit-canon or the Gros-parangon. It is therefore always possible to deviate from the Regulation, and this has been freely done without infringing the letter of the Regulation, because if one makes one Saint-augustin body of smaller size than another, it is possible to make the Petit-canon

TABLE GÉNÉRALE
DE LA PROPORTION
des différens Corps de Caractères.

ÉCHELLE FIXE
de 144 points Typographiques.

Nomb.	Corps.	Points
1	PARISIENNE.	5
2	NOMPAREILLE.	6
3	MIGNONE.	7
4	PETIT-TEXTE.	8
5	GAILLARDE.	9
6	PETIT-ROMAIN. – 2 Parisiennes.	10
7	PHILOSOPHIE. = 1 Parif. 1 Nompareille.	11
8	CICÉRO. – 2 Nomp. = 1 Parisienne, 1 Mignone.	12
9	SAINT-AUGUSTIN. – 2 Mignones. = 1 Nompareille, 1 Petit-texte.	14

FIG. 44.—*Facsimile reproduction of Fournier's table of proportions of body-sizes.*

134 *TABLE*

Nomb.	Corps.	Points
10	GROS-TEXTE. – 2 Petit-textes. = 1 Parif. 1 Philofophie. = 1 Nomp. 1 Petit-rom. = 1 Mignone, 1 Gail. + 2 Parifiennes, 1 Nompareille.	16
11	GROS-ROMAIN. – 2 Gaillardes. – 3 Nompareilles. = 1 Nompareille, 1 Cicéro. = 1 Mign. 1 Philofophie. = 1 Petit-texte, 1 Petit-romain. + 2 Parif. 1 Petit-texte. + 1 Parif. 1 Nompareille, 1 Mignone.	18
12	PETIT-PARANGON. – 2 Petit-rom. – 4 Parifiennes. = 1 Nompareille, 1 Saint-Auguftin. = 1 Petit-texte, 1 Cicéro. = 1 Gaillarde, 1 Philofoph. + 2 Parif. 1 Petit-rom. + 2 Nomp. 1 Petit-texte. + 2 Mign. 1 Nomp. + 1 Parifienne, 1 Nomp. 1 Gaill. + 1 Parifienne, 1 Mign. 1 Petit-texte.	20
13	GROS-PARANGON. – 2 Philofoph. = 1 Nomp. 1 Gros-tex. = 1 Petit-tex. 1 Saint-auguftin. = 1 Petit-romain, 1 Cicéro. + 2 Parifiennes, 1 Cicéro. + 2 Nomp. 1 Petit-rom. + 2. Mign. 1 Petit-texte. + 2 Petit-tex. 1 Nomp.	22

FIG. 45.—*Fournier's table (page 2), continued.*

DES PROPORTIONS. 135

Nomb.	Corps.	Points
	+ 1 Parif. 1 Nomp. 1 Philofophie. + 1 Nomp. 1 Mignone, 1 Gaill. + 2 Parif. 2 Nomp. + 3 Parifiennes, 1 Mignone.	
14	PALESTINE. – 2 Cic. – 3 Petit-tex. – 4 Nomp. = 1 Nomp. 1 Gros-rom. = 1 Petit-tex. 1 Gros-tex. = 1 Petit-rom. 1 Saint-augult. + 2 Parifiennes, 1 Saint-auguftin. + 2 Nomp. 1 Cic. + 2 Mign. 1 Petit-rom. + 2 Gaill. 1 Nomp. + 1 Parif. 1 Mign. 1 Cic. + 1 Parif. 1 Gaill. 1 Petit-romain. + 1 Nomp. 1 Mign. 1 Philofophie. + 1 Nomp. 1 Petit-tex. 1 Petit-rom. + 1 Mignone, 1 Petit-texte, 1 Gaill. + 2 Parif. 2 Mign. + 3 Parif. 1 Gaill.	24
15	PETIT-CANON. – 2 Saint-auguftin. – 4 Mign. + 1 Nomp. 1 Gros-par. + 1 Petit-texte, 1 Petit-parangon. + 1 Petit-rom. 1 Gros-rom. + 1 Cic. 1 Gros-texte. + 2 Parif. 1 Gros-rom. + 2 Nomp. 1 Gros-texte. + 2 Mign. 1 Saint-auguftin. + 2 Petit-textes. 1 Cic. + 2 Gaill. 1 Petit-romain.	28

FIG. 46.—*Fournier's table (page 3), continued.*

136 *TABLE*

Nomb.	Corps.	Points
	+ 2 Petit-rom. 1 Petit-tex. + 2 Phil. 1 Nomp. + 2 Parifiennes, 2 Gaill. + 2 Nomp. 2 Petit-textes. + 2 Parif. 3 Nomp. + 3 Nomp. 1 Petit-rom. + 4 Parif. 1 Petit-texte. + 1 Parif. 1 Mign. 1 Gros-texte. + 1 Nomp. 1 Petit-texte, 1 Saint-aug. + 1 Parif. 1 Gaill. 1 Saint-auguftin. + 1 Parif.	

DES PROPORTIONS. 137

Nomb.	Corps.	Points
17	GROS-CANON. – 2 Gros-parangons. – 4 Philofophies. = 1 Petit-texte. 1 Trifmégifte. = 1 Gros-texte, 1 Petit-canon. = 1 Petit-parangon, 1 Pal. + 2 Cic. 1 Petit-par. + 1 Petit-tex. 2 Gros-rom. + 1 Cic. 2 Gros-textes. + 2 Petit-texte, 2 Saint-auguftins. + 1 Petit-texte, 3 Cic. + 2 Mign.	44

138 *TABLE*

Nomb.	Corps.	Points
19	TRIPLE-CANON. – 2 Trifmégifte. – 3 Paleftine. – 4 Gros-romain. – 6 Cicéro. – 8 Gaillarde. – 9 Petit-tex. – 12 Nompareilles. = 1 Gr. texte, 1 Double-canon. = 1 Petit-canon, 1 Gros-canon. + 1 Gros-tex. 2 Petit-canon. + 1 Nomp. 3 Gros-parang. + 1 Cic. 3 Petit-parangons.	72

Nomb.	Corps.	Points.
6	Petit-romain. — 2 Pariſiennes.	10
7	Philosophie. = 1 Parif. 1 Nompareille.	11
8	Cicéro. — 2 Nomp. = 1 Pariſienne, 1 Mignone.	12
9	Saint-Augustin. — 2 Mignones. = 1 Nompareille, 1 Petit-texte.	14

FIG. 44.—*Facsimile reproduction of Fournier's table of proportions of body-sizes.*

Nomb.	Corps.	Points.
	... + 2 Mign. 1 Nomp. + 1 Pariſienne, 1 Nomp. 1 Gaill. + 1 Pariſienne, 1 Mign. 1 Petit-texte.	
13	Gros-parangon. — 2 Philoſoph. = 1 Nomp. 1 Gros-tex. = 1 Petit-tex. 1 Saint-auguſtin. = 1 Petit-romain, 1 Cicéro. + 2 Pariſiennes, 1 Cicéro. + 2 Nomp. 1 Petit-rom. + 2. Mign. 1 Petit-texte. + 2 Petit-tex. 1 Nomp.	22

FIG. 45.—*Fournier's table* (*page* 2), *continued.*

Nomb.	Corps.	Points.
	+ 2 Parif. 2 Mign. + 3 Parif. 1 Gaill.	
15	Petit-canon. — 2 Saint-auguſtin. — 4 Mign. + 1 Nomp. 1 Gros-par. + 1 Petit-texte, 1 Petit-parangon. + 1 Petit-rom. 1 Gros-rom. + 1 Cic. 1 Gros-texte. + 2 Parif. 1 Gros-rom. + 2 Nomp. 1 Gros-texte. + 2 Mign. 1 Saint-auguſtin. + 2 Petit-textes. 1 Cic. + 2 Gaill. 1 Petit-romain.	28

FIG. 46.—*Fournier's table* (*page* 3), *continued.*

136 TABLE

Nomb.	Corps.	Points.
	+ 2 Petit-rom. 1 Petit-tex. + 2 Phil. 1 Nomp. + 2 Pariſiennes, 2 Gaill. + 2 Nomp. 2 Petit-textes. + 2 Parif. 3 Nomp. + 3 Nomp. 1 Petit-rom. + 4 Parif. 1 Petit-texte. + 1 Parif. 1 Mign. 1 Gros-texte. + 1 Nomp. 1 Petit-texte, 1 Saint-aug. + 1 Parif. 1 Gaill. 1 Saint-auguſtin. + 1 Parif. 1 Philoſophie, 1 Cicéro. + 1 Nomp. 1 Petit-rom. 1 Cicéro. + 1 Mign. 1 Gaill. 1 Cic. + 2 Nomp. 1 Mign. 1 Gaill. + 2 Mign. 1 Nompareille, 1 Petit-texte.	
16	Trismégiste. — 2 Gros-romains. — 3 Cicéros. — 4 Gaillardes. — 6 Nompareilles. = 1 Petit-tex. 1 Petit-canon. = 1 Cic. 1 Paleſt. = 1 Saint-auguſtin, 1 Gros-parang. = 1 Gros-texte, 1 Petit-parang. + 2 Petit-rom. 1 Gros-texte. + 1 Petit-tex. 2 Saint-auguſt. + 2 Philoſoph. 1 Saint-auguſt. + 1 Nomp. 3 Petit-rom. + 3 Petit-textes, 1 Cic. + 4 Mign. 1 Petit-tex. + 6 Pariſiennes, 1 Nomp.	36

FIG. 47.—*Fournier's table* (*page* 4), *continued.*

DES PROPORTIONS. 137

Nomb.	Corps.	Points.
17	Gros-canon. — 2 Gros-parangons. — 4 Philoſophies. = 1 Petit-texte. 1 Triſmégiſte. = 1 Gros-texte, 1 Petit-canon. = 1 Petit-parangon, 1 Pal. + 2 Cic. 1 Petit-par. + 1 Petit-tex. 2 Gros-rom. + 1 Cic. 2 Gros-textes. + 2 Petit-texte, 2 Saint-auguſtins. + 1 Petit-texte, 3 Cic. + 2 Mign. 3 Petit-rom. + 1 Petit-tex. 4 Gaill. + 2 Nomp. 4 Petit-tex. + 5 Mign. 1 Gaill. + 6 Nomp. 1 Petit-texte. + 7 Parif. 1 Gaill.	44
18	Double-canon. — 2 Petit-canons. — 4 Saint-auguſtins. — 8 Mignones. = 1 Cic. 1 Gros-canon = 1 Petit-par. 1 Triſmég. + 1 Petit-texte, 2 Paleſt. + 1 Cic. 2 Gros-parang. + 1 Gros-texte, 2 Petit-parang. + 2 Petit-rom. 2 Gros-rom. + 1 Petit-tex. 3 Gr.-tex. + 1 Petit-texte, 4 Cic. + 2 Nomp. 4 Philoſoph. + 1 Nomp. 5 Petit-rom. + 1 Parif. 1 Nomp. 5 Gaill. + 1 Petit-texte, 8 Nomp. + 10 Pariſiennes, 1 Nompareille.	56

FIG. 48.—*Fournier's table* (*page* 5), *continued.*

138 TABLE

Nomb.	Corps.	Points.
19	Triple-canon. — 2 Triſmégiſte. — 3 Paleſtine. — 4 Gros-romain. — 6 Cicéro. — 8 Gaillarde. — 9 Petit-tex. — 12 Nompareilles. = 1 Gr. texte, 1 Double-canon. = 1 Petit-canon, 1 Gros-canon. + 1 Gros-tex. 2 Petit-canon. + 1 Nomp. 3 Gros-parang. + 1 Cic. 3 Petit-parangons. + 6 Petit-rom. 1 Cic. + 1 Petit-tex. 4 Gros-tex. + 2 Petit-tex. 4 Saint-auguſt. + 1 Nomp. 6 Philoſophies. + 2 Nomp. 6 Petit-rom. + 1 Gaill. 9 Mignones. + 1 Mignone. 13 Parif.	72
20	Grosse-nompareille. — 4 Paleſtines. — 6 Gros-tex. — 8 Cicéros. — 12 Petit-tex. — 16 Nompareilles. + 1 Paleſt. 1 Triple-canon. + 2 Petit-parang. 1 Double-canon. + 1 Petit-texte, 2 Gros-canons. + 1 Paleſt. 2 Triſmégiſtes. + 1 Cic. 3 Petit-can. + 1 Pet.-tex. 4 Gros-par. + 1 Nomp. 5 Gros-rom. + 1 Cic. 6 Saint-aug. + 1 Petit-tex. 8 Philoſ. + 1 Nomp. 9 Petit-rom. + 1 Nomp. 10 Gaill. &c.	96

FIG. 49.—*Fournier's table* (*page* 6), *concluded.*

to double that body-size, by which means the Regulation is fulfilled: another makes his Saint-augustin bodies of greater or lesser size and from the two body-sizes he makes his Petit-canon; here again the Regulation is fulfilled although in spirit it has been evaded. Thus has confusion been perpetuated in the matter and to such an extent that it is sometimes difficult to distinguish between two bodies of which the larger is of small size for its kind and the smaller of large size. It follows that Types reputedly of the same body-size vary to greater or lesser extent, and when such type find their way into a Printing-Office the workmen mix the quads and spaces together, thus spoiling both founts.

"The Regulation has provided against this mischance, I shall be told, since it requires that a certain number of type of each body-size shall be delivered to the Founders to which they shall work, under penalty. But these type, selected haphazard, were never delivered, and they could in no way have remedied the evil which it was desired to avoid since their body-sizes would not have been correlated to one another, they would have been devoid of any reasoned out proportion, would not have worked together, and finally were without any definite underlying principle. These farcical Regulations, instead of introducing precision and order, have on the other hand increased confusion by an unnecessary multiplication of units. Hence it happens that the bodies of Petit-canon, of Gros-parangon, of Gros-romain, of Cicero, of Philosophie, of Gaillarde, of Mignonne, according to the Regulation, are without double bodies on which two-line letters can be made, notwithstanding that such are necessary for all these bodies. Hence there arise seven or eight bastard body-sizes, useless for any other purpose, and mere useless burdens on the Printing-Office. Moreover, this division of bodies using a Cicero and a Petit-romain to equal a Gros-parangon, using a Petit-romain and a Petit-texte to equal a Gros-romain, using a Petit-texte and a Nompareille to form a Saint-augustin, clearly show the limited experience and knowledge of those who proposed this method. Why make a division of the type-bodies into these unequal parts which lead nowhere, and of which one cannot render any account? Moreover, this clause in the Regulation has never been carried into effect. The trouble was indeed realized, though no one knew how to find the remedy for it, and for the good reason that the Printers, who alone are called into consultation on these matters, are not themselves Typographers enough to be able to discuss with authority, and to make regulations respecting, a branch of the art which they do not themselves practise, and of which frequently they know nothing but the name.

"It is this fact which led me to unravel this tangle by establishing order where no order had ever previously existed: I think that by my invention of the *Typographic point system*, I have had the good fortune to succeed with an exactitude and a precision that leave nothing to be desired. This system consists merely in the division of the body-sizes of the type into equal and definite parts which I call *Points*. By this means the difference between and ratio to one another of the body-sizes can be exactly determined. They can be associated together in the same manner as numerical signs can be combined; and, as two and two make four, add two, and six will result; double this total and the result will be twelve, etc., similarly a Nompareille, which consists of six points, taken with another Nompareille, will together equal a Cicero which consists of twelve points; add to this another Nompareille and a body of eighteen points or the Gros-romain will result; double this total, making thirty-six points, and the Trismégiste, which contains this number, will result, and thus with other sizes, as will be seen from the *Table of Sizes* which follows [figs. 44 to 49].

"In order to combine bodies, it is merely necessary to know the number of *Typographic points* of which each consists. For this reason it is necessary that the points, or given dimensions, should be constant, so that they may serve as guides in the Printing-Office, just as the *pied de roi*, the *inches*, and the *lines* are used in Mensuration [Géometrie]. With this object I have fixed the exact size which the point should have, in the scale which appears at the head of the *Table of Sizes*; and in order to ensure uniform exactitude of workmanship in the production of the body-sizes of Type, I have designed an appliance which I have called the *Prototype*, and which is described and figured later.

"The invention of these points is the first tribute which I paid to Typography in 1737. Thereafter compelled to carry on continuously a painful and exacting profession, that of cutting all the punches necessary for the equipment of my Foundry, I could find no established rule which might have guided me in determining the body-sizes of the Type I had to produce. This being the case, I was compelled to set up laws for myself; this I did, and I kept my record of them in the following Table [pp. 62–63].

"At the head of this Table a definite scale is printed divided into two inches, the inch divided into twelve lines, and the line into six of these typographical points; the total length is 144 points. The small divisions at one end are each of two points, which is the exact difference between the Petit-texte and the Petit-romain, between the latter and the Cicero, etc. The number of points which I assign to each body-size must be taken from this scale. These sizes when accurately taken for each particular body-size, and after they have been verified upon the *Prototype*, will together show a general agreement amongst all the body-sizes of type, as will be shown by the combinations which follow.

"This scale has a total length equal to twelve Ciceros. After the printing of this Table, which I published in 1737, I found that in drying, the paper had slightly reduced the true length of the scale: in the present case I have taken precautions against this defect by adding what was required for the shrinkage of the paper.

"Each body-size at the head of its own paragraph is divided or made up with the greatest exactitude by the combinations which are recorded in

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the Table, combinations which are made up of equal bodies, unequal bodies and multiples. The first are preceded by a —, the second by =, and the third by +." [Fournier uses these signs for reference marks and not in their arithmetical sense; figs. 44 to 49 are self-explanatory.]

Fournier's system has now, however, been almost entirely superseded by the system of Didot, and the Fournier point or *corps* is now used only in Belgium, in parts of Austria, and in the North of France.

THE DIDOT POINT SYSTEM.

Didot was a celebrated typefounder of Paris, who somewhere about 1770, or not long after the death of Fournier, proposed the improvement of that reformer's system of typographic points, basing the point upon some well-known and authoritative lineal measure, selecting for this purpose the *pied de roi*, or the governmental standard foot of France. This foot is the equivalent of 12·7897 English inches. He retained Fournier's subdivisions and made no alteration in the number of 72 points to the inch; twelve inches of course went to the foot, and twelve lines to the inch; each line was divided into six typographic points.

The Didot system, now generally adopted, has as its basis the point or *corps* of 0·376 millimetre. It is to this Didot unit that most foreign type-casting and composing machines are designed. The *philosophie* or *corps onze*, of 11 Didot points, measures 0·1628 inch and is therefore nearly equal to the English pica. The *corps douze*, now generally regarded as the standard for body-sizes, measures 4·512 millimetres or 0·1776 inch. The French point is 0·01480 inch, whereas the English point is 0·013837 inch.

The bodies in use are named according to the number of points; the sizes most generally in use are 5, 6, 7, 8, 9, 10, 11, 12, 14, 16, 18, 20, 22, 24, 28, etc.

The height-to-paper of French type is 23·50 millimetres, but is increased to 23·545 millimetres for very fat black faces. The height of quads and spaces is from 19·18 millimetres to 19·50 millimetres. The height of leads and furniture is about the same, the minimum being 18·05 millimetres.

OTHER SYSTEMS.

Other plans for securing uniformity in type-bodies were proposed by Fergusson of Scotland in 1824, by Bower of Sheffield in 1841, and Shanks of London in 1857; but, with the exception of the last mentioned, none of these suggestions ever came into practical use.

Fergusson's system, which is quoted from Hansard's "Typographia," is interesting, as the sizes would form a harmonic in place of an arithmetical progression; but obviously the bodies would not work together as in the arithmetical and more rational systems that have been adopted.

"PLAIN AND ACCURATE RULES

"For obtaining Permanent Uniformity in the Sizes of the Bodies of Types and in their Height to Paper.

"1. Let the fount called Nonpareil be made the fundamental standard, and make 12 lines of Nonpareil measure exactly one inch.—2. Let 14 lines of Nonpareil be the common measure for all other founts; this measure to take in 5 lines of Great Primer, 6 of English, 7 of Pica, 8 of Small Pica, 9 of Long Primer, 10 of Bourgeois, 11 of Brevier, and 12 of Minion.—3. Let 11 lines of Nonpareil be the standard height to paper.

"A conformity with these three rules would evidently prove a great benefit to Printers, and might ultimately not be less so to Letter-founders. If adopted, the bodies of English, Pica, and Small Pica will be a little enlarged; Long Primer and Brevier a little diminished.

"The standard foot measure kept at the Royal Society should be made use of for obtaining an accurate inch to proceed upon. I shall be glad to find these hints taken into due consideration; and unless some strong objection be stated, I trust they will be readily adopted.

"JAMES FERGUSSON."

The system introduced by Shanks in the Patent Type Foundry, and there used for many years, differed from the foregoing system insomuch as it adopted a decimal division of his nonpareil body, which latter was one-twelfth of an inch. The following table (table 5) shows the number of points and the actual sizes of the various bodies up to english.

TABLE 5.—*Shanks's point system.*

Body.	Points.	In.	Body.	Points.	In.
Semi-nonpareil .	5	0·0417	Brevier . .	13	0·1083
Brilliant . .	6	0·0500	Bourgeois . .	14	0·1167
Diamond . .	7	0·0583	Long primer .	16	0·1333
Pearl . . .	8	0·0667	Small pica . .	18	0·1500
Ruby . .	9	0·0750	Pica . . .	20	0·1667
Nonpareil . .	10	0·0833	English . .	22	0·1833
Minion . .	12	0·1000			

It will be seen that these sizes, based on a different point system, agreed very closely with the body-sizes then in use by many founders.

It is strange that in the history of this subject a geometrical progression for the sizes of type does not appear to have ever been proposed. Had the art of typefounding not come into being until the latter half of the nineteenth century, it is probable that a system of increase of body in geometrical proportions, each size being six-fifths of the next smaller body, or some similar ratio, would have received serious attention. Although difficulty would have occurred in working the different bodies together, there would yet have been found partisans of such a system amongst those who print different sizes of the same works, for instance Bibles, prayer-books, and other devotional compilations, in which type of different sizes are required at different periods of human life, each new volume resembling its predecessor in every respect save in its dimensions and in those of the characters used.

With such an arrangement of geometrically-proportioned body, a man, whose failing sight required him to have recourse to large type, would find on the same page of the work and in the same relative position, the same word, the same letter and the same space as in the smaller copy to which daily use had made him accustomed. This result is now actually attained, but it requires very careful workmanship and elaborate precaution in the selection of the founts and in the spacing.

To facilitate comparison between type made to the various point systems at present in use, table 6 (pp. 70–71) is given. In this table the sizes of each body are given in decimals of inches and millimetres with their corresponding names, which practically cover the field for Great Britain, her colonies and dependencies, Europe, the United States of America and all South America, and indeed, for the matter of that, the whole civilized world. The point, or one of the *corps* systems, is now in use everywhere, and though, in consequence of the large quantities of standing matter that yet exist, bastard bodies, namely, bodies not conforming to any of the point or *corps* systems, are still in use and still produced, their employment is steadily dying out. Moreover, the names which originally belonged to them, are now occasionally applied to the next larger or nearest true point size, as the faces have been transferred to such sizes. It is, however, preferable to avoid this use of the old names, and to style the different body-sizes by the number of points or *corps* which truly represent them, reserving the old names only to designate bastard sizes, in which case it is further advisable to supplement the name of the body with that of the maker, for example pica (Caslon's), bourgeois (Figgins'), minion (Miller & Richard's).

In the European names for bodies still further confusion arises from the fact that the *cicéro* of 12 Fournier points measured 0·1648 inch. When the Didot system was introduced it was found that 11 Didot points were nearly equal to the Fournier *cicéro*, and the name *cicéro* was generally applied to *corps onze*. In the specimen book of Didot ainé, Paris 1819, the writer recommends the use of numbers of points to designate size owing to the confusion caused by names relating to the old sizes. The confusion commenced at *mignonne*, the next name *petit-texte* being used for $7\frac{1}{2}$ Didot points; *saint-augustin* was used indifferently for 12 or 13 points; *gros-romain* for 15 or 16 points; *petit-parangon* for 18 or 20 points; *gros-parangon* for 21 or 22 points; *petit-canon* for 28 to 32 points; *gros-canon* for 40 to 44 points; and *double canon* for 48 to 56 points Didot. The Germans, who appear to prefer names to numbers, called the body of 12 Didot points the *Cicero*. So that the French *cicéro* had 11 points while the German had 12 points; after much confusion the *cicéro* was accepted in France, about 1860, to mean *corps* 12, or 12 Didot points. The names and sizes of type-bodies are given in table 6, pp. 70 and 71.

ACCURACY OF BODY AND SET.

Limits of accuracy.—Most of the matter which is printed is set in type of the sizes comprised between english and ruby, and it is generally with these and the intermediate sizes that typecasting and composing machines deal. A column of newspaper commonly measures about 22 to 25 inches in height, and is very usually set in brevier or minion; it therefore contains from 200 to 250 lines. The type must be sufficiently parallel in body to lock up in the forme. A uniform error of one ten-thousandth of an inch in parallelism would result in the end lines being inclined each over 0·01 inch from the vertical. Greater inclination would interfere with the truth of impression and with safety in handling; therefore every endeavour must be used to keep the body of the type uniform and the product of every machine has to be continually checked. This can readily be done in practice by means of an |__-gauge, fig. 50, measuring about two inches, but actually made to the calculated length of the type to be received.

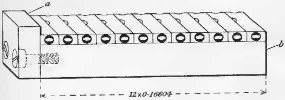

FIG. 50.—*Body-gauge for type, single-ended,* $1\frac{1}{3}$ times full size.

The type are carefully cleaned from grease and small particles of metal and then pressed firmly against the stop *a* with the fingers. The finger-nail is then passed over the flat surface *b* of the end of the gauge and the end of the line of type, where a total difference of one-thousandth of an inch in the total body and of inequality in parallelism can easily be felt. A better form of gauge is made with two ends screwed to a base-block

TABLE 6.—*Comparative table giving names of English and foreign type and their dimensional relationships in Fournier, Didot, and standard points, in inches, and in millimetres* (*continued on opposite page*).

Fournier. In.	Fournier. Mm.	Fournier. Corps.	French names of bodies. Fournier.	French names of bodies. Didot.	Didot. Corps.	Didot. Mm.	Didot. In.	Standard. In.	Standard. Mm.	Standard. Points.	American names of bodies.
0·0137	0·349	1			1	0·376	0·0148	0·0138	0·351	1	
0·0275	0·697	2			2	0·752	0·0296	0·0277	0·703	2	
0·0343	0·872	2½	Micro-scopique		2½	0·940	0·0370	0·0346	0·879	2½	
0·0412	1·046	3	Semi-nompareille	Diamant	3	1·128	0·0444	0·0415	1·055	3	Excelsior
0·0481	1·221	3½			3½	1·316	0·0518	0·0484	1·230	3½	
0·0549	1·395	4		Sédanoise	4	1·504	0·0592	0·0553	1·406	4	Brilliant
0·0618	1·569	4½	Diamant		4½	1·692	0·0666	0·0623	1·582	4½	Diamond
0·0686	1·744	5	{Sédanoise Parisienne	Parisienne	5	1·880	0·0740	0·0692	1·757	5	Pearl
0·0755	1·918	5½			5½	2·068	0·0814	0·0761	1·933	5½	Agate
0·0824	2·093	6	Nompareille	Nonpareille	6	2·256	0·0888	0·0830	2·109	6	Nonpareil
0·0892	2·267	6½			6½	2·444	0·0962	0·0899	2·285	6½	Minionette
0·0961	2·441	7	Mignone	Mignonne	7	2·632	0·1036	0·0969	2·460	7	Minion
0·1098	2·790	8	Petit-texte	Gaillarde	8	3·008	0·1184	0·1107	2·812	8	Brevier
0·1236	3·139	9	Gaillarde	Petit-romain	9	3·384	0·1332	0·1245	3·163	9	Bourgeois
0·1373	3·488	10	Petit-romain	Philosophie	10	3·760	0·1480	0·1384	3·515	10	Long primer
0·1510	3·836	11	Philosophie	Cicéro *	11	4·136	0·1628	0·1522	3·866	11	Small pica
0·1648	4·185	12	Cicéro *	Saint-augustin*	12	4·512	0·1776	0·1660	4·218	12	Pica
0·1922	4·883	14	Saint-augustin	Gros-texte	14	5·264	0·2072	0·1937	4·921	14	English
0·2197	5·580	16	Gros-texte	Gros-romain	16	6·016	0·2369	0·2214	5·624	16	Columbian
0·2471	6·278	18	Gros-romain		18	6·768	0·2665	0·2491	6·327	18	Great primer
0·2746	6·975	20	Petit-parangon	Petit-parangon {	20	7·520	0·2961	0·2767	7·029	20	Paragon
0·3020	7·672	22	Gros-parangon	Gros-parangon	22	8·272	0·3257	0·3044	7·732	22	Double small pica
0·3295	8·370	24	Palestine	Palestine	24	9·024	0·3553	0·3321	8·436	24	Double pica
0·3844	9·765	28			28	10·528	0·4145	0·3874	9·842	28	Double english
0·4119	10·464	30	Petit-canon	Petit-canon {	30	11·280	0·4441	0·4151	10·543	30	Five-line nonpareil
0·4393	11·160	32			32	12·032	0·4737	0·4428	11·247	32	Four-line brevier
0·4942	12·555	36	Trismégiste	Trismégiste	36	13·536	0·5329	0·4981	12·653	36	Double great primer
0·5492	13·950	40			40	15·040	0·5922	0·5535	14·058	40	Double paragon
0·5766	14·648	42	Gros-canon	Gros-canon {	42	15·792	0·6218	0·5811	14·761	42	
0·6041	15·356	44			44	16·544	0·6514	0·6088	15·464	44	Meridian
0·6590	16·740	48			48	18·048	0·7106	0·6642	16·870	48	Pica canon or four-line pica
0·7139	18·137	52	Double-canon	Double-canon {	52	19·552	0·7698	0·7195	18·278	52	
0·7414	18·834	54			54	20·304	0·7994	0·7472	18·978	54	
0·7688	19·530	56			56	21·056	0·8290	0·7748	19·684	56	
0·8238	20·928	60			60	22·560	0·8883	0·8302	21·087	60	Five-line pica
0·9061	23·019	66			66	24·816	0·9770	0·9132	23·196	66	
0·9884	25·110	72	Triple-canon or deux points de trismégiste	Triple-canon	72	27·072	1·0658	0·9962	25·304	72	Six-line pica

* See p. 69.

TABLE 6.—*Comparative ta their dimensional relatio inches, and in millimetre*

Standard points.	English names of bodies.	Corps Didot.	Germ of
1			
2			
2½			
3	Minikin	3	Seminc
3½		3½	
4	Brilliant	4	Diama
4½	Diamond	4½	
5	Pearl	5	Perl
5½	Ruby	5½	
6	Nonpareil	6	Nonpar
6½	Emerald	6½	
7	Minion	7	Kolone
8	Brevier	8	Petit or
9	Bourgeois	9	Borgis
10	Long primer	10	Korpus monc
11	Small pica	11	Brevier Rhei
12	Pica	12	Cicero
14	English	14	Mittel
16	Two-line brevier	16	Tertia
18	Great primer	18	
20	Paragon	20	Text or
22	Double pica	22	
24	Two-line pica	24	Doppelc
28	Two-line english	28	Doppelı
30		30	
32		32	Kleine
36	Two-line great primer	36	Kanon
40	Two-line paragon	40	
42		42	Grobe I
44	Two-line double pica	44	
48	Canon or four-line pica	48	Kleine I
52		52	Missal
54		54	
56		56	
60	Five-line pica	60	Grobe M
66		66	
72	Six-line pica	72	Kleine S

TABLE 6.—*Comparative table giving names of English and foreign type and their dimensional relationships in Fournier, Didot, and standard points, in inches, and in millimetres (concluded from opposite page).*

Standard points.	English names of bodies.	Corps Didot.	German names of bodies.	Dutch names of bodies.	Italian names of bodies.	Spanish names of bodies.
1						
2				Non-plus-ultra		
2½						
3	Minikin	3	Seminonpareille		Occhio di mosca	Brillante
3½		3½				
4	Brilliant	4	Diamant	Diamant or Robijn	Diamante	Diamante
4½	Diamond	4½				
5	Pearl	5	Perl	Parel or Jolij	Parmigianina	Perla
5½	Ruby	5½				
6	Nonpareil	6	Nonpareille	Nonparel	Nompariglia	Nomparelle
6½	Emerald	6½				
7	Minion	7	Kolonel	Colonel	Mignone	Miñona or glosilla
8	Brevier	8	Petit or Jungfer	Brevier	Testino	Breviario
9	Bourgeois	9	Borgis	Burgeois or Galjar	Garamoncino	Medio texto
10	Long primer	10	Korpus or Garmond	Garmond	Garamone	Entredós
11	Small pica	11	Brevier or Rheinlander	Dessendiaan	Filosofia	Lecturita
12	Pica	12	Cicero	Mediaan	Lettura	Lectura
14	English	14	Mittel	Augustijn	Silvio	San Agustín
16	Two-line brevier	16	Tertia		Soprasilvio	Atanasia
18	Great primer	18		Tekst	Testo	Texto
20	Paragon	20	Text or Secunda	Paragon	Parangone	Parangona
22	Double pica	22		Assendonica or Dubbele Dessendiaan	Ascendonica	Doble lecturita
24	Two-line pica	24	Doppelcicero	Dubbele Mediaan	Palestina	Doble lectura
28	Two-line english	28	Doppelmittel	Dubbele Augustijn	Canoncino	
30		30				
32		32	Kleine Kanon			Doble atanasia
36	Two-line great primer	36	Kanon	Kanon	Sopracanoncino	Doble texto
40	Two-line paragon	40		Groote Kanon	Canone	Doble parangona
42		42	Grobe Kanon			
44	Two-line double pica	44		Parijs Kanon	Corale	Cánon
48	Canon or four-line pica	48	Kleine Missal		Ducale	Cuatro lectura
52		52	Missal			
54		54				
56		56				
60	Five-line pica	60	Grobe Missal		Reale	Cioco lectura
66		66				
72	Six-line pica	72	Kleine Sabon		Imperiale	

TABLE 7.

Set widths of a pica fount (MODERN) *without spaces and quads.*

Set.	Characters.	Matrices.	Type.
0·16604	W Æ Œ + − × ÷ = — … @ ℔ ⁀ ‿ ⁀ W Æ Œ	18	10,770
0·13145	K M ffi ffl m ℔ ffi ffl H K M N X .	13	26,650
0·12453	H G N U X $ m A D U V Y .	12	14,750
0·11761	A D E O Q R V Y w œ ff E F R ẃ ŵ	16	38,270
0·11070	B C F L T æ w Æ Œ % £ ¶ & w æ œ & B G L P T Z £ Ç ẃ ŵ . .	27	25,900
0·10378	P Z fi fl C J O Q Ç . . .	9	4,965
0·08994	S J b d g h k n p q u ff fi fl K M a d n u x S ñ ú ù û ü á à â ä ã ñ ú ù û u	37	206,655
0·08302	V X Y G H N U X 1 2 3 4 5 6 7 8 9 0 * † ‡ § ‖ – h k p y I ½ ¼ ¾ ⅓ ⅔ ⅛ ⅜ ⅝ ⅞ 1 2 3 4 5 6 7 8 9 0 . .	48	82,190
0·07610	a O Z A D E O Q R V Y b f g q á à â ä ã ó ò ô ö	24	118,270
0·07264	e C B C F L P T Z & o r v ? ç é è ê ë ó ò ô ö	23	125,700
0·06573	I r s ? J S c e s z ç é è ê ë . .	15	108,680
0·05535	f j t i j í ì î ï	9	80,920
0·04843	i l - / [ ) l t !]) I í ì î ï . . .	16	100,120
0·04151	. , : ; ’ ! : ;	8	56,160
		275	1,000,000

Length a to z = 12·50 ems.
Length of 1,000,000 type = 77,630 inches = 467,600 ems.

carefully prepared to the correct length. The type are laid on this, and the last type inserted gives the feel of the fit and consequently an appreciation that the type are of the requisite degree of accuracy. A gauge of this kind is shown in fig. 51.

Such a gauge would measure 1·9924 inches for 12 pica, for 18 brevier, or for 24 nonpareil; a gauge 2·0340 inches would serve for 14 small pica or 28 ruby and also for 21 minion. In this connexion it should be noted that the multiples of the decimal sizes given in table 3 (p. 59) do not agree exactly, but this gauge should be 147 points in length. The variations in approximate decimal sizes have proved a great stumbling-block to some founders

TABLE 8.

Set widths of a pica fount (OLD-STYLE) *without spaces and quads.*

Set.	Characters.	Matrices.	Type.
0·17296	W Æ Œ *M W Æ Œ* . . .	7	4,970
0·16604	... — + – × ÷ = ⁀ ℔ .	11	5,880
0·13837	H M m œ @ ℔ ¶ ffi ffl *X D ffi ffl* .	13	27,910
0·13145	D G K N O Q R X w & w Æ Œ *H* *K N R & m* ẃ ŵ . . .	21	39,530
0·12107	A C T U V Y æ *A B G L P U V* Y Ç *w ẃ ŵ*	19	21,830
0·11416	B E F L P Z £ $ M *C E F O Q T* *Z £ ff æ œ* Ç	21	21,685
0·09340	S b d g h k n p q u x ff fi fl D G H K N R U & *S J g y fi fl* ñ ú ù û ü	33	205,180
0·08648	a o v y A B C E L O P Q T V X Y Z *a d h k n p u x* á à â ä ã ó ò ô ö *á à â ä ã ñ ú ù û ü*	44	161,855
0·08302	1 2 3 4 5 6 7 8 9 0 * † ‡ § ‖ % - ½ ¼ ¾ ⅓ ⅔ ⅛ ⅜ ⅝ ⅞ *1 2 3 4 5 6 7 8 9 0* .	36	43,380
0·07264	J c e z F S *I b q r v z ? [* ç é è ê ë .	19	117,880
0·06054	I r s t - / ? J *c e f j o s t)* *ç é è ê ë ó ò ó ö*	25	180,990
0·05189	f i j l) [I *l i !* í ì î ï *í ì î ï* . .	18	112,750
0·04151	. , ' ; : ! *; :*	8	56,160
		275	1,000,000

Length a to z = 12·99 ems.
Length of 1,000,000 types = 77,300 inches = 465,600 ems.

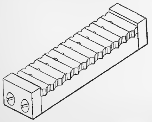

FIG 51.—*Body-gauge for type, double-ended.*

who, for the body, have first worked out the decimal approximation and then multiplied it, and have so obtained varying results, which would have been avoided entirely by working from the point as the unit.

A still better form of body-gauge would be one in which one end of the gauge was replaced with a micrometer-screw reading to thousandths of an inch and enabling a direct measurement of the error to be obtained. Such a gauge is not, so far as the authors are aware, in actual use at present among typefounders, though it would have advantages over the old methods where determinations of such accuracy are left largely to the personal equation of the operator. A gauge of the form suggested is shown in fig. 52.

In setting up tabular work it is necessary that the points, figures, and fractions should all agree, so that the figures may fall vertically under each other and the columns may be of uniform width. For this reason the figures and two-figure fractions ($\frac{1}{2}$, $\frac{1}{3}$) are almost invariably made on the en set; the

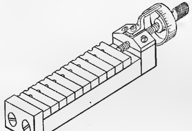

Fig. 52.—*Micrometer body-gauge.*

diagonal and straight fractions ($1/2$, $\frac{3}{16}$, $\frac{21}{32}$) on the em set; and those points used in tabular work, such as the full point, which inverted becomes the decimal point, the comma, the colon and the semicolon are usually placed on the same set as the middle space, namely, one-fourth of the body.

Some founders place these points on the thick-space set (or $\frac{1}{3}$ body), but with this arrangement spacing is more difficult, as the column can only be made a multiple of the en or em by adding two thick spaces, whereas with the points on the middle space the addition of a single middle space will bring the column to a multiple of the en.

The same gauge that is used for the body will serve for checking the set of these particular characters; but as a column of matter is seldom more than four inches wide, a larger error is here admissible than in the body-size.

It may be of interest to show the means employed by practical mould-makers and typefounders for the last 150 years to ensure the requisite degree of accuracy in type without the use of the, then unknown, micrometer. The instrument used for this purpose is known in the trade as the *turning-gauge*, and is shown in fig. 53. The upper jaw of the gauge is fixed to the stem by screws, and the lower jaw, which is made a good sliding fit on the stem by grinding and lapping, can be secured in any desired position by the thumb-screw. The jaws are made with a small amount of taper, the inclination being usually 3 in 1000, or less if required. The sides of the jaws have lines engraved $\frac{1}{6}$ inch apart; each division ordinarily, therefore, equals 0·0005 inch. To use the gauge the type are rubbed free from grease and gently pushed into the taper opening of the jaws, the

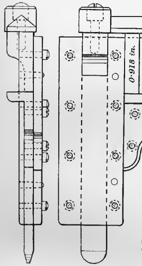

FIG. 54.—*Height-to-paper gauge.* Full size.

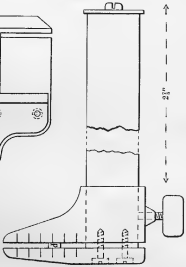

FIG. 53.—*Turning-gauge.* Full size. Inverted view.

position of the type being as shown in fig. 53; the type are turned end-for-end to compare the sizes at head and foot; a variation of 0·0001 inch can be as easily detected by feel as can a similar variation in the size of a shaft when compared with a Whitworth gauge by means of callipers. The gauge is also used for checking parallelism in set as well as the definite set width produced by the typefounder. Still greater delicacy of comparison can be obtained by using three or four types together in the turning-gauge. This is actually the usual practice in typefoundries. Commercially perfect type should fulfil the following conditions :—

1. The face must be true for flatness, that is its plane must be normal to the four sides of the body; the degree of accuracy is governed by condition 4.

2. The face must be true for position, that is in plan the vertical main-strokes must be parallel to the set and the line parallel to the body; the degree of accuracy is governed by condition 3.
3. It must also be true for alinement, that is within plus or minus 0·0005 inch the dimension line-to-back must be correct to gauge.
4. The height-to-paper must be correct within plus or minus 0·0005 inch.
5. The body must be parallel within plus or minus 0·0001 inch.
6. The set width must give the correct side-wall on both sides of the character; the tolerance varies according to the character.

The height-to-paper gauge in ordinary use by the typefounder is shown in fig. 54. This gauge is generally used for testing flatness of face for compliance with condition 1 above, and, unlike the turning-gauge, the jaws are made parallel. The type is placed in the gauge and sighted against the light in two directions, in the plane of the face of the upper jaw, at right angles to each other and inclined each at 45° to the faces of the body.

A steel gauge, shown in place in fig. 54, is used for verifying that

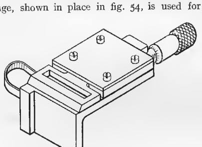

FIG. 55.—*Lining-gauge.*

the height-to-paper is correct. In some foundries a gauge of simple horse-shoe form, like the engineers' outside-calliper gauge, but with the jaws arranged at a small angle to each other, is used; and in others a gauge with a sliding carriage and a guide against which the type is placed enables any error in height-to-paper to be estimated by the distance of the type from a mark made where the jaws of the gauge are separated by the dimension of the true standard height; this form was invented by Henry Barth, of the Cincinnati Typefoundry, and is illustrated by De Vinne in his book on "Plain Printing Types." It is, however, little used in this country.

The dimension line-to-back is checked by comparing the type on a lining-gauge with a lower-case **m**, this letter being taken as the standard. An ordinary lining-gauge is shown in fig. 55. One somewhat similar in principle, but more elaborate, is shown in fig. 209, p. 234.

Spacing.—The width of a column of newspaper or a printed page of a book generally varies between 14 and 40 ems. Where this is ordinary reading matter each line contains on the average from 7 to 10 words. As many of the letters are unequal in set, and since the widths of set generally bear no particular relation to the em (or body), it follows that the spacing has to be done after the line has been composed. If the line, made up with thick spaces in hand-composition, comes short, or long, some or all of the spaces must be removed and replaced with others.

The hair-space is not used for this purpose, but only for spacing out between the characters of words where a very narrow column of matter runs alongside a block or table, and occasionally its use is allowed to obviate overrunning where author's corrections occur.

The spacing must therefore be obtained by the use of the thin, middle and thick spaces forming $\frac{1}{5}$, $\frac{1}{4}$, and $\frac{1}{3}$ of the body respectively. Obviously the minimum error obtainable with such a system, in the most favourable circumstances, is the product of the fractions of the body, namely $\frac{1}{60}$ em. The line cannot be made longer than the allowed width, therefore the amount of admissible error based on practical experience may be taken at $\frac{1}{60}$ em, and it is probable that it frequently amounts to $\frac{1}{30}$ em. This in pica becomes about $\frac{1}{180}$ inch, and in nonpareil about $\frac{1}{360}$ inch.

The problem of spacing is one of the most serious difficulties met with in composing-machinery; throughout this work it is defined as *line-justification*, but is known to printers by the unfortunate name of justification, a term which is always used elsewhere in this treatise for those manufacturing operations to which the term justification has also been applied. Various attempts have been made to effect the spacing more readily than by the crude trial and error method just mentioned. It is, however, by no means a simple problem. Even if all letters were equal in set width, as in the case of most typewriter faces, there would be a variable number from nought to nine to be added and inserted with those already in the line. Taking a line ending in the longest English indivisible word known to the authors, that is *strengths*, there are nine letters to be considered, and if this word comes at the end of the line and proves one letter too long, there are still nine spaces to be dealt with since one space precedes the last word. In German still longer indivisible words exist, for instance *schleichst* and *schnarchst*.

SELF-SPACING TYPE.

Thick added spaces would generally make large, irregular, and unsightly white gaps over the page. The nearest approach to accurate spacing of type is afforded by the so-called *self-spacing* type invented by L. B. Benton. In this all characters are made on set widths each multiples of one-sixth of the body, so that any combination can be made up to a multiple of the em by the addition of some of the self-spacing spaces which are also equal multiples of the sixth of the body; the arrangement is shown in table 9, p. 78.

The provision of so small a number of set sizes results in the production of characters which do not conform sufficiently closely to those ordinarily in use to secure the general adoption of the system, and the difficulty, which becomes apparent if table 9 is compared with tables 7 and 8, pp. 72 and 73, is even more marked with the italic sorts.

TABLE 9.

Self-spacing type.

Set.	Characters.	Number.
2 body	2 em quad	1
$\frac{7}{6}$ body	W Æ Œ ffi ffl *W Æ Œ*	8
1 body	em-quad m ffi ffl H K M X ℔ ℞ @ … — × + − ÷ = ½ ¼ ¾ ⅓ ⅔ ⅛ ⅜ ⅝ ⅞ *m H K M X*	32
$\frac{5}{6}$ body	w æ œ A B D E F G N O P Q R T U V Y & H K M W Æ Œ *w æ œ ff fi fl A B D E F G N O P Q* *R T U V Y &* ẁ ŵ *ẁ ŵ*	51
$\frac{2}{3}$ body	3-to-2-em quad a b d g h k n o p q u v x y ff fi fl £ $ C J L S Z A B C D E F G L N O P Q R T U V X Y & ⌉ } ⌋ . . (leader) — (rule) 1 2 3 4 5 6 7 8 9 0 *C J L S Z a b d g h k n o p q u v x y I 1 2 3 4 5* *6 7 8 9 0* ä á à â ã ñ ö ó ò ô ü ú ù û Ç ç *ä á à â* *ã ñ ö ó ò ô ü ú ù û Ç*	120
$\frac{1}{2}$ body	en-quad c e r s t z ȷ s z I ? ( ] * † ‡ § ‖ ¶ *c e f r s* *t z ?*) *I* ç ë é è ê *ç ë é è ê*	40
$\frac{1}{3}$ body	3-to-em space f i j l ı . , ; : ' ! - / *i j l ; : !* ï í ì î *ï í ì î*	28
$\frac{1}{6}$ body	Hair-space	1
Total .	Spaces and quads, 6. Characters, 275 . .	281

KERNING AND BEARDING.

Kerned type and italics.—Some of the italic sorts, and occasionally the roman lower-case **f** and **j** in certain display and fancy faces, project beyond the sides of the body, fig. 56; these are known as kerned characters. The projecting kern requires to be dressed by hand, as explained on p. 21, so as to enable the face to approach closely to that of the adjacent character and to clear its shoulder when composed, fig. 57. This, of course, makes the type extremely weak, the sharp projecting edges of the face being peculiarly liable to damage.

In early printing some of the characters kerned above or below the body, or bearded, and this was liable to cause fouling where an ascending or a descending kern in one line came immediately under a descending or over an ascending letter in the next line. A still more exaggerated form of kerning was found in some seventeenth century type to which ornamentation was added at the top to fill up part of the white adjacent to the much-inclined italic letters and some characters, among which may be quoted the *K*, *N*, *Q*, *R*, *X*, and *Z*, had their tails greatly extended to the right; so much so that in certain instances they would come under two or three succeeding lower-case characters. These bizarre forms are now seldom found, for the

FIG. 56.—*Kerned type, as cast: isometric view.* About $2\frac{1}{4}$ times full size.

FIG. 57.—*Kerned type, after dressing: isometric view.* About $2\frac{1}{4}$ times full size.

artistic effect produced is not commensurate with the technical difficulties of the construction and use of such letters.

In modern type, kerning above and below the body is rare; the only notable exceptions are accented capitals—the use of which is now being abandoned by the French—and the very ingenious two-line letter for commencing advertisements introduced by the Linotype Company, a form of overhang which is described on p. 429.

The French have for many years abandoned the grave accent on **A** while retaining it in the lower-case: "A Paris il faisait beau, à Londres un brouillard."

In the head-lines of the French newspapers, while the accent is now almost universally omitted on **A**, one finds accents sometimes on other characters; but the influence of the composing machine is to be seen in the gradual abandonment of accented capitals, which is now in progress.

For example: "L'ANGLETERRE REFUSE LE SYSTEME METRIQUE ......car la plus grande partie du commerce extérieur britannique intéresse des pays qui n'ont pas le système métrique...." *Le Matin*, 23 *mars*, 1907.

One instance of the ill-advised use of accented type kerning above the body occurs in the case of Esperanto, for which several accented ascending characters are used, for example, Ĉ Ĥ Ĝ Ĵ Ŝ Ŭ ĥ, apart from the lower-case characters ĉ ĝ ĵ ŝ ŭ, which, of course, present no difficulty except that they require special matrices. The Esperantists would have done far better in adopting a non-kerning form of modification; examples of such modifications are the Danish ø, the Polish ł, ą and ę, and the Maltese Ħ; and they would have been better advised had they adopted a simple bar or a dot added within the body of the character, thus: Ɉ or Ȼ.

In one specimen of Esperanto printed in Switzerland we find that owing to the absence of accented characters a substitute has been formed by using an inverted full point after each such letter:—

"Ni donas c·i sube kiel specimenon la tradukon de la antauparolo. Oni vidas ke la tradukinto ne uzis la kutimajn supersignojn, sed anstatauigis ilin per ordinara punkto renversita.

"Kompreneble, io ajn nova prezentas unuavide aspekton iom nekutiman, sed antau ol esprimi definitivan jug·on pri g·i, oni devas uzi g·in dum tempo sufic·e longa."

The difficulty of kerning accented characters also affects German type, the modified capital vowels having this peculiarity. The difficulty can be overcome by placing the dots lower at each side of the vertex of the **A** and within the **O** and **U** respectively: a practice now occasionally adopted.

It is difficult to understand why different nations should cling to these accented or modified characters; they usually represent sounds quite dissimilar from those of the primary form, and it is but seldom that the use of a particular accent is intended to produce a consistent change in sound.

Speaking generally, it would be better for these countries to abandon the accents altogether and to produce and adopt a few national characters in their place. That there is no difficulty whatever in reading a language fluently in which a few only of the less important characters are changed is apparent from the two paragraphs forming fig. 123, p. 154, the second being set up in a slightly-reformed English alphabet.

Characters kerned in set are, however, still common in the case of many of the best book-founts; they present a serious difficulty to most type-casting and composing machines. Where the type is ejected through the length of the mould, as in the Wicks machine, they cannot be made. Where no subsequent dressing operation can be performed, as in the Monotype, they must be of the form left by the matrix in its withdrawal, and although the sides of the kern may be nearly vertical, as shown in fig. 56, yet these portions will, when the line is closed, come into juxtaposition with the base of the neck of the next character and fouling will very easily occur.

The use of a small percentage of kerning sorts in hand-composition is not a very serious matter, nor does it add greatly to the cost of the type; in fact, the founders may supply it at the same cost in order to secure a demand, but the questions involved in the various forms of machine-composition are so greatly and unnecessarily complicated by these few and little-used characters that it would be better to face the problem once and for all and adopt non-kerning italics and accents as the general rule.

In any case the weakness of the kern renders such italic type easily damaged in distributing and composing, and it is probably only a matter of time for the kern to be abandoned, except in the case of the highest classes of printing and in artistic work where appearance is considered to be the most important factor.

Example of kerning italic :—

The ejection of kerned italic type offers difficulty.

Example of non-kerning italic :—

The ejection of non-kerned italic type offers no difficulty.

The principal difficulty in designing a non-kerning italic lies in the ascending and descending sorts and particularly in the letters ***f*** and ***j***, which have to be somewhat modified from the more familiar shape. Whereas the slope of the italic main-strokes in the kerning type will be found frequently to be as much as 1 in 3, it is necessary to reduce it to about 1 in 5 in designing a non-kerning fount, and 1 in 4 is generally the maximum slope permissible. With this the ***f*** requires to be considerably distorted and shows excess of side-wall and consequent space between it and the adjacent characters.

Nicking, bearding, and kerning planes are used in conjunction with a dressing-stick for putting the extra nicks in certain small capitals and for other purposes, such as bevelling the top or bottom kern, known as the beard, of accented and certain other sorts, and for dressing the kern in *set* of italics and other type respectively; this latter operation, however, is more generally done by hand by rubbing the type on a dressing-file, or by treating it, when set up in line, with a small milling-cutter on a power-driven kerning-machine.

CHAPTER VIII.

TYPE FACES.

"He that readeth a Face at Sight hath the Gift of Kings; And verily for him that is of the Craft it is a Dower-Royal so to tell Face from Face, for some be Right-Rogues and offend in any Forme."

Mirrour of Pryntyng.

Long primer condensed De Vinne.

Variety of faces.—Type faces may be divided into three main groups so far as they concern the maker of typecasting and composing machines.

1. Old-style faces. Example :—

   Notice the short serifs and the ample fillet connecting each to the main-stroke. These features tend to durability as well as to legibility. 1 2 3 4 5 6 7 8 9 0.

   Pica old-style (Miller & Richard).

2. Modern faces. Example :—

   Note how thin are the hair lines, how long are the serifs, and how small the fillet connecting each to the main-stroke. Wear takes place more rapidly and legibility is sacrificed. 1 2 3 4 5 6 7 8 9 0.

   Pica modern (Stephenson & Blake).

3. Fancy faces. Example :—

   Our eyesight is one of our most precious assets, and the designer of type should therefore consider legibility as of greater importance than artistic effect. **1 2 3 4 5 6 7 8 9 0.**

   12-point blackfriars (Blackfriars, formerly Wicks, Type Foundry).

The faces may be extended or condensed, and the strokes may be fat or lean. The faces used for the greater part of the printed matter of the day are either old-style, or modern, or follow the leading features of one or of the other very closely.

1. *The old-style face* has thick hair-lines and a large radius connecting the serif with the main-stroke. These features render it more legible and durable. On the other hand the old-style numerals are irregular, and, owing to the smallness of some sorts, their legibility is no greater than that of the modern figures. Moreover, the fact that they comprise ascenders, descenders and small sorts makes them unsuitable for most scientific works. Old-style founts are therefore frequently ordered with modern figures.

2. *The modern face*—to which reference is again made under sections 11 and 12 of ordinary faces—is very largely used; the defect from which it suffers has arisen from the endeavour to obtain a more highly-finished outline without regard to the ultimate object in view. Thicker hair-lines and a larger radius connecting the serif and main-stroke increase both the clearness and the durability of the type, and a face comprising these features is very suitable for most newspapers, periodicals, magazines, text-books and novels.

De Vinne, in his classical work, has not only drawn attention to the requisites for legibility, but has himself produced some excellent examples of easily-readable type faces.

3. *Fancy faces.*—There are so many varieties of fancy faces, and they differ so widely, that they rarely come into question under conditions which permit of their production in large quantity. These faces are used chiefly for advertisements, circulars, bill-heads and titling; that is in instances in which the fount occurs in such small quantity that hand-composition is the only effective method of setting.

The chief varieties of faces in ordinary use, figs. 58 to 60, may be broadly subdivided into the following classes:—

1. *Black.*—This is the old English character used by the earliest printers and now reproduced more or less correctly by modern typefounders for various uses, for the headings of certain journals, for Christmas cards, etc.

2. *Black ecclesiastical.*—A variety of the preceding, used principally for prayer-books and texts. Ornamented forms of the two preceding are known, with a more or less degree of ornament, under various names, such as Anglo-Saxon and St. John.

The term *gothic*, which was formerly and correctly applied by most people to describe nearly all forms of black-letter, is not used here, being restricted by modern usage, and especially American usage, to a simple, and "sturdy type that has neither serif nor hair-line."

3. *Sans serif*, or, to be strictly accurate, *sanserif.*—In modern usage frequently called gothic, grotesque or sans. In its italic form, 13, fig. 60, this face is generally referred to as *inclined sans serif, gothic, grotesque*, etc.

4. *Old-face* is a light face, very open and with long ascenders. This face has inclined serifs, is accompanied by an italic, 14, fig. 60, and is a precursor of the old-style already mentioned, which has a heavier face and also small sorts of larger size.

1. A B C D E F G H I J K L M N O P Q R S T
2. A B C D E F G H I J K L M N O P Q R S T
3. A B C D E F G H I J K L M N O P Q R S T
4. A B C D E F G H I J K L M N O P Q R S T
5. A B C D E F G H I J K L M N O P Q R S T
6. A B C D E F G H I J K L M N O P Q R S T
7. A B C D E F G H I J K L M N O P Q R S T
8. A B C D E F G H I J K L M N O P Q R S T
9. A B C D E F G H I J K L M N O P Q R S T
10. A B C D E F G H I J K L M N O P Q R S T
11. A B C D E F G H I J K L M N O P Q R S T
12. A B C D E F G H I J K L M N O P Q R S T

FIG. 58.—*Roman capitals and figures (continued on opposite page).*

1. a b c d e f g h i j k l m n o p q r s t u v w
2. a b c d e f g h i j k l m n o p q r s t u v w
3. a b c d e f g h i j k l m n o p q r s t u v w
4. a b c d e f g h i j k l m n o p q r s t u v w
5. a b c d e f g h i j k l m n o p q r s t u v w
6. a b c d e f g h i j k l m n o p q r s t u v w
7. a b c d e f g h i j k l m n o p q r s t u v w
8. a b c d e f g h i j k l m n o p q r s t u v w
9. a b c d e f g h i j k l m n o p q r s t u v w
10. a b c d e f g h i j k l m n o p q r s t u v w
11. a b c d e f g h i j k l m n o p q r s t u v w
12. a b c d e f g h i j k l m n o p q r s t u v w

FIG. 59.—*Roman lower-case, ligatures and points (continued on opposite page).*

1. Black.
2. Tudor black (ecclesiastical).
3. Sanserif.
4. Old-face.
5. Antique old-style.
6. De Vinne.
7. Blackfriars.
8. Cheltenham old-style.
9. Bold latin.
10. Modernized old-style.
11. Modern.
12. Egyptian.

1. U V W X Y Z 1 2 3 4 5 6 7 8 9 0 £ $
2. U V W X Y Z i v x l c d m
3. U V W X Y Z Æ Œ 1 2 3 4 5 6 7 8 9 0 £ $
4. U V W X Y Z Æ Œ 1 2 3 4 5 6 7 8 9 0 £ $
5. U V W X Y Z Æ Œ 1 2 3 4 5 6 7 8 9 0 £ $
6. U V W X Y Z Æ Œ 1 2 3 4 5 6 7 8 9 0 £ $
7. U V W X Y Z Æ Œ 1 2 3 4 5 6 7 8 9 0 £ $
8. U V W X Y Z Qu 1 2 3 4 5 6 7 8 9 0 £ $
9. U V W X Y Z Æ Œ 1 2 3 4 5 6 7 8 9 0 £ $
10. U V W X Y Z Æ Œ 1 2 3 4 5 6 7 8 9 0 £ $
11. U V W X Y Z Æ Œ 1 2 3 4 5 6 7 8 9 0 £ $
12. U V W X Y Z Æ Œ 1 2 3 4 5 6 7 8 9 0 £ $

FIG. 58.—*Roman capitals and figures (concluded from opposite page).*

1. x y z æ œ fi ff fl ffi ffl & , . ; : ! ? = ' ( ) [ ]
2. x y z æ œ fi ff fl ffi ffl , . ; : ! ? = ' ( ) [ ]
3. x y z æ œ fi ff fl ffi ffl & , . ; : ! ? - ' ( ) [ ]
4. x y z æ œ fi ff fl ffi ffl & , . ; : ! ? - ' ( ) [ ]
5. x y z æ œ fi ff fl ffi ffl & , . ; : ! ? - ' ( ) [ ]
6. x y z æ œ fi ff fl ffi ffl & , . ; : ! ? - ' ( ) [ ]
7. x y z æ œ fi ff fl ffi ffl & ct , . ; : ! ? - ' ( ) [ ]
8. x y z æ œ fi ff fl ffi ffl & ct st , . ; : ! ? - ' ( ) [ ]
9. x y z æ œ fi ff fl ffi ffl & , . ; : ! ? - ' ( ) [ ]
10. x y z æ œ fi ff fl ffi ffl & , . ; : ! ? - ' ( ) [ ]
11. x y z æ œ fi ff fl ffi ffl & , . ; : ! ? - ' ( ) [ ]
12. x y z æ œ fi ff fl ffi ffl & , . ; : ! ? - ' ( ) [ ]

FIG. 59.—*Roman lower-case, ligatures and points (concluded from opposite page).*

1. Black.
2. Tudor black (ecclesiastical).
3. Sanserif.
4. Old-face.
5. Antique old-style.
6. De Vinne.
7. Blackfriars.
8. Cheltenham old-style.
9. Bold latin.
10. Modernized old-style
11. Modern.
12. Egyptian.

13. *A B C D E F G H I J K L M N O P Q R S T*
14. *A B C D E F G H I J K L M N O P Q R S T*
15. ***A B C D E F G H I J K L M N O P Q R S T***
16. *A B C D E F G H I J K L M N O P Q R S T*
17. *A B C D E F G H I J K L M N O P Q R S T*
18. *A B C D E F G H I J K L M N O P Q R S T*
19. *A B C D E F G H I J K L M N O P Q R S T*

---

13. *a b c d e f g h i j k l m n o p q r s t u v w*
14. *a b c d e f g h i j k l m n o p q r s t u v w*
15. ***a b c d e f g h i j k l m n o p q r s t u v w***
16. *a b c d e f g h i j k l m n o p q r s t u v w*
17. *a b c d e f g h i j k l m n o p q r s t u v w*
18. *a b c d e f g h i j k l m n o p q r s t u v w*
19. *a b c d e f g h i j k l m n o p q r s t u v w*

FIG. 60.—*Italic capitals, figures, lower-case, ligatures and points (continued on opposite page).*

13. Inclined sanserif.
14. Old-face.
15. De Vinne.
16. Blackfriars.
17. Cheltenham old-style.
18. Modernized old-style.
19. Modern.

5. *Old-style antique* is similar in its general features to old-style, but has a still heavier face; like the preceding, it has inclined serifs and is sometimes accompanied by an italic.

6. *De Vinne* is based on the old-style, modernized with inclined serifs, made heavier and with some features specially modified with a view to improving its effect and increasing its legibility. The italic is shown in 15.

7. *Blackfriars* is a modernized old-style in which the actual serifs have been to a great extent replaced by thickening the main-strokes, the object being an increase in durability and legibility. The italic is shown in 16.

8. *Cheltenham.*—A very popular series which comprises many forms of modernized old-face and retains its long ascenders and its short small characters, but is made heavier and has further peculiarities. The italic is shown in 17. With regard to Nos. 6, 7, and 8, italic is generally regarded as a separate fount.

9. *Latin.*—Sometimes called *antique*, has triangular serifs and a heavy face. This class of character usually has no italic.

13. *U V W X Y Z Æ Œ   1 2 3 4 5 6 7 8 9 0 £ $*
14. *U V W X Y Z Æ Œ   1 2 3 4 5 6 7 8 9 0 £*
15. ***U V W X Y Z Æ Œ   1 2 3 4 5 6 7 8 9 0 £***
16. *U V W X Y Z Æ Œ   1 2 3 4 5 6 7 8 9 0 £ $*
17. *U V W X Y Z   1 2 3 4 5 6 7 8 9 0 £*
18. *U V W X Y Z Æ Œ   1 2 3 4 5 6 7 8 9 0 £*
19. *U V W X Y Z Æ Œ   1 2 3 4 5 6 7 8 9 0 £*

13. *x y z æ œ fi ff fl ffi ffl &   , . ; : ! ? - ' ( ) [ ]*
14. *x y z æ œ fi ff fl ffi ffl &   , . ; : ! ? - ' ( ) [ ]*
15. ***x y z æ œ fi ff fl ffi ffl &   , . ; : ! ? - ' ( ) [ ]***
16. *x y z æ œ fi ff fl ffi ffl & ct , . ; : ! ? - ' ( ) [ ]*
17. *x y z   fi ff fl ffl ffi &   , . ; : ! ? - ' ( ) [ ]*
18. *x y z æ œ fi ff fl ffi ffl &   , . ; : ! ? - ' ( ) [ ]*
19. *x y z æ œ fi ff fl ffi ffl &   , . ; : ! ? - ' ( ) [ ]*

FIG. 60.—*Italic capitals, figures, lower-case, ligatures and points (concluded from opposite page).*

13. Inclined sanserif.
14. Old-face.
15. De Vinne.
16. Blackfriars.
17. Cheltenham old-style.
18. Modernized old-style.
19. Modern.

10. *Modernized old-style.*—To avoid the inconveniences attendant on the use of the modern face in its most pronounced form, many faces of modernized old-style have been produced with a view to greater durability, the serifs being shortened, thickened and better supported by more adequate connexion to the main-strokes. In these series the slope of the italic, 18, is usually made less and the amount of kerning thereby considerably reduced.

11. *Modern.*—This is an example of over-development resulting from a slavish attention to the technicalities of an art rather than to the object for which that art was originated. In consequence of its weakness and want of legibility it is now being rapidly replaced owing to a more healthy taste which is leading the reader back to insist on legibility rather than on uniformity of tint, delicacy of appearance, and beauty of workmanship; an apparently happy combination which, however, was unfortunately not productive of a durable or desirable result. The italic is shown in 19.

12. *Antique*, sometimes called *clarendon* or *egyptian*, is a development, with

its derivatives *ionic* and *french antique*, of the modern face in which the serifs are made parallel and heavy, thereby rendering it legible and durable. It has, however, a heavy appearance, which is perhaps slightly incongruous with the characteristics of the style; none the less for such purposes as the printing of railway time-tables and directories it is largely used for the sake of contrast with a lighter face.

The foregoing classification, however, must really be considered a very imperfect *résumé* of the matter, for the subject is such a large one that it is impossible to do more within the scope and limits of this treatise than sketch out some leading features. Those interested are therefore referred to text-books such as De Vinne's "Plain Printing Types," which is perhaps the most complete work known to the authors. For examples of early printing, readers should consult the fine work of Drs. F. Lippmann and R. Dohme, "Druckschriften des fünfzehnten bis achtzehnten Jahrhunderts in getreuen Nachbildungen."

In order to facilitate the comparison of the various styles of faces mentioned in the foregoing brief classification, the sorts have been arranged in tabular form for capitals, lower-case, figures and points, and for italics where such are used, in figs. 58, 59 and 60, pp. 84 to 87.

Founts of fancy faces usually comprise from 78 to 111 sorts.

WIDTH OF FACE.

Standard width of face.—There is no definite standard width for any character; in fact, what appears standard on one body will, if proportionately reduced or enlarged, appear narrower on a smaller body and wider on a larger body. This applies to all the characters of a fount, and the actual mean set can only be obtained by taking the aggregate set of a true fount scheme and dividing it by the total number of type in the scheme. It is found more convenient in practice to use the a–z length in ems as the measure by which to judge the width of a face. This does not permit of a very fair comparison because the a–z length of an old-style face, for instance, may measure 4 per cent more than that of a modern face of the same gauge and body and yet have a slightly smaller true mean set.

As the compositor in England and America is paid by the ens or ems he sets up, this question of the a–z length affects the cost of composition and tends to the use of faces of shorter a–z length. In France a fairer system prevails based on filling the measure with the alphabet, and its characters repeated in order, and taking the total thus obtained as the basis for payment. This question, together with its bearing on legibility, is treated at greater length in a subsequent chapter.

In calculating the comparative weights of different founts given in tables 25 and 26, the authors have adopted increases and decreases of percentage of 10, 20 and 30 per cent of the standard width, and have also allowed for the variation with change of body of the standard a–z length.

Unfortunately in England
to the thickness of stroke an
antique and egyptian. More
elongated, extended and ex
British founders to cover diff
does the same founder always
his own specimen book.

A face having an a–z length
as the standard, and other f
according to the proportion t
may be roughly classified as fo

Narrower faces.
Lean 86 to 90 per cent.
Condensed 72 to 80 ,,
Extra condensed 58 to 70 ,,

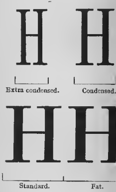

FIG 61.—*Narrow, stan*

In this arrangement the
American nomenclature adopte
of consistency and reasonablen

TYPE OF MATERI

Steel letters.—Apart from
printing machines and for
produced for setting the date
stamps, as well as for other si
these types are usually produce
are used for the production of
preparation of the matrices fo

Unfortunately in England the term fat, like the French *gras*, is applied to the thickness of stroke and hence to define a group of faces such as antique and egyptian. Moreover, the terms compressed and condensed, elongated, extended and expanded, are used very loosely by different British founders to cover different proportional variations of width; nor does the same founder always maintain a uniform use of the terms even in his own specimen book.

A face having an a–z length of 13 ems in pica to bourgeois may be taken as the standard, and other faces referred to it will be differently styled according to the proportion the a–z length bears to this standard; they may be roughly classified as follows:—

Narrower faces.		*Standard face.*	*Wider faces.*	
Lean	86 to 90 per cent.		110 to 114 per cent,	fat.
Condensed	72 to 80 ,,	100 per cent.	120 to 128 ,,	broad-faced.
Extra condensed	58 to 70 ,,		130 to 142 ,,	expanded.

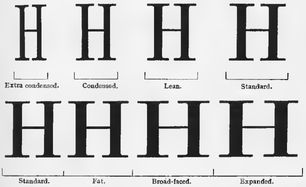

FIG 61.—*Narrow, standard, and wide type.* Enlarged 6 times.

In this arrangement the authors have followed De Vinne, and the American nomenclature adopted by him has been used, for it has the virtue of consistency and reasonableness.

TYPE OF MATERIALS OTHER THAN TYPE-METAL.

Steel letters.—Apart from steel punches, steel wheels for telegraphic printing machines and for numbering-machines, actual steel type are produced for setting the date in postmarking stamps and in ticket-dating stamps, as well as for other similar purposes involving hard, rough wear; these types are usually produced by engraving. Steel types cut by machines are used for the production of logotype matrices, and in particular for the preparation of the matrices for rubber type for addressing-machines.

Specimen	Fount	Length a–z, ems.
abcdefghijklmnopqrstuvwxyz	*Nonpareil black No. 3 (Figgins).*	13·4
abcdefghijklmnopqrstuvwxyz	*Nonpareil tudor black (Miller & Richard).*	15·1
abcdefghijklmnopqrstuvwxyz	*Long primer black No. 1 (Stephenson & Blake).*	13·8
abcdefghijklmnopqrstuvwxyz	*Long primer augustan black (Stephenson & Blake).*	10·8
abcdefghijklmnopqrstuvwxyz	*Long primer old-style antique No. 3 (Miller & Richard).*	15·7
abcdefghijklmnopqrstuvwxyz	*Brevier old-style antique No. 7 (Miller & Richard).*	13·9
abcdefghijklmnopqrstuvwxyz	*Minion on brevier antique (Stephenson & Blake).*	15·6
abcdefghijklmnopqrstuvwxyz	*Brevier italian (Reed).*	13·2
abcdefghijklmnopqrstuvwxyz	*Pica old-style (Miller & Richard).*	12·3
abcdefghijklmnopqrstuvwxyz	*Bourgeois old-style (Miller & Richard).*	12·8
abcdefghijklmnopqrstuvwxyz	*Brevier old-style antique No. 8 (Miller & Richard).*	16·0
abcdefghijklmnopqrstuvwxyz	*Pica modern (Monotype).*	13·0
abcdefghijklmnopqrstuvwxyz	*Brevier modern (Monotype).*	13·8
abcdefghijklmnopqrstuvwxyz	*22 long primer italic modern.*	11·7
abcdefghijklmnopqrstuvwxyz	*Pica modern (Miller & Richard).*	12·1
abcdefghijklmnopqrstuvwxyz	*17 bourgeois (Figgins).*	13·1
abcdefghijklmnopqrstuvwxyz	*23 bourgeois (Miller & Richard).*	13·2
abcdefghijklmnopqrstuvwxyz	*Long primer italian (Reed).*	13·9
abcdefghijklmnopqrstuvwxyz	*Long primer skeleton antique (Stephenson & Blake).*	11·4

FIG. 62.—*Comparison of a–z lengths of type founts (continued on pp.* 91 *and* 92).

Specimen	Type	Length a–z, ems.
abcdefghijklmnopqrstuvwxyz	*Long primer condensed sans No. 5 (Stephenson & Blake).*	12·7
abcdefghijklmnopqrstuvwxyz	*Brevier condensed sans italic (Miller & Richard).*	12·3
abcdefghijklmnopqrstuvwxyz	*Long primer condensed sans (Wicks).*	11·3
abcdefghijklmnopqrstuvwxyz	*Long primer gothic (Clowes).*	17·1
abcdefghijklmnopqrstuvwxyz	*10-point hawarden (Haddon).*	13·5
abcdefghijklmnopqrstuvwxyz	*10-point winchell (American Type Founders Co.).*	16·7
abcdefghijklmnopqrstuvwxyz	*8-point condensed windsor (Stephenson & Blake).*	12·2
abcdefghijklmnopqrstuvwxyz	*Long primer ronaldson (Monotype).*	12·9
abcdefghijklmnopqrstuvwxyz	*Pica typewriter (Marr).*	15·8
abcdefghijklmnopqrstuvwxyz	*12-point blackfriars roman (Blackfriars).*	13·0
abcdefghijklmnopqrstuvwxyz	*8-point blackfriars roman (Blackfriars).*	13·0
abcdefghijklmnopqrstuvwxyz	*10-point blackfriars italic (Blackfriars).*	12·1
abcdefghijklmnopqrstuvwxyz	*12-point columbus (Haddon).*	14·5
abcdefghijklmnopqrstuvwxyz	*8-point morland.*	17·8
abcdefghijklmnopqrstuvwxyz	*12-point cheltenham old-style (American Type Founders Co.).*	10·7
abcdefghijklmnopqrstuvwxyz	*10-point cheltenham old-style (American Type Founders Co.).*	11·2
abcdefghijklmnopqrstuvwxyz	*8-point cheltenham old-style (American Type Founders Co.).*	11·4
abcdefghijklmnopqrstuvwxyz	*12-point cheltenham bold condensed (American Type Founders Co.).*	10·65
abcdefghijklmnopqrstuvwxyz	*10-point cheltenham bold condensed (American Type Founders Co.).*	11·3
abcdefghijklmnopqrstuvwxyz	*8-point cheltenham bold condensed (American Type Founders Co.).*	11·1

FIG. 62.—*Comparison of a–z lengths of type founts (continued on p. 92).*

Specimen	Length a–z, ems
abcdefghijklmnopqrstuvwxyz *12-point cheltenham bold (American Type Founders Co.).*	13·25
abcdefghijklmnopqrstuvwxyz *10-point cheltenham bold (American Type Founders Co.).*	14·25
abcdefghijklmnopqrstuvwxyz *8-point cheltenham bold (American Type Founders Co.).*	13·8
abcdefghijklmnopqrstuvwxyz *6-point cheltenham bold (American Type Founders Co.).*	15·4
abcdefghijklmnopqrstuvwxyz *12-point cheltenham bold expanded (American Type Founders Co.).*	17·9
abcdefghijklmnopqrstuvwxyz *10-point cheltenham bold expanded (American Type Founders Co.).*	19·1
abcdefghijklmnopqrstuvwxyz *8-point cheltenham bold expanded (American Type Founders Co.).*	18·7
abcdefghijklmnopqrstuvwxyz *12-point cheltenham wide (American Type Founders Co.).*	12·2
abcdefghijklmnopqrstuvwxyz *10-point cheltenham wide (American Type Founders Co.).*	12·9
abcdefghijklmnopqrstuvwxyz *8-point cheltenham wide (American Type Founders Co.).*	13·4
abcdefghijklmnopqrstuvwxyz *12-point De Vinne condensed (American Type Founders Co.).*	11·9
abcdefghijklmnopqrstuvwxyz *10-point De Vinne condensed (American Type Founders Co.).*	11·3
abcdefghijklmnopqrstuvwxyz *8-point De Vinne condensed (American Type Founders Co.).*	12·8
abcdefghijklmnopqrstuvwxyz *6-point De Vinne condensed (American Type Founders Co.).*	14·2
abcdefghijklmnopqrstuvwxyz *12-point De Vinne (American Type Founders Co.).*	15·1
abcdefghijklmnopqrstuvwxyz *10-point De Vinne (American Type Founders Co.).*	13·8
abcdefghijklmnopqrstuvwxyz *8-point De Vinne (American Type Founders Co.).*	15·5
abcdefghijklmnopqrstuvwxyz *6-point De Vinne (American Type Founders Co.).*	16·8
abcdefghijklmnopqrstuvwxyz *12-point De Vinne italic (American Type Founders Co.).*	15·2
abcdefghijklmnopqrstuvwxyz *10-point De Vinne italic (American Type Founders Co.).*	13·8
abcdefghijklmnopqrstuvwxyz *8-point De Vinne italic (American Type Founders Co.).*	15·5

FIG. 62.—*Comparison of a–z lengths of type founts (concluded from p. 91).*

Brass letters.—Brass letters are used by bookbinders, leather-stampers, and other craftsmen working in similar materials. Not only are letters used, but also stamps of various designs, floral, classical, and others. The technology of these forms of printing-surface presents nothing of special interest, as they are produced in the usual way by engraving blanks of suitable size and section, though occasionally they are made by casting.

Wooden letters.—Characters of large size made of wood are used for the production of printed matter, but almost always for advertisements. It is a curious reversion to the earliest type, for the first types were wooden; but these were comparatively small and used for book-work, whereas the modern wooden types are all large and used, as has been said, for the production of printing practically unknown to our forefathers; advertisement—as we understand it—being a comparatively late development in the history of the credulity of mankind.

The technology of the components of this form of printing-surface presents nothing particularly novel, the letters being developed from drawings or templets by various specialized forms of routing machines (usually pantographic), high-speed cutters, saws, abrading tools, etc., similar to those forming part of any fully-organized and extensive woodworking-plant.

INITIALS.

Initial letters.—The initial letter which commences a chapter is usually of much larger body than the normal type of the work. Some modern specimens of these are among the most tasteful examples of the typefounder's art, and when properly reproduced, frequently in more than one colour, are, apart from sentiment, quite equal to many of the masterpieces of the old penmen. Their use, however, is a relic of the early printed book in which a space for an initial letter of large size was left blank by the printer for the work of the skilled professional illuminator, whose duties also included that of marginal decoration. Subsequently combined engraved blocks inked separately in different colours were used in order to complete the work from the printer's hands, and at a later period the single-colour ornamented initial letter took the place of these composite characters.

THE initial letter subsequently became of less and less importance, becoming the 2-line letter still retained in advertisements, and the capital letter followed by small capitals of the ordinary publications of the day.

THE later history of initials is this: firstly, complete blanks were left by the printer for the illuminator to fill in; secondly, outlines were printed in for a less skilled illuminator to go over and fill up with colour; thirdly, outline letters were printed in the blank spaces, and it was left to the fancy of the purchaser to fill them in for himself. Subsequently the whole art of initial-letter illumination degenerated until mechanically revived by the modern typographer, who cut beautiful letters or blocks, by the use of which the printer himself now completes the page when these adjuncts are desired.

TYPE FOR ILLUSTRATING GAMES.

Chess and draughts.—To illustrate the handbooks on the subjects of chess and draughts and the problems, resulting from the study of these games, so often given in the daily press and the special journals devoted to

FIG. 63.—*Chess.*

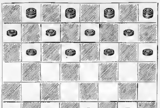

FIG. 64.—*Draughts.*

the matter, type are made for representing the various pieces on the white or black squares which they may respectively occupy. Of course, these

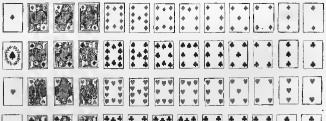

FIG. 65.—*Playing-cards.*

pieces are cast on the em-quad and their production involves no technical difficulty.

Playing-cards.—To illustrate the handbooks on card games and games of patience, complete sets of playing-cards are represented in type as shown in fig. 65. These are usually cast on a 36-point body and have a set width of 24 points. As in the preceding case, these present no technical difficulty.

Dice, dominoes, and backgammon or trick-track are also cast as type and used for the illustration of works on the games in which the pieces

FIG. 66.—*Dice.*

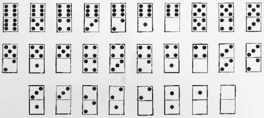

FIG. 67.—*Dominoes.*

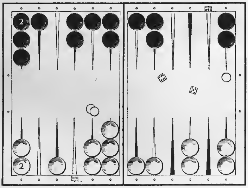

FIG. 68.—*Backgammon or trick-track, showing small dice and counters.*

represented take part; they are shown in figs. 66 to 68, and their production involves no technical difficulty.

ITALICS AND SCRIPT.

Italic is a form of type directly imitative of the art of the penman and is said to have been founded on the handwriting of Petrarch, which it closely resembles. It was first produced by Aldus Manutius, and used by him in his famous edition of Virgil published in 1501; for this Pope Leo X granted a Letter of Privilege entitling him to the sole use of the type he had invented.

Italic was formerly much more largely used than at present, and in early founts amounted to perhaps forty per cent of the total. Its use in conjunction with roman type is rapidly decreasing. With few exceptions it is now not used as a body type.

Script.—Script type, called in French *anglaise* (an example of curious modesty, for it is really a French invention), is a yet closer imitation of handwriting of the form frequently used by early scribes and popularly

Fig. 69.—*Script type section.*

known as copper-plate. Much technical skill and attention were devoted to this face on the Continent, particularly with a view to designing the characters so that they would join up properly in combination, and give the

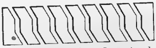

Fig. 70.—*Script type section; Laurent and Deberny.*

effect of continuous writing, without requiring a large number of shapes to be given to each character according to the combination in which it was to be used. The difficulty is analogous to that met with in the arabic

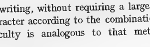

Fig. 71.—*Script type section; Firmin Didot.*

face, in which some characters are made in four forms, initial, medial, final and detached.

Owing to its great inclination, the kerning of script much exceeds that of italic characters; to meet this difficulty, type have been made of a section composed of two rhomboids with sides inclined to each other. Type cast on this form of body kerns but little, and the angle of one type fitting into the recess in the adjacent type enables the line to be locked up as securely as if it were composed of rectangular type; an end type of appropriate shape is provided for each end of the line, having a face at right angles to the front and back of the body, fig. 69. Other sections adopted in France to arrive at this simple result are shown in figs. 70 and 71.

In some cases the difficulty has been overcome in another manner, the shank of the type being retained of rectangular form for the greater portion of its length; inclined pieces are cut away in the mould and added on the corresponding halves, so that the upper portion of the type forms a supporting bracket to the kern and nests against the cut-away corner of the succeeding type. This may be done by removing and adding portions of a pyramidal form, as in the script type shown in fig. 72; or portions of a prismatic form, as in the test type shown in fig. 73, cast in moulds

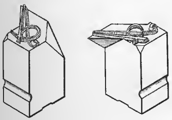

FIG. 72.—*Script type with bracketed kern*

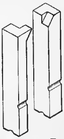

FIG. 73.—*Test type from mould for Kanarese.*

made for Kanarese but without the face, a plain matrix, as is usual in testing, having been used instead of a struck matrix.

TYPEWRITER AND DUPLICATING-MACHINE TYPE.

Typewriter type.—The type used generally on typewriters differs to a marked extent from printers' type, because, with a view to avoiding complication in the typewriting machine, it is necessary to make it of uniform set-width. A few machines, it is true, have been constructed to work with differential spacing, but these have not found popular favour. Typewriter faces in use are generally either one-tenth or one-twelfth of an inch in set width, all the characters coming on the same set. Another peculiarity of the hardened steel type-heads used on typewriting machines is that the actual faces are made slightly curved instead of plane. The magnitude of the sagitta of the small arc of contact of the type with the paper is less than 0·003 inch for j, which is the longest character, and amounts to only 0·0005 inch in the lower-case small sorts. It is somewhat remarkable that notwithstanding the elastic rubber backing of the roller it should be necessary to allow for so small an amount of curvature.

For many commercial purposes a close imitation of typewriter type is required. This has led to the production of ordinary type with typewriter characters of the kinds most generally in use; it presents no special technical difficulties. In some few cases the face has been cut with chequered lines so as to reproduce more accurately the effect given by the ribbon in typewritten manuscript. The resemblance between work printed from typewriter type and actual typewriting is increased to a very marked extent if the points (. , ; :) are made from 0·003 to 0·005 inch high-to-paper. The illusion is carried even further in some founts which comprise cancelled characters, so that the typist's corrections can be imitated.

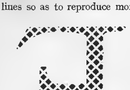

Fig. 74.—*Chequered face typewriter type.* Scale: about 16 times full size.

Duplicating-machine type. — The remarks already made relating to typewriter faces apply here also, but the peculiar troubles attendant on the production of characters so short in body and so irregular in shape as are some of those required in certain of these machines, often present technical difficulties which necessitate the

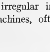

Fig. 75.—*Duplicating machine type; cored.*

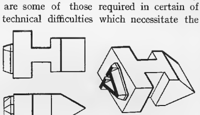

Fig. 76.—*Gammeter multigraph type.*

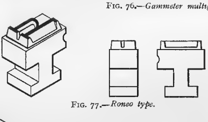

Fig. 77.—*Roneo type.*

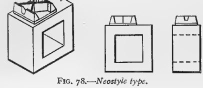

Fig. 78.—*Neostyle type.*

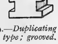

Fig. 79.—*Duplicating machine type; grooved.*

construction of special moulds for their production. Examples of these are given in figs. 75 to 79.

Addressograph type.—Very similar to the preceding are the short-body types used in some forms of addressing-machines; the example shown in fig. 80 is cored with a double core to obtain lightness and a drag is fitted to ensure delivery; this type shows marks indicating that it has been finished

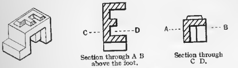

FIG. 80.—*Addressograph metal type.*

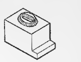

FIG. 81.—*Addressograph rubber type.*

and dressed by knives on the machine. It is more usual to use rubber type of the section shown in fig. 81.

TYPE FOR MISCELLANEOUS PURPOSES.

Semaphore type. — In consequence of the interest taken in various signalling systems, particularly in this country with respect to the boy-scout movement, the authors have designed and cut punches for a fount of type in which a small ordinary capital character is cut at a lower level than that of the actual signal formed by the printing-surface. These small characters enable the sorts to be recognized by any one not conversant with semaphore signals, and as they are intended to be read by those not accustomed to the setting of type, they have been cut erect instead of inverted, fig. 82. A specimen set up in this semaphore character is shown in fig. 83.

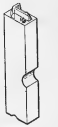

FIG. 82.—*Semaphore type with designating letter.*

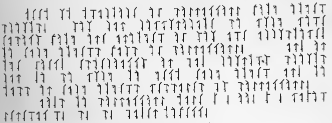

FIG. 83.—*Semaphore type.*

In the actual sending of messages by semaphore, each word is concluded by bringing the arms down to their lowest or zero position. The authors have consulted several authorities on signalling and have been advised by them that in the case of the printed character it is preferable to use an ordinary space between the words, reserving the zero sign for the full stop.

Morse type.—For the same reason as that mentioned in connexion with semaphore type, the authors have designed and cut a face of Morse type following the Estienne form rather than the continuous line as recorded on the tape. An example of this type is shown in fig. 84 and a specimen of matter printed from it is given in fig. 85.

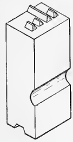

FIG. 84.—*Morse type.*

In this form the printed message has the advantage that the same actual length of line is occupied by the symbol sent, whether dot or dash, but like the 'sounder' it has not the advantage, possessed by the tape, of similarity to the actual impression to be made on the brain of the receiving operator. The visible interrupted line of the tape resembles the wireless telegram as heard in the telephone receiver and is as easy to read; it is this perfect clearness of the telephonically-received wireless message that has led the authors to devise a similar system of embossed type for the blind to which allusion is made later.

FIG. 85.—*Morse type; Estienne form.*

Figure 86 shows the Wheatstone perforated ribbon as well as the Morse tape printed from it. This perforated ribbon is the earliest practical

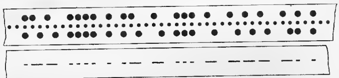

FIG. 86.—*Wheatstone perforated ribbon and Morse tape;* full size.

example of the widened application of the Jacquard principle to printing, a principle which is now extensively adopted in many composing machines.

Embossed metal type has been proposed for many purposes—frequently for large body type for display work, in place of wood type—but its chief utility as a typographical printing-surface is in certain forms of addressing-machines. The plates used in these machines are usually of zinc about 0·01 to 0·016 inch thick and the blanks are first stamped out to shape, so as to be capable of being ultimately linked together in order to form a continuous chain for use on the addressing-machine. In other patterns of

ːS.

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An example of
cimen of matter

as the advantage
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by the tape, of
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sy to read; it is
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o devise a similar
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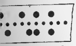

; full size.

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PLATE IV.

FIG. 87.—*Embossed metal type; Addressograph.*

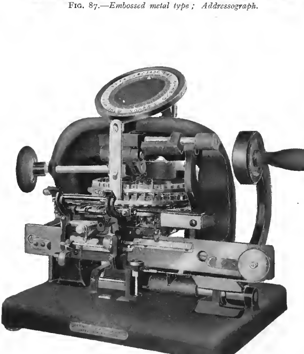

FIG. 88.—*Embossing machine: hand "Graphotype"; Addressograph.*

To face page 101.]

machines the plates are wo
index system.

An embossed, address-be

The embossing is effecte
a typewriter, fig. 88, plate
in pairs above each other i
position by a hand-wheel or
by a taper-ended piece whic
lever on the right of the ma
holder which advances step
also be moved radially tow
the range of lines the mach
four to five lines according
generally adopted is one
punch are each about 0·31
chamfered to clear the pr
character. For erasing mis
machine illustrated is an o
a name which has no cor
casting machines illustrated
machine here shown is inte
prepared from time to time
plates have to be prepared
In this the power for embos
shaft carrying an eccentric,
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Printing-telegraph type.—
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machines the plates are worked automatically in conjunction with a card-index system.

An embossed, address-bearing plate is shown in fig. 87, plate IV.

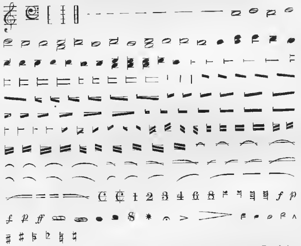
The embossing is effected by means of a machine somewhat similar to a typewriter, fig. 88, plate IV, but carrying dies and punches arranged in pairs above each other in two revolving die-heads, set approximately to position by a hand-wheel on the left of the machine, and finally to register by a taper-ended piece which comes between guides on the die-head as the lever on the right of the machine is brought down. The plate is held by a holder which advances step by step as each character is embossed, and can also be moved radially towards the centre of the die-head so as to cover the range of lines the machine is capable of embossing. This varies from four to five lines according to the size of type face used. The style of face generally adopted is one of the usual typewriter faces. The die and punch are each about 0·31 inch square by 1·25 inches long, and the die is chamfered to clear the projecting portion of the preceding embossed character. For erasing mistakes a flat punch and die are provided. The machine illustrated is an office pattern known as the hand Graphotype, a name which has no connexion with the Graphotype keyboard and casting machines illustrated and described in a subsequent chapter. The machine here shown is intended for use in offices where the plates are prepared from time to time in small quantities. Where large numbers of plates have to be prepared a similar, but power-driven, machine is used. In this the power for embossing is obtained from a continuously-revolving shaft carrying an eccentric, which, as in the case of punching, shearing or stamping machines, can be thrown into gear by the depression of a key.

Printing-telegraph type.—Another form of type is that which is used in various machines, all of which perform somewhat similar functions; among these may be enumerated the printing-telegraph, by which news is distributed to the various journals, news-agencies, clubs, offices, and a few private persons. In this class of machines the type themselves are carried in relief, generally on an aluminium wheel.

On certain of the receiving-telegraphs, such as the Hughes, in which the relief type are carried on a steel wheel, they are formed by actually engraving away the portions of the wheel not required for producing the impression. But a number of the telegraphs, especially some of the more modern systems, use type-heads and methods similar in character to those adopted in ordinary typewriters, modified, however, to admit of a higher speed than would be possible to a hand-operated machine. It has not been thought necessary to give illustrations of all these varied but very similar forms of type.

Numbering-machine type are of different kinds and uses; some of these types are used in numbering-machines, pure and simple, and some of them in other machines which are made of small size and type-high. These machines can be locked up in the forme with printing-surfaces and effect the numbering with their type after inking in the usual way. They are used for printing tickets, manifold books and other business documents requiring consecutive numbering.

Whereas twenty-five years ago the output of numbering-machines in America was only some twenty-five per week, it has risen to approximately one thousand per week at the present time. The chief difficulty in the way of manufacturing these machines at the commencement was caused by the engraving of the wheels: these were formerly engraved by hand, the number of figures which a skilled engraver could turn out being from twenty-five to fifty per day. The wheels are now engraved by machines operated by girls who can each produce from 300 to 1000 figures per day.



Diamond music characters (P. M. Shanks & Co., The Patent Type Foundry).

Fig. 89.—*Music type.*

The typographical numbering-wheels are first blanked out of sheet steel practically to size. The drop-cipher grooves are then milled, after which a ratchet-wheel with the proper number of teeth, usually ten, is riveted to the blank. The blank is then milled to leave the spots for engraving and the drop-cipher is inserted. After engraving the wheel is ground, the drop-cipher freed, and the central hole reamed out to size, this last operation finishing the wheel.

It is within the authors' knowledge that wheels for numbering-machines have been produced by casting instead of by engraving, but they are not aware of any extended use of this method.

Music type.—Music type, fig. 89, is cast on an em basis, and the smallest type are on the en. As the note heads are on the lines or on the spaces, and as the stems may cut one or more lines or form angles with them, and as the number of parts required for building up the whole line is very large, it is necessary that the type should be of the highest quality as regards accuracy, and that it should be justified specially with a view to the use of all the various components in any combination which may occur in practice. As a music fount runs to some 260 characters or portions of characters, the difficulties connected with this type are those of composition rather than those of typefounding. So far as the authors are aware, no advance has been made of recent years towards a simplification in the method of setting music other than by the use of a large number of small individual component pieces.

Shorthand type.—With regard to shorthand type, fig. 90, it would be ungracious to mention the subject without bringing in the name of Sir Isaac Pitman, to whom the present very generally-used system of shorthand owes its existence. Prior to 1873 this tireless reformer made experiments on printing shorthand from metal type, but owing to the cost of

Shorthand characters (Sir Isaac Pitman & Sons).

FIG. 90.—*Shorthand type; from "The Life and Work of Sir Isaac Pitman."*

punches, he subsequently tried the process of engraving as a means by which type might be reproduced. He found the plan of forming shorthand words by combining their separate parts less practicable than engraving the whole word on the blank; the blanks used are selected of the width required by the word from 1-en to 3-ems in set width. The shorthand pages of the "Phonetic Journal" and similar publications are composed of type prepared from engravings. The pages of shorthand are distributed each week into cases so arranged as to enable any given word to be found readily, but in distributing, the types are not thrown loose into the case as with ordinary printing-type; they are placed in position showing their faces to the compositor. Two sizes are used, and in the composition of shorthand printing-faces a difficulty somewhat similar to that which must be experienced by the classical Chinese printer has been satisfactorily overcome. On the excellent authority of the late Samuel L. Clemens, better known as Mark Twain, it sometimes takes forty years to sort a pie of Chinese type. This information is doubtlessly not new to all who recollect his description of a Chinese printing-establishment in San Francisco, and whose hearts are yet warm with affectionate recollection of the great and kindly humorist who has not long passed away, leaving a name that is almost a household word with the Anglo-Saxon race.

Type for the blind.—The introduction of printing for the blind is generally ascribed to Valentin Haüy, of Paris, who about 1784 used a large

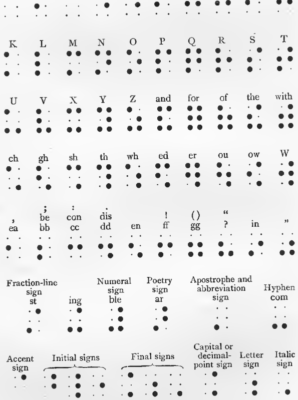


FIG. 91.—*Braille type alphabet.*

relief script character. Various relief alphabets have been invented since, but of these it will only be necessary to describe one, the braille. This alphabet consists of combinations of dots formed as hemispheres in relief by pressing suitable dies into a specially-prepared paper, generally while moist, or warm and plastic.

The braille alphabet uses dots occupying any one of the possible combinations of six positions taken one or more at a time. The total number of combinations is therefore the sum of those taken one at a time, two at a time,......six at a time, or 1, 6, 15, 20, 15, 6, 1, that is, 64 in all, including the space (no dots) and the whole six dots. The six dots are arranged in three horizontal rows of two each and two vertical columns of three each, thus ⠿ ; the dots are described and recognized by numbering them thus: $\begin{smallmatrix}1 & 2\\ 3 & 4\\ 5 & 6\end{smallmatrix}$.

Somewhat like the semaphore alphabet the braille uses special signs to change from lower-case to capitals and italics and *vice versa*. The position occupied by the W among the logotypes proclaims the French origin of the alphabet. The last three signs given representing the change to capitals, letters and italics respectively, are also used as final signs.

It is in the method adopted for printing the relief sheets that great originality has been displayed. In the first instance depressions were formed in a malleable metal sheet, and paper in a plastic state was pressed into these by an elastic backing, the plate being itself supported by a rubber or other elastic medium.

A great advance on this method was made when a double sheet of metal, usually zinc, was used and the depressions were formed in both sheets simultaneously by a machine somewhat resembling a heavy typewriter; the depressions thus form both type and matrix, but it is from the matrix that the actual reading-surface is produced; the process is therefore one of composition of matrices in which the printed surface is formed, and the number of consecutive operations necessary is remarkably small in comparison with those involved in the preparation of an ordinary printed page.

A still further improvement was effected by simply folding the zinc plate so that the halves would always register when opened and closed, the fold being held in the printing machine and the thinness of the plate permitting of the two parts being pulled by clips sufficiently wide open to receive the sheet to be printed; the zinc plate used is about 0·01 inch thick.

Subsequent to the invention of the double metal sheet came that of printing in relief on both sides of the paper, which was first accomplished by the interline method; in this the space between consecutive lines of reliefs on one side of the paper was used for the depressions corresponding to the printing on the other side; the dots are raised 0·023 to 0·030 inch.

The latest advance has been the placing of one of the dots on the one side so that it occupies the centre of the square formed by four dots on the other side; by this interdot arrangement the amount of matter which can be printed on each side of the paper is increased some 50 per cent.

The same alphabet is used on a machine, somewhat like the stenotype, for printing relief characters on a paper ribbon. The speed attainable with these machines is practically as great as that obtained by ordinary shorthand. In fact, the authors have seen a letter taken down by a blind girl at the rate of 160 words per minute; read back by passing the ribbon through the fingers at the same rate as the ordinary written stenography is read back; and finally typed by the same girl without a single error on an ordinary typewriter.

The braille alphabet has been coded for most of the European and many other languages, and many books—educational, literary, and scientific—are now printed in it. F. A. J. Burns of the English and Foreign Braille Literature Society has, for some thirty years, been engaged in the disinterested and philanthropic work of the society which provides syllabaries which enable a sighted person who can read to instruct a blind learner; following the syllabaries introductory reading books are used for such knowledge as is usually taught in elementary schools, and, of course, this is followed with the biblical matter which comes more particularly within the scope of the society's efforts.

Should it be found necessary to produce an edition of a work simultaneously in the same language, in several different countries, a process suggested by the authors for this purpose might be found practical and

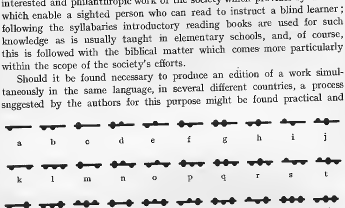


FIG. 92.—*Line-braille.*

advantageous, especially as books for the blind are very bulky, and it would be more convenient to send the metal matrix-sheets to countries in which editions were required than to send the printed editions of the books themselves.

The process would consist in the cutting of a small fount of steel braille characters which would be sufficient for the composition of two or more pages and would be redistributed after each page was completed, as was done with ordinary type in the early days of printing. The forme of steel type would be used as stamps for the production of a number of the sheet metal matrices under a press, and these matrices could then be distributed to the various countries in question where the actual printing would be performed by the local blind institutions where such existed, or by ordinary hands.

A further suggestion, here merely put forward, however, by the authors for what it is worth, is an idea that occurred to them of line-braille.

In this system of writing braille, the points are arranged in two horizontal rows and three vertical columns, and placed, not as at present separately from each other, but lying contiguously on both sides of a raised straight line or straight depression, as may be found most suitable to the sense of touch.

If this system is feasible, it is, in the authors' opinion, fraught with many practical advantages, which, for lack of space, they are not able to discuss here. Among these are technical details connected with saving of space, ease of composition, tension of paper, and printing upon a rotary machine for cheapness and rapidity of reproduction. The number of different punches required to strike the matrices for this form of braille could be reduced to three for producing the components from which the characters would be formed, that is the double dot, the single dot above and below the line—the second form being the inversion of the first—and the plain line used where no dots occur and, when duplicated or multiplied, serving as the space between the letters and words. In practice it might be found more convenient to use a plain space instead of the raised line for the separation of the letters and words. It would, therefore, not be a costly matter to make the type. This type could be made, if necessary, of bronze or other practically unwearable material, and, as has been said, at first sight many technical advantages apparently group themselves about this method of writing braille. The blind, for instance, could with the greatest ease and rapidity set up a letter, circular, or other original or dictated correspondence and reproduce the matter by means of a simple press as often as wished. It is not, however, a question on which the authors are competent to pronounce an opinion, though their idea has been received with kindly consideration by several authorities not only competent and interested, but occupied in dealing technically with the requirements of the blind. One advantage possessed by this system is that it makes no alteration in the present braille beyond one of position, an alteration which could be mastered almost as soon as explained, or in other words, in the course of a few minutes.

Braille, in its latest developments, owes much to the sympathetic ability of the Secretary General of the National Institute for the Blind, Henry Stainsby, to whose inventive powers, the authors believe, are due many of the latest and most important improvements in connexion with what might be termed the giving of sight to the sightless. In this treatise the authors have always carefully avoided anything which might savour of advertisement of any corporation, individual, or machine. They make, however, one exception, and that is in the case of the blind; and if in any way they can influence any reader of this work, they would like that influence used for the purpose of calling attention to this excellent society, with the hope that it may receive not only what they believe no human being would refuse, namely, sympathy, but also some practical help. The address of the Institute is 206 Great Portland Street, London, W., and they are sure that any calling there will receive the same courtesy and attention that the authors received when investigating the matter of braille type for the purposes of this book, and will themselves be as interested and moved by what they there see.

Reversed type.—The advent of the offset printing-press has given rise to a demand for type faces in reverse. This, of course, presents no new technical difficulties, but involves the cutting of reversed punches and the striking of reversed matrices throughout, as well as the construction of special moulds of the opposite hand where these have been required for the production of an inclined ordinary face.

It is interesting to note that patents for reversed type were taken out in Great Britain as early as 1864, nearly half a century before they were

JABBERWOCKY.

'Twas brillig, and the slithy toves
Did gyre and gimble in the wabe;
All mimsy were the borogoves,
And the mome raths outgrabe.

From "Through the Looking Glass," by Lewis Carroll.

FIG. 93.—*Reversed type.*

put to any real and practical use. The pneumatic tyre presents another instance of long lapse of time between the taking out of a really useful and valuable patent and its coming into general practical use.

Logotypes.—When two or more characters are cast together on the same body, the resulting type bearing the word or combination of letters

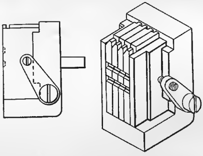


FIG. 94.—*Logotype matrix-box for the Davis pivotal typecaster, using modified Linotype matrices.*

and symbols on its face is known as a logotype. These are largely used for such works as directories and railway time-tables, for example: *street*, *Mr.*, *p.m.*, *stop*. In the case of railway time-tables in particular, they present the advantage of exactly filling the column of figures. Such logotypes may be cast from single matrices, or, in some forms of casting machine, by utilizing a group of composing-machine matrices in combination.

Borders.—This term was originally used to apply to the illuminated border with which the printed page was surrounded. It is now generally applied to ornament-designs so cast as to be capable of being combined to

FIG. 95.—*Borders*.

form continuous lines or borders, for which purpose they are largely used in advertisement and fancy printing, as in fig. 95.

Corners are special ornaments made with a view to enabling the design

FIG. 96.—*Corners*.

of a border to be changed from one direction to another at right angles to it without destroying the general spirit of the design, fig. 96.

Combination borders.—These are cast so that some portion of the design terminates at a definite portion of the body corresponding to a similar termination on the body of another design in such manner that two or more

FIG. 97.—*Combination borders*.

portions of the design can be fitted together, producing a complete design in which there is no break but which is capable of variation when the arrangement of the component parts is altered, fig. 97.

Ornaments are small figures or designs capable of being used independently for decorative and fancy printing.

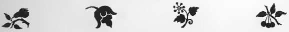


FIG. 98.—*Ornaments*.

Combination ornaments are similarly designed to the above, so that various designs can be built up by means of modified arrangements of similar parts. Type used in such combinations is generally cast on 6-point and 12-point bodies or multiples of them for convenience of fitting together and assembling into complete and frequently very complex designs.

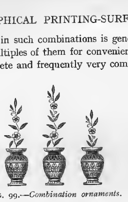


FIG. 99.—*Combination ornaments.*

Groundwork is formed by the aggregation of the same ornament either in the same position in each line, or inverted, or turned through a right

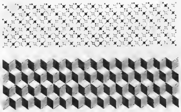


FIG. 100.—*Groundwork.*

angle. It serves to cover space in which much predominance of white is not desired.

Natural objects are what their name implies and are cast on large bodies, generally not exceeding 72 points. They include everything in heaven above,

FIG. 101.—*Natural objects.*

in the earth beneath, and in the water under the earth, from Beelzebub on a bicycle to the fatted calf, or the fish that swallowed Jonah. Their classification is absolutely hopeless, and their technology presents no difficulty whatever to the skilled typefounder.

Rules and cheque-rules are strips of metal, type-high, accurately machined or cast to form a printing-surface which may be a plain line, a series of dots or a recurring pattern. When of brass they are machined from the solid; when of metal they are cast in type-metal in a rule-mould

FIG. 102.—*Rules and cheque-rules.*

and finished on the foot by machining, as in the case of brass rules. They must be cast in a rule-mould by hand when they exceed 12 pica ems in length.

Scrolls are a survival of the finish to the old scribes' signatures, and are at present chiefly used in commercial work to form a background for writing

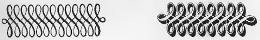


FIG. 103.—*Scrolls.*

as a safeguard against alteration in business documents, such, for example, as cheques and bills.

Braces are the larger forms of bracket and are generally cast in rule-moulds except when they exceed 12 pica ems in length, in which case they

FIG. 104.—*Braces.*

are cast in a hand rule-mould. Line or pen dashes, ornamental rules, curves and various other similar designs used in printing are similarly produced.

Arrows are made of various lengths, usually straight, but occasionally curved or irregular. Some are made with the head and feathers in two

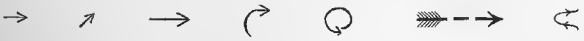


FIG. 105.—*Arrows.*

separate parts so that by the use of a rule for the shaft, they may be made up to any desired length; these are used for the direction of trains in railway time-tables and for route-books and other similar purposes; the shape of the arrow, however, is by no means confined to the above, and takes various forms in fancy and jobbing printing.

Ornamental dashes are usually symmetrical designs of short lengths used principally to decorate tradesmen's circulars and similar jobbing work.

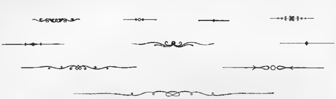


FIG. 106.—*Ornamental dashes.*

Pen or line dashes, flourishes and combination flourishes, are frequently made right and left handed, though sometimes only one-handed. They are used for the same purpose as the ornamental dashes, but occasionally also for terminating the signature at the foot of letters printed

FIG. 107 —*Pen or line dashes; flourishes and combination flourishes.*

in script type. They are a survival of the old writing-masters' flourishes, and are made both as simple flourishes and in more elaborate form as combination flourishes, fig. 107.

Colophons, sometimes called imprints, were originally the individual

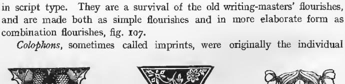


FIG. 108.—*Colophons.*

devices of early printers, but became generalized later on as an ornamental finish or ending to a book and occasionally to each chapter.

Illusional forms.—Another use of the typographical surface is the representation of various concrete objects, more or less accidental to ordinary printing, such as screw-heads, nail-heads and ink blots, fig. 109.

FIG. 109.—*Illusional forms.*

Although the authors have not come across other examples of these illusional forms, it is obvious that the paper-fastener, the pin, or rather those parts of a pin which show when one is used to secure papers together, the turned-up or turned-down corner of a sheet and other additions to or alterations in the appearance of the printed sheet could be simulated equally satisfactorily and the thumb print of the printer might be added to the list, although, under modern conditions, it is more rarely seen than was the case when inking was performed with balls and by hand.

Leads, which have already been defined on page 55, were formerly usually cast in a lead-mould by hand and cut to length to gauge by a lead-cutting machine, fig. 110.

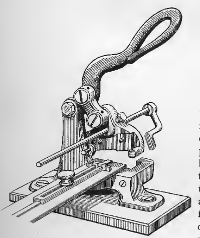


FIG. 110.—*Lead-cutting machine.*

Leads, when cast in the hand-mould, usually do not exceed 60 ems, or ten inches in length; the sharp corners left by the mould are removed by means of a scraper of hardened steel having a V notch. The casting of leads accurate both for thickness and parallelism throughout their length demands high skill on the part of the founder. Modern, improved, or standard leads can be obtained of greater length than the old hand-cast leads; they are scraped by machine, and should be so true when finished that they are capable of standing on a level plane surface.

Space lines are made of brass; they are of greater strength and durability than ordinary leads and can be obtained of greater length; they are frequently known as *brass leads* and are much used for newspaper work.

Reglets are made of wood, usually oak or beech, of thicknesses equal to those body-sizes in most common use; they are produced in 36-inch lengths. Frequently only two or three sizes, multiples of 6-point, are used.

Clumps are also cast in a lead-mould, and in some cases a core is fixed to one side of the lead-mould so that the clump may be lightened by the recess so formed. In America clumps are known as *slugs* and several improved patterns of tying-up clumps have been devised in that country. These have a groove or hollow in one side to receive the paging cord; this groove is of sufficient depth to permit of locking up with the cord in place. Clumps are usually made of thicknesses equal to the commonest body-sizes, and often serve as foot-lines to pages or columns.

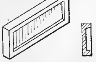


FIG. 111.—*Cored clumps.*

Quotations.—Quotations are usually cast on a casting machine, special provision being made in the mould for the withdrawal of the core to permit of the quotation being ejected. The large quads now known as quotations will probably in time be comprised under the definition of furniture.

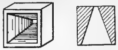


FIG. 112.—*Quotations.*

Furniture.—Frequently known as metal furniture, to distinguish it from the hardwood furniture previously used for the purpose, is of H or girder section throughout its length, fig. 113. When made of this section, however, it is liable to become distorted under the pressure applied in locking up the forme. When this class of metal furniture is used it is frequently the practice to supplement it with wood furniture, using the latter for actual contact with the chase.

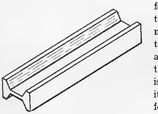


FIG. 113.—*H or girder furniture*

Ordinary french metal furniture, which is shown in isometric projection and in cross-section in fig. 114, has the core for one side made shorter than the length of the piece of furniture to be cast, and has grooves cut across it so that the furniture is cast with ends extending for one-half of the depth, and with stiffening bars forming ribs on the medial web. This style of furniture is merely a compromise between girder furniture and the improved french furniture, described next, which has superseded it for most purposes as it has the advantage of greater stiffness for the same weight of material.

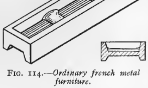


FIG. 114.—*Ordinary french metal furniture.*

Improved french metal furniture, fig. 115, is cast in a mould in which both cores are of less length than the furniture to be cast, and are provided with grooves; the cores in this instance are made deeper so as to meet each other, and the furniture formed has rectangular holes through it, besides being connected by struts of approximately circular section.

Furniture is usually cast of 24, 36, 48, 72, and 96-point widths and of lengths varying from 36 points or 3 ems up to 48 ems, the lengths advancing by two or three ems to give multiples of 2 or 3 ems.

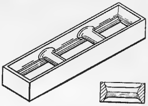


Fig. 115.—*Improved french metal furniture.*

Locket furniture, fig. 116, is an improvement on french metal furniture. It is made in 36-point size and has a projection 12 points square at the centre of each end. It can be made with special corners to facilitate the setting of inclined lines, as is shown in fig. 116.

Mild-steel furniture.—Of late, furniture of mild steel, either milled or stamped, fig. 117, has been introduced, but this in turn is likely to give way to furniture cast from some of the alloys of aluminium. Such a material appears to be the ideal substance for this particular purpose.

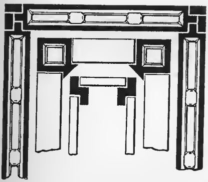


Fig. 116.—*Locket furniture.*

Another and very ingenious form of steel furniture recently exhibited consists of two pressed-steel halves placed back to back and secured by short tubes passing through the central rib so formed and beaded over. The resulting structure is finished on the vertical surfaces by grinding on a disk-grinding machine.

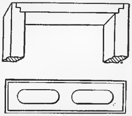


Fig. 117.—*Mild-steel furniture.*

ACCURACY OF TYPE FACES.

The same degree of accuracy is required in type cast by typecasting and composing machines as in the type cast in the simple typecaster. The

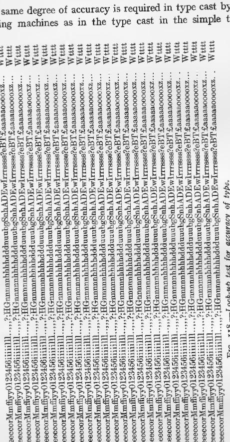


FIG. 118.—*Lock-up test for accuracy of type.*

The types shown in this figure represent rather more than a block of type as delivered by the Wicks rotary typecasting machine. The types for this example were cast in a mould of the body-slide class at the rate of 160 types per minute. The speed of the Wicks machine was 1000 types per minute, but as there were 100 moulds only ten types were cast per mould per minute. Omitting the five sorts which are repeated, this example represents two-and-a-half minutes' work for the Wicks rotary typecasting machine.

test usually applied to check accuracy is that known as the lock-up, which consists of repeating the same characters for a whole page. A page thus set up is shown in fig. 118; the type for the example given were actually cast in a single mould at the rate of 160 per minute.

In another form the accuracy and interchangeability of foundry type is well illustrated by the following incident, a form of experience from which others engaged in the wide fields of mechanical work have doubtless suffered as well as the authors. All are acquainted with the "expert," the "practical man" of unpractical people; the man who *knows* all type by sight; can tell the house of its origin, the very composition of its metal, its hardness and durability, and every face cast upon any particular body. With such a one the authors came in contact, and the following was their answer to his *ipse dixit*:—

THE EXPERT.

I.

The expert is a man of worth,
Far above me and you;
For he knows everything on earth
From China to Peru!

II.

Should you engage him on the spot
To criticize you this,
You'll find his criticism not,
The thing he thinks it is.

III.

Suppose he says, "It's clear as day,"
The thing he's asked to do,
Well, it's been done the other way:
We've different points of view.

IV.

Which type is which? "Aye, there's the rub!"
Come Experts to the test;
From London even to the "Hub"
And do your very best!

FIG. 119.—*Exactitude of face reproductions.*

These verses are set up in type from three different foundries using different matrices, different moulds, and different machines. In one verse the product is entirely that of foundry A, in another it is mixed with sorts from foundry B; in yet another it is mixed with sorts from foundry C, while in the remaining verse the products of the three foundries are mingled. Which verse is the product of the one foundry and which of the three? In the other verses which are the sorts that have been introduced in place of the original characters?

Our friend, the expert, fled before the test when it took practical shape as here given. He was wise in his generation, knowing the difficulty which faced him. These few verses, fig. 119, are set up in type of the same body, set and face, made by different leading typefounders and in quite different machines, and to distinguish which individual type is the product of which individual typefoundry is probably beyond the limits of human achievement. Immediately after the completion of his work, the very compositor who set up the specimen confessed himself unable to solve the problem, without referring to the back of the forme in which this curious puzzle was locked up. The authors themselves were almost as surprised as their friend, the "expert," and the compositor, at the severity of the test they had devised, and hope that they have profited from what was equally a lesson to themselves. Apart, however, from anything connected with personal equation in this matter, the essential facts brought to light by the above test are the faithfulness to the original of electrotype reproduction, the accuracy of the justifiers in positioning the characters, the accuracy of the mould makers in the construction and finish of their moulds, and generally the smallness of the total error resulting from the combination of the many different processes which are applied in the production of a type, even when carried out independently by different firms with different workpeople, and under different conditions.

The matter has, moreover, a very important side with regard to the question of copyright in type faces. The production of letters, founts and matrices has in the course of the development of printing been so gigantic that the authors have no hesitation in stating that to originate a new letter for the latin faces, or, in other words, one that has no affinity with, or similarity to, a predecessor is a practical impossibility.

In dealing with questions of design in individual type and type faces, in the first place, actual size in vertical height, in width, and in thickness of stroke, speaking broadly, cannot count as constituting a difference of design.

Imagine five mirrors, one a normal or plane glass, one a proportionately enlarging or spherical glass, one a proportionately diminishing or spherical glass, one a proportionately expanding or broadening cylindrical glass, and one a proportionately narrowing cylindrical glass; the curvature of the glasses being convex or concave as necessary. With these five mirrors successively placed in front of him, a man would be shown in five different states: normal, large, small, stout, and thin. The design of the man, however, would remain the same. He would still be the same individual. Similarly with type, a new design must not comprise anything that is merely an enlarging, a diminishing, a broadening, a lengthening, or even a distorting of some already-known form; although another kind of optical device may be imagined giving the effect known generally as shearing and showing a sloping figure for a vertical one, which in type is known as italic, even this alteration is not sufficient to produce change in the design. Nor can a new design be produced by the mere removal of some portion of a letter, and the substitution of another portion, from a type form already known, for the portion removed.

A new design in type must present an actual and demonstrable difference of outline and change when compared with any of the existing forms of type, or indeed, of any existing forms of portions of type. New design must mean an essential change in the structure of the character, and an essential change in its outline, so as to produce not only a different form and effect for the eye, but also an altogether different set of proportional measurements.

The standard type forms, apart from sans serif, fall under less than a dozen heads, depending upon the shape, position, and relative dimension of the serif, and the means by which the serif itself is joined to the strokes. Outside of these, practically only freak faces are formed, and with freak faces the authors are not dealing here. The likenesses in two apparently different faces of type are often not immediately apparent to one who has not made a study of the matter.

Two pages of type set up from two founts might appear different to the ordinary observer, and yet from the point of view of the designer the individual letters might be identical, the characteristics causing the change of appearance to the reader having no place in the question of type design.

The authors have themselves produced what have been and would still be called original faces, but, for their part, they have never attempted to register them, as with their present knowledge of type faces they cannot honestly declare that anything they have ever done in this matter has been truly original. A merciless analysis has shown these designs to have merely been the unconscious adaptation or combination of some already-existing, if not well-known, designs.

What frequently comes under the head of new design in typefounders' catalogues and circulars is simply a compilation from and variation in dimension of existing originals, by which an apparent or temporary novelty or improvement is brought about to meet the taste of the day.

The form of each character in a fount of type can only vary between those limits outside of which the individual character ceases to be recognizable: the impression formed by the same type under different conditions of printing varies by a relatively large amount; recognizable differences of thickness of line, of ratio of height to length of line, of position and even of curve of line are therefore numerically limited, and although the total number of forms which can be produced of any individual character will be expressed by the product of these finite numbers, yet the total of such forms will not in general exceed the total number of forms which have already been produced, as an enormous number of varieties have been created in the past four and a half centuries.

Moreover, in a series of type faces of different body-sizes, it has been customary to alter the proportions of height to width, and of relative thickness of stroke, so that the field covered by the various faces forming any particular series is enlarged, and the chance of producing a really original character is reduced still further. Hence it frequently happens that the difference of form which is found between the same character in different body-sizes of the same series is greater than that which is found in characters from two different series.

Seeing that type of the latin character have been cast for at least four and a half centuries, in thousands of complete founts, and in millions of individual characters, and that probably every possible variety of standard face and form of letter has been produced, so far as type design is concerned, modern type-designing is not and cannot be new and original type-designing, and careful consideration of the factors of the case is bound to lead any unprejudiced person to the same conclusion.

The authors believe that this question has never been fought and decided in a court of law.

CHAPTER IX.

SERIES, PROPORTIONS, AND WEIGHT.

"Brethren in Types be of different Bodies even as among Men brothers of one Family are of different bigness; Yet by their Faces may ye tell them together or apart even as Twins for Likeness of feature, though Bone be lesser and the Bulk ne so Grosse."

Mirrour of Pryntyng.

10-point cheltenham old-style italic (American Type Founders Co.).

Series.—Founts of different bodies but of faces made to appear similar are said to form a series. A fount of a small body generally has a greater a-z length than a large-body fount of the same series.

At present there is no uniformity in the set widths of the various faces, but it should be possible to cover all requirements by the adoption of a strengthened modern face in three widths, namely: extended, standard, and condensed, each bearing a definite ratio to the other. The only convenient unit for gauging whether type is extended, standard, or condensed, is by the measure of the alphabet, a–z, in ems. By em is meant the size of the em-quad; the total set of the alphabet is consequently expressed as a multiple of the body. In making such comparisons, however, it must be noted that it is only possible to compare founts of the same body and style by this measure.

It has been the custom of typefounders to have the punches cut so that the size of the small sorts is made larger than the truly proportionate size as the body diminishes, the length of the ascenders and descenders being correspondingly altered. If reference is made to the figures in tables 12 to 23, pp. 128–129, *et seq.*, it is seen that nearly all the vowels and most of the more frequently-occurring consonants are small sorts, and this is not only the case in English, but also in the languages of the other countries in which typefounding has been longest established, namely, in Germany, Holland, France, and America. In the English language in 10,000 lower-case characters there are on the average 5830 small sorts; but only 3510 ascenders and 620 descenders, and 40 characters which both ascend and descend. It is the influence of the greater number of the small sorts and the adoption of as large a size as possible for the small sorts, in order to obtain legibility, which is responsible for this change of shape as the size of the face is reduced, and for the descenders being more shortened in proportion than the ascenders.

Series of type faces.—The minimum width usually permissible for the hair-line in modern faces is 0·002 inch; owing to the enlargement of the small sorts and to the fact that the hair-line is the minimum width of line which will give a good impression, it is not possible to use the same model or former upon a punch-cutting machine for a large range of reduction, but, in order that the type may appear similar, other formers must be provided of the proper proportions. It will be found in practice that the same formers can be used for pica, small pica, and long primer; a second set is often required for bourgeois, brevier, and minion; and a third set for nonpareil and ruby. In some cases one set is used for faces from 12-point, or pica, to 8-point, or brevier, with a second set for 7-point, or minion, to $5\frac{1}{4}$-point, or ruby. Larger body-sizes up to 36-point are usually cut from the same formers as the 12-point; the difference of form being more marked the smaller the body-size becomes.

A *former* is the enlarged model of the character to be produced upon the punch-cutting machine, and is described later on in the chapter on punch-cutting.

When three sets of formers are used, the set widths of the second set of formers are from 8 to 10 per cent greater than those of the first, and the set widths of the third set from 16 to 20 per cent greater than those of the first. When only two sets are used, the widths of the second set are from 10 to 15 per cent greater than those of the first.

The relative appearance of the characters produced from three sets of formers is shown in fig. 120.

The a–z length for a standard face in pica is about $12\frac{1}{2}$ to 13 ems, in brevier about $13\frac{3}{4}$ to $14\frac{1}{2}$ ems, and in nonpareil about 15 to $15\frac{2}{3}$ ems.

Owing to different characters being affected by differences in set width, an old-style face having its a–z length equal to 13 ems will average nearly the same length as a modern face of $12\frac{1}{2}$ ems. (See foot of tables 7 and 8, pp. 72 and 73.)

Family.—When a number of series of type faces have common peculiarities, and differ only for the same body by increase or decrease of set and by thickening or thinning of the lines, they are said to belong to the same family. A well-known example of a type family, of American origin, is the cheltenham, which comprises the cheltenham old-style, cheltenham bold, cheltenham wide, and cheltenham bold expanded series.

Line.—The line, on which the lower serifs of the lower-case **m** or capital **H** stand, was usually placed in a haphazard position relatively to the back and front of the type. Consequently different founts of the same body seldom lined alike, a fact which can be readily verified from the irregular appearance of sixteenth and seventeenth century printing, where much italic was used in conjunction with roman, with the result that even when the roman and the italic occurred together, their lines were differently positioned.

For a long time it has been recognized that standardization of the line

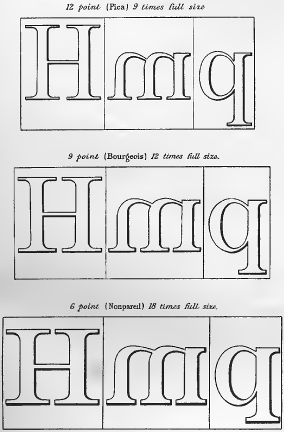


FIG. 120.—*Type series.*

was desirable, and this important improvement has for some time past been accepted and used in the United States. The American practice has been adopted in several of the English foundries, though it is to be regretted that it has not yet come into universal use, and that the standard line adopted in this country, while accepting the point as the unit, has not conformed in detail throughout to the American standard.

Two forms of standard line are in use: *common line* which applies to all ordinary founts, and *title line* which relates to founts consisting entirely of capitals and other signs without any descending portions, usually known as *lining series*.

A comparison of the American and English lines is made in table 10, in which the position of the line is given as beard or distance of line-to-front. The line-to-back, which is the dimension generally used when

TABLE 10.

Amount of beard expressed in points.

Type body.	American common line.	American point title line.	S. B. & Co. point common line.	S. B. & Co. point title line.	Type body.	American common line.	American point title line.	S. B. & Co. point common line.	S. B. & Co. point title line.
5	1	1	1	1	18	4	1	4	2
6	1	1	1	1	20	4	1	4	2
7	2	1	2	1	24	5	1	5	2
8	2	1	2	1	30	7	1	6	3
9	2	1	2	1	36	8	1	7	3
10	2	1	2	1	42	8	1	8	3
11	3	1	3	1	48	8	1	10	3
12	3	1	3	1	54	8	1	11	—
14	3	2	3	1	60	8	7	12	4
16	3	1	3	1	72	14	—	14	4

designing type faces, can, of course, be obtained by subtracting the number of points in the beard from those in the body-size.

The fact that the line does not always occupy the same relative position in type of different bodies leads to some difficulty in so designing faces that they can be reduced proportionately for different bodies. It is also necessary that when they are placed upon those bodies they shall not kern at the top or bottom, or, as some founders would say, "shall not beard." It is necessary, in fact, that they should do more than this and leave an adequate amount of wall at the front and back.

In Germany the standard line of type has been laid down in accordance with the decisions of the commission appointed by the *Deutscher Buch-*

drucker-Verein and by the *Verein deutscher Schriftgiessereien*, Leipzig, 14 September, 1905, as follows :—

TABLE 11.

Position of the standard line in German type, in Didot points.

Body.	Line-to-back.	Line-to-front.	Gauge of capital H.	Back wall of capital H.	Difference of gauge of capitals
4	3·1	0·9	3·0	0·1	0·6
5	4·1	0·9	3·6	0·5	0·8
6	4·6	1·4	4·4	0·2	0·5
7	5·1	1·9	4·9	0·2	0·9
8	6·1	1·9	5·8	0·3	1·0
9	7·1	1·9	6·8	0·3	0·6
10	7·6	2·4	7·4	0·2	0·0
Gr. 10	8·1	1·9	7·4	0·7	1·2
12	9·1	2·9	8·6	0·5	1·2
14	11·1	2·9	9·8	1·3	1·8
16	12·1	3·9	11·6	0·5	1·5
18	14·1	3·9	13·1	1·0	1·5
20	16·1	3·9	14·6	1·5	2·0
24	18·1	5·9	16·6	1·5	4·5
28	22·1	5·9	21·1	1·0	2·0
32	24·1	7·9	23·1	1·0	4·0
36	28·1	7·9	27·1	1·0	4·0
42	32·1	9·9	31·1	1·0	3·8
48	36·1	11·9	34·9	1·2	5·7
54	42·1	11·9	40·6	1·5	4·0
60	46·1	13·9	44·6	1·5	4·0
66	50·1	15·9	48·6	1·5	4·0
72	54·1	17·9	52·6	1·5	10·0
84	64·1	19·9	62·2	1·5	8·0
96	72·1	23·9	70·6	1·5	10·0
108	83·1	24·9	80·6	2·5	9·0
120	92·1	27·9	89·6	2·5	10·0
132	102·1	29·9	99·9	2·5	9·0
144	111·1	32·9	108·6	2·5	

In this arrangement it was proposed to obtain exact agreement of the line in the various body-sizes by the addition of one or more quarter-*Petit* (*corps* 2) leads. Apparently a difficulty of considerable magnitude must have influenced the decision as to the position of the line which is uniformly 0·1 Didot point low to the nearest unit position, or half unit in two cases. In English measure this is only 0·0015 inch or about double the tolerance allowable in the alinement of a character. The German authorities have, however, appreciated that the successive difference of position of the line is of greater importance than the position of the datum.

In the process for making formers, patented by the authors, special provision has been made for securing the necessary clearances on all the bodies comprised within the range which the former, or model, is destined to cover. This matter is fully dealt with in the chapter on punch-cutting.

The advantage of the standard line is particularly apparent in those faces known in the trade as lining and titling. These faces, which generally have no lower-case, are frequently used together to obtain effects similar to those usually produced by the mixture of lower-case and capitals. An example of this convenient alinement is given in fig. 121.

FIG. 121.—*Point title line of letters.*

7-point to 30-point.

Proportions.—Type is usually supplied according to a *bill of fount*, or *fount scheme*, which determines the proportion each character bears to the whole. In some cases the order is for a certain total weight of type and this is translated by the typefounder into a bill of so many m's. In this case it is the lower-case **m** which is taken as the standard of demand, and the bill is for 3000 or 5000, etc., m's; for this reason the lower-case **m** is placed first in the bill. The spaces and quads are usually reckoned separately from the characters. For many of the problems which arise, in the design of typecasting and composing machinery, it is necessary to consider the total number either of type or of type and spaces together.

The authors have calculated tables 12 and 13, pp. 128 to 131, which show the number of each character in a million type either *exclusive* of or *inclusive* of spaces and quads up to the em quad. Although these proportions are followed very closely in making up an order, the trade recognize the possibility of irregularity in the demand; for example, directories and voters' lists require an abnormally large supply of capitals and small capitals, while almanacs and some scientific works require an excessive quantity of figures. Thus it may happen that printers occasionally require abnormal quantities of some particular character, of capitals, of small capitals, or of figures. By the custom of the trade the printer is entitled to be supplied with sorts or imperfections at the same rate as paid for the fount, provided these are ordered within three months of the date on which the fount was supplied.

In the above-mentioned tables the authors have given the proportions generally supplied by typefounders to printers using the English language. The proportions for other languages are, of course, different in each case.

Table 14, pp. 132 and 133, gives a bill of 100,000 type, exclusive of spaces and quads, for Welsh.

It will be noticed that the quantity of lower-case **d** is nearly double that in the corresponding English scheme, while the lower-case **l** has a frequency more than two and a half times as great as in English ; so also have the lower-case **w** and y. The greater frequency of occurrence of these letters compensates for the small quantity of the lower-case **o**, of which only one-half the number required for the English fount bill is provided.

The bill of fount for French type gives proportions very different from those of the English bill. The bill shown in table 15, pp. 134 and 135 (based on that of M. Rignoux), will probably be found useful. It is not usual to include italic unless specified ; when italic is supplied it is usually in the ratio to roman of about 1 to 6. The authors have taken 15 per cent. The quantities, for a fount of roman only, can be obtained by summing those given for roman and italic.

The superiors are used for abbreviations, such as :—

M$^{\text{gr}}$ *Monseigneur*, C$^{\text{ie}}$ *Compagnie*, N$^{\text{os}}$ *Numéros*, etc.

It is the custom of the trade to supply only É È Ê in capitals, small capitals, and italic capitals, but in this bill the authors have included the other accented capitals which may be called for.

The supplementary nick, used for distinguishing the small capitals **O S V W X Z** and **I** in old-style, is also used in France.

There are certain differences between some of the characters as usually cut in France and those cut in England ; for example, the capital **C** has cat's-ears at the top and bottom (**C**), while in England they occur at the top only ; also a French fount comprises a sign for inverted commas « *le guillemet* » not used in England. The triple ligatures **ffi** and **ffl** are now scarcely ever used (see chapter X) outside the English-speaking countries.

The German fount scheme presents considerable difference, according as the *Fraktur*, table 16, p. 136, or the ordinary roman (*Antiqua*), table 17, p. 137, style of character is used, one reason for this being the large number of ligatures in general use in *Fraktur* ; these account for two letters each, so that the *Fraktur* scheme for 100,000 characters, or strictly speaking for 100,000 type, includes some 5,600 more letters than does the roman scheme.

The bills of fount of Italian, table 18, p. 138, and of Spanish, table 19, p. 139, as well as that of Bohemian, table 20, p. 140, call for no special comment, but the fount scheme for Greek, table 21, p. 141, is remarkable for the very large number of accents required and for the provision which must necessarily be made for adding these accents as loose type above certain characters, which must be cast on a smaller body as indicated in the scheme.

In the case of Russian, the italic face is generally treated as a separate fount, and accordingly both the roman, table 22, p. 142, and the italic, table 23, p. 143, have been given independently.

The Hebrew bill of fount as shown in table 24, p. 143, gives only the ordinary characters and does not take into account the numerous point combinations which would make a complete scheme nearly as complex as that for Greek. A great deal of news and other matter in Yiddish is set without these points and in this form its difficulty to the reader resembles that of shorthand written without the vowels.

TABLE 12 (*continued on opposite page*).

Bill of 1,000,000 *type,* EXCLUSIVE *of spaces and quads.* (*England.*)

Roman lower-case.		Roman small capitals.		Roman capitals.		Roman figures, fractions and points.		Roman accents.	
m	16,780	A	2,510	A	3,900	1	3,900	á	250
a	50,330	B	1,510	B	2,510	2	3,350	à	1,200
b	11,180	C	1,960	C	2,800	3	3,350	â	600
c	22,370	D	1,960	D	3,070	4	2,800	ä	250
d	27,960	E	2,510	E	4,200	5	2,800	ã	200
e	78,300	F	1,680	F	2,510	6	2,800	ç	250
f	16,780	G	1,510	G	2,510	7	2,800	é	1,200
g	11,180	H	1,680	H	2,510	8	2,800	è	600
h	33,550	I	2,510	I	5,020	9	2,800	ê	400
i	50,300	J	1,120	J	1,680	0	3,900	ë	600
j	2,800	K	1,120	K	1,680	½	840	í	250
k	4,470	L	1,680	L	3,070	¼	840	ì	250
l	27,960	M	1,680	M	3,630	¾	840	î	250
n	44,740	N	1,960	N	3,070	⅓	280	ï	250
o	44,700	O	1,960	O	3,070	⅔	280	ñ	200
p	13,420	P	1,510	P	2,800	⅛	280	ó	250
q	3,360	Q	670	Q	1,120	⅜	280	ò	250
r	39,150	R	1,850	R	2,800	⅝	280	ô	300
s	44,740	S	1,960	S	3,320	⅞	280	ö	300
t	55,930	T	2,350	T	4,440	.	16,780	ú	250
u	25,170	U	1,340	U	2,000	,	25,170	ù	250
v	8,390	V	1,120	V	2,000	;	4,470	û	300
w	13,980	W	1,510	W	3,070	:	3,350	ü	300
x	2,800	X	670	X	1,120	-	5,600	ẃ	200
y	13,980	Y	1,120	Y	2,000	'	4,470	ŵ	200
z	1,680	Z	670	Z	840	!	1,120	Ç	50
æ	1,120	Æ	330	Æ	560	?	1,680		
œ	560	Œ	330	Œ	560	(	2,240		
ff	2,240	&	1,120	&	1,680	[	1,120		
fi	2,800								
fl	1,680								
ffi	1,680								
ffl	1,120								
Total 677,200		Total 43,900		Total 73,540		Total 101,500		Total 9,400	

Total number of sorts 275.

TABLE 12 (*concluded from opposite page*).

Bill of 1,000,000 *type*, EXCLUSIVE *of spaces and quads.* (*England.*)

Peculiars and commercial signs.		Italic lower-case.		Italic capitals.		Italic accents.		Italic figures and points.	
*	1,400	*a*	5,030	*A*	390	*á*	25	*1*	390
†	560	*b*	1,120	*B*	250	*à*	120	*2*	330
‡	560	*c*	2,240	*C*	280	*â*	65	*3*	330
‖	560	*d*	2,800	*D*	310	*ä*	25	*4*	280
§	560	*e*	7,830	*E*	420	*ã*	20	*5*	280
¶	370	*f*	1,680	*F*	250	*ç*	25	*6*	280
⌐	280	*g*	1,120	*G*	250	*é*	120	*7*	280
‿	280	*h*	3,350	*H*	250	*è*	50	*8*	280
¬	280	*i*	5,030	*I*	500	*ê*	40	*9*	280
–	560	*j*	280	*J*	170	*ë*	65	*0*	390
—	2,800	*k*	450	*K*	170	*í*	25	*;*	450
…	560	*l*	2,800	*L*	310	*ì*	25	*:*	350
@	280	*m*	1,680	*M*	360	*î*	25	*!*	110
⅌	280	*n*	4,470	*N*	310	*ï*	25	*?*	170
℔	280	*o*	4,470	*O*	310	*ñ*	20	*)*	220
£	1,120	*p*	1,340	*P*	280	*ó*	25	*]*	110
$	560	*q*	340	*Q*	110	*ò*	25		
%	560	*r*	3,910	*R*	280	*ô*	30	Total 4,530	
/	560	*s*	4,470	*S*	330	*ö*	30		
+	280	*t*	5,590	*T*	440	*ú*	25	Totals.	
—	280	*u*	2,510	*U*	200	*ù*	25	R. l. c.	677,200
×	280	*v*	840	*V*	200	*û*	30	R. s.c.	43,900
÷	280	*w*	1,400	*W*	310	*ü*	30	R. c.	73,540
=	280	*x*	280	*X*	110	*ẅ*	20	R. figs. & pts.	101,500
		y	1,400	*Y*	200	*ŵ*	20	R. accs.	9,400
		z	170	*Z*	80	*Ç*	5	Pec. & coml.	13,810
		æ	110	*Æ*	55			Ital. l.c.	67,720
		œ	60	*Œ*	55			Ital. c.	7,460
		ff	220	*&*	170			Ital. accs.	940
		fi	280	*£*	110			Ital. figs. & pts.	4,530
		fl	170						
		ffi	170						
		ffl	110						
Total 13,810		Total 67,720		Total 7,460		Total 940		Grand total 1,000,000	

TABLE 13 (*continued on opposite page*).

Bill of 1,000,000 *type*, INCLUSIVE *of spaces and quads.* (*England.*)

Roman lower-case.		Roman small capitals.		Roman capitals.		Roman figures, fractions and points.		Roman accents.	
m	13,230	A	1,990	A	3,000	1	3,110	á	200
a	39,700	B	1,190	B	1,980	2	2,640	à	950
b	8,820	C	1,540	C	2,420	3	2,640	â	470
c	17,630	D	1,540	D	2,420	4	2,200	ä	200
d	22,040	E	1,990	E	3,300	5	2,200	ã	160
e	61,710	F	1,320	F	1,980	6	2,200	ç	200
f	13,230	G	1,190	G	1,980	7	2,200	é	950
g	8,820	H	1,320	H	1,980	8	2,200	è	470
h	26,450	I	1,990	I	3,960	9	2,200	ê	300
i	39,680	J	880	J	1,320	0	3,110	ë	470
j	2,200	K	880	K	1,320	½	660	í	200
k	3,530	L	1,320	L	2,420	¼	660	ì	200
l	22,040	M	1,320	M	2,840	¾	660	î	200
n	35,300	N	1,540	N	2,420	⅓	220	ï	200
o	35,270	O	1,540	O	2,420	⅔	220	ñ	160
p	10,580	P	1,190	P	2,200	⅛	220	ó	200
q	2,640	Q	530	Q	880	⅜	220	ò	200
r	30,860	R	1,460	R	2,200	⅝	220	ô	230
s	35,270	S	1,540	S	2,640	⅞	220	ö	230
t	44,090	T	1,860	T	3,520	.	13,230	ú	200
u	19,840	U	1,070	U	1,540	,	19,840	ù	200
v	6,610	V	880	V	1,540	;	3,530	û	230
w	11,020	W	1,190	W	2,420	:	2,650	ü	230
x	2,200	X	530	Z	880	-	4,410	ẃ	160
y	11,020	Y	880	Y	1,540	'	3,530	ŵ	160
z	1,320	Z	530	Z	660	!	880	Ç	40
æ	880	Æ	260	Æ	440	?	1,320		
œ	440	Œ	260	Œ	440	(	1,760		
ff	1,760	&	880	&	1,320	[	880		
fi	2,200								
fl	1,320								
ffi	1,320								
ffl	880								
Total 533,900		Total 34,610		Total 57,980		Total 80,030		Total 7,410	

Total number of sorts, including spaces up to the em quad, 281.

TABLE 13 (*concluded from opposite page*).

Bill of 1,000,000 *type*, INCLUSIVE *of spaces and quads*. (*England*.)

Peculiars and commercial signs.	
*	1,110
†	440
‡	440
‖	440
§	440
¶	300
⌐	220
‿	220
¬	220
–	440
—	2,220
…	440
@	220
℔	220
lb	220
£	880
$	440
%	440
/	440
+	220
—	220
×	220
÷	220
=	220
Total 10,890	

Spaces.	
Hair	13,230
Thin	35,270
Middle	35,270
Thick	88,150
En quad	26,450
Em quad	13,230
Total 211,600	

Italic lower-case.	
a	3,970
b	880
c	1,760
d	2,200
e	6,170
f	1,320
g	880
h	2,650
i	3,970
j	220
k	350
l	2,200
m	1,320
n	3,530
o	3,530
p	1,060
q	260
r	3,090
s	3,530
t	4,410
u	1,990
v	660
w	1,100
x	220
y	1,100
z	130
æ	90
œ	50
ff	180
fi	220
fl	130
ffi	130
ffl	90
Total 53,390	

Italic capitals.	
A	300
B	200
C	240
D	240
E	330
F	200
G	200
H	200
I	400
J	130
K	130
L	240
M	280
N	240
O	240
P	220
Q	90
R	220
S	260
T	350
U	155
V	155
W	240
X	90
Y	155
Z	65
Æ	45
Œ	45
&	130
£	90
Total 5,880	

Italic accents.	
á	20
à	90
â	50
ä	20
ã	15
ç	20
é	90
è	40
ê	35
ë	50
í	20
ì	20
î	20
ï	20
ñ	15
ó	20
ò	20
ô	25
ö	25
ú	20
ù	20
û	25
ü	25
ẃ	15
ŵ	15
Ç	5
Total 740	

Italic figures and points.	
1	310
2	260
3	260
4	220
5	220
6	220
7	220
8	220
9	220
0	310
;	360
:	260
!	90
?	130
(	180
[	90
Total 3,570	

Totals.	
R. l.c.	533,900
R. s.c.	34,610
R. c.	57,980
R. figs. & pts.	80,030
R. accs.	7,410
Pec. & coml.	10,890
Spaces	211,600
Ital.	53,390
Ital. c.	5,880
Ital. accs.	740
It. figs. & pts.	3,570
Grand total	1,000,000

TABLE 14 (*continued on opposite page*).

Welsh bill of fount for 100,000 *characters*, EXCLUSIVE *of spaces and quads.*

Roman lower-case.		Roman small capitals.		Roman capitals.		Roman figures, fractions and points.	
m	1,500	A	225	A	350	1	350
a	4,500	B	135	B	225	2	300
b	2,000	C	175	C	600	3	250
c	2,000	D	175	D	550	4	250
d	5,100	E	225	E	375	5	250
e	3,500	F	150	F	225	6	250
f	1,500	G	135	G	450	7	250
g	2,000	H	150	H	225	8	250
h	1,500	I	225	I	450	9	250
i	4,500	J	100	J	300	0	350
j	125	K	100	K	150	½	70
k	200	L	150	L	275	¼	70
l	7,700	M	150	M	650	¾	70
n	2,000	N	175	N	275	⅓	35
o	2,000	O	175	O	275	⅔	35
p	2,400	P	135	P	225	⅛	35
q	300	Q	60	Q	100	⅜	35
r	7,300	R	165	R	250	⅝	35
s	4,000	S	175	S	300	⅞	35
t	2,500	T	210	T	400	⅙	35
u	2,250	U	120	U	175	.	1,500
v	750	V	100	V	175	,	2,300
w	3,950	W	135	W	275	;	400
x	250	X	60	X	100	:	300
y	3,950	Y	150	Y	175	-	500
z	150	Z	60	Z	80	'	400
æ	100	Æ	30	Æ	50	!	110
œ	50	Œ	30	Œ	50	?	150
ff	200			&	150	(	200
fi	250					[	100
fl	150						
ffi	150						
ffl	150						
Total 68,975		Total 3,875		Total 7,880		Total 9,165	

Total number of sorts 253.

TABLE 14 (*concluded from opposite page*).

Welsh bill of fount for 100,000 characters, EXCLUSIVE *of spaces and quads.*

Accents: roman		Peculiars and commercial signs.		Italic lower-case.		Italic capitals.		Italic figures and points.	
Lower-case.									
ẃ	100	*	125	*a*	450	*A*	35	*1*	35
ẁ	100	†	50	*b*	200	*B*	20	*2*	30
ŵ	100	‡	50	*c*	200	*C*	60	*3*	25
ý	100	‖	50	*d*	510	*D*	55	*4*	25
ỳ	100	§	50	*e*	350	*E*	35	*5*	25
ŷ	100	¶	35	*f*	150	*F*	20	*6*	25
Capitals.		⌐	25	*g*	200	*G*	45	*7*	25
Ẃ	15	⁀	25	*h*	150	*H*	20	*8*	25
Ẁ	15	¬	25	*i*	450	*I*	45	*9*	25
Ŵ	15	–	50	*j*	10	*J*	30	*0*	35
Ý	15	—	250	*k*	20	*K*	15	*;*	40
Ỳ	15	…	50	*l*	770	*L*	25	*:*	30
Ŷ	15	@	25	*m*	150	*M*	65	*!*	10
Sm. Caps.		℔	25	*n*	200	*N*	25	*?*	15
ẃ	5	lb	25	*o*	200	*O*	25	*(*	20
ẁ	5	£	100	*p*	240	*P*	20	*[*	10
ŵ	5	$	50	*q*	30	*Q*	10		
ý	5	%	50	*r*	730	*R*	25	Total 400	
ỳ	5	/	50	*s*	400	*S*	30		
ŷ	5	+	25	*t*	250	*T*	40	R. l.c.	68,975
Italic.		−	25	*u*	225	*U*	15	R. s.c.	3,875
ẃ	10	×	25	*v*	75	*V*	15	R. c.	7,880
ẁ	10	÷	25	*w*	395	*W*	25	R. f. & p.	9,165
ŵ	10	=	25	*x*	25	*X*	10	Accs.	810
ý	10			*y*	395	*Y*	15	Pec. com.	1,235
ỳ	10			*z*	15	*Z*	5	Ital. l.c.	6,895
ŷ	10			*æ*	10	*Æ*	5	Ital. c.	765
Ẃ	5			*œ*	5	*Œ*	5	It. f. & p.	400
Ẁ	5			*ff*	20	*&*	15		
Ŵ	5			*fi*	25	*£*	10		
Ý	5			*fl*	15				
Ỳ	5			*ffi*	15				
Ŷ	5			*ffl*	15				
Total 810		Total 1,235		Total 6,895		Total 765		Grand total 100,000	

TABLE 15 (*continued on opposite page*).

French bill of fount for 100,000 *characters*, EXCLUSIVE *of spaces and quads.*
(Police de 100,000 caractères, les espaces et cadratins non compris.)

Bas de casse.

a	4,220
b	845
c	2,110
ç	90
d	2,510
e	9,250
f	845
g	845
h	845
i	4,630
j	420
k	80
l	3,820
m	2,110
n	4,220
o	3,820
p	1,720
q	1,010
r	4,630
s	5,540
t	4,630
u	4,220
v	845
x	420
y	260
z	260
æ	40
œ	80
w	40
ff	160
fi	300
fl	210
32	65,025

Ponctuations.

.	1,500
,	1,800
;	250
:	170
?	170
!	170
6	4,060
Signes.	
-	950
'	950
»	300
*	40
†	40
(	130
[	40
§	40
—	260
9	2,750
Bas de casse accents.	
à	380
â	210
ä	40
é	1,250
è	380
ê	260
ë	40
î	125
ï	40
ô	125
ö	40
ù	210
û	125
ü	40
14	3,265

Capitales.

A	260
B	125
C	210
Ç	20
D	210
E	380
F	125
G	125
H	125
I	260
J	80
K	20
L	260
M	170
N	210
O	260
P	170
Q	125
R	260
S	260
T	260
U	210
V	170
X	65
Y	40
Z	40
Æ	20
Œ	20
W	20
&	125
30	4,625

Petites capitales.

A	170
B	80
C	125
Ç	20
D	170
E	300
F	80
G	80
H	80
I	210
J	80
K	20
L	170
M	125
N	170
O	170
P	125
Q	80
R	170
S	170
T	170
U	150
V	110
X	65
Y	40
Z	40
Æ	20
Œ	20
W	20
&	80
30	3,310

Capitales accents.

À	65
Â	35
É	80
È	65
Ê	20
Î	15
Ô	15
Ù	35
Û	15
9	345
Petites capitales accents.	
À	40
Â	20
É	65
È	50
Ê	25
Î	10
Ô	10
Ù	20
Û	10
9	250
Ital. capitales accents.	
À	15
Â	10
É	20
È	15
Ê	10
Î	5
Ô	5
Ù	10
Û	5
9	95

Total number of sorts 259.

TABLE 15 (*concluded from opposite page*).

French bill of fount for 100,000 characters, EXCLUSIVE *of spaces and quads.*
(Police de 100,000 caractères, les espaces et cadratins non compris.)

Supérieures.	
d	100
e	200
g	100
i	100
l	150
m	100
n	100
o	200
r	150
s	100
t	100
11	1,400

Chiffres.	
1	400
2	300
3	250
4	250
5	400
6	250
7	250
8	250
9	250
0	400
10	3,000

Ital. bas de casse.	
a	650
b	125
c	325
ç	20
d	380
e	1,400
f	125
g	125
h	125
i	715
j	65
k	15
l	575
m	325
n	650
o	575
p	260
q	150
r	715
s	840
t	715
u	650
v	125
x	65
y	40
z	40
æ	10
œ	15
w	10
ff	25
fi	45
fl	35
32	9,935

Ital. capitales.	
A	40
B	20
C	35
Ç	5
D	35
E	60
F	20
G	20
H	20
I	40
J	15
K	5
L	40
M	25
N	35
O	40
P	25
Q	20
R	40
S	40
T	40
U	35
V	25
X	10
Y	10
Z	10
Æ	5
Œ	5
W	5
&	20
30	745

Ital. ponctuations.	
;	40
:	25
?	25
!	25
4	115

Ital. bas de casse accents.	
à	55
â	35
ä	10
é	190
è	55
ê	40
ë	10
î	20
ï	10
ô	20
ö	10
ù	35
û	20
ü	10
14	520

Ital. chiffres.	
1	75
2	65
3	45
4	45
5	75
6	45
7	45
8	45
9	45
0	75
10	560

TABLE 16.

German bill of fount for 100,000 *characters* (Fraktur), EXCLUSIVE *of spaces and quads.* (Giesszettel für 100,000 Lettern, Fraktur.)

1. Gemeine.	
m	2,000
a	4,000
b	1,600
c	250
d	4,400
e	12,000
f	1,100
g	2,200
h	1,660
i	5,500
j	300
k	800
l	2,400
n	8,000
o	2,200
p	600
q	150
r	5,500
ꝛ	80
ſ	1,900
s	1,600
t	4,000
u	3,600
v	800
w	1,400
x	120
y	350
z	900
	69,410

2. Ligaturen.	
ch	2,200
ck	250
ſſ	400
ſt	900
ſi	800
ff	250
fi	150
fl	150
ll	400
ß	450
tz	400
ä	600
ö	500
ü	600
	8,050

3. Ziffern.	
1	720
2	640
3	600
4	600
5	600
6	600
7	600
8	600
9	600
0	720
	6,280

4. Versalien.	
A	280
B	280
C	280
D	400
E	400
F	250
G	400
H	400
J	300
K	350
L	280
M	280
N	280
O	280
P	280
Q	80
R	400
S	400
T	280
U	240
V	280
W	320
X	80
Y	80
Z	200
Ä	80
Ö	80
Ü	80
	7,340

5. Punkturen.	
.	2,000
,	2,800
=	1,440
:	280
;	280
!	200
?	200
'	240
"	400
(	240
[	120
§	80
*	160
†	80
—	400
	8,920
1	69,410
2	8,050
3	6,280
4	7,340
5	8,920
	100,000

Total number of sorts 95.

TABLE 17.

German bill of fount for 100,000 *characters* (Antiqua), EXCLUSIVE *of spaces and quads.* (Giesszettel für 100,000 Lettern, deutsche Antiqua.)

1. Gemeine.		2. Lig. und Akzente.		3. Versalien.		4. Versalien Akzente.		6. Punkturen.	
m	1,900	&	60	A	240	Ä	40	.	2,000
a	3,800	ff	300	B	240	Ç	20	,	2,800
b	1,500	fi	200	C	240	É	20	-	1,440
c	2,500	fl	200	D	380	È	20	:	280
d	4,200	á	20	E	380	Ê	20	;	280
e	11,500	à	120	F	240	Ô	10	!	200
f	1,000	â	40	G	380	Ö	40	?	200
g	2,300	ä	600	H	380	Ù	10	'	240
h	3,800	ç	40	I	300	Û	10	»	400
i	5,300	é	120	J	200	Ü	40	(	240
j	300	è	60	K	300			[	120
k	800	ê	40	L	240			§	80
l	2,600	ë	40	M	240		230	*	160
n	8,000	í	20	N	240			†	80
o	2,300	ì	20	O	240			—	400
p	600	î	40	P	240				
q	300	ï	40	Q	60				8,920
r	5,200	ñ	20	R	380	5. Ziffern.			
s	5,200	ó	20	S	380	1	720		
t	4,500	ò	20	T	240	2	640		
u	3,400	ô	40	U	240	3	600		
v	700	ö	500	V	240	4	600		
w	1,300	ú	20	W	300	5	600	1.	74,600
x	300	ù	40	X	60	6	600	2.	3,310
y	350	û	40	Y	60	7	600	3.	6,660
z	900	ü	650	Z	200	8	600	4.	230
æ	25			Æ	10	9	600	5.	6,280
œ	25			Œ	10	0	720	6.	8,920
	74,600		3,310		6,660		6,280		100,000

Total number of sorts 117.

TABLE 18.

Italian bill of fount for 100,000 *characters,* EXCLUSIVE *of spaces and quads.*

1. Lower-case.		2. Capitals.		3. Sm. caps.		4. Points.		6. Accents, etc.	
m	1,700	A	300	A	150	.	1,200	&	100
a	7,550	B	160	B	80	,	1,200	ff	200
b	1,400	C	200	C	100	-	750	fi	400
c	3,200	D	200	D	100	:	200	fl	200
d	2,800	E	300	E	150	;	200	à	400
e	7,750	F	150	F	75	!	100	è	500
f	950	G	150	G	75	?	100	ì	200
g	1,400	H	100	H	50	'	1,200	ò	400
h	1,000	I	480	I	240	)	600	ù	350
i	7,900	J	60	J	30	(	400	À	40
j	200	K	60	K	30	*	100	È	60
k	300	L	300	L	150	†	100	Ì	40
l	5,750	M	180	M	90	—	300	Ò	40
n	4,900	N	200	N	100		6,450	Ù	40
o	6,750	O	360	O	180			À	20
p	2,700	P	180	P	90			È	30
q	1,000	Q	100	Q	50	5. Figures.		Ì	20
r	4,900	R	240	R	120	1	450	Ò	20
s	4,800	S	240	S	120	2	450	Ù	20
t	5,250	T	240	T	120	3	400		3,080
u	2,900	U	180	U	90	4	400	1.	78,700
v	1,800	V	200	V	100	5	400	2.	5,080
w	200	W	60	W	30	6	400	3.	2,540
x	300	X	200	X	100	7	400	4.	6,450
y	200	Y	40	Y	20	8	400	5.	4,150
z	1,100	Z	200	Z	100	9	400	6.	3,080
						0	450		
	78,700		5,080		2,540		4,150		100,000

Total number of sorts 120.

TABLE 19.

Spanish bill of fount for 100,000 *characters*, EXCLUSIVE *of spaces and quads.*

1. Lower-case.		2. Capitals.		3. Sm. caps.		4. Points.		6. Accents, etc.	
m	1,840	A	430	A	430	.	2,700	&	100
a	5,550	B	280	B	280	,	2,700	ff	70
b	930	C	330	C	370	-	2,140	fi	280
c	2,460	D	520	D	460	:	710	fl	140
d	2,970	E	570	E	570	;	860	á	480
e	7,360	F	280	F	220	!	380	ã	90
f	900	G	280	G	220	?	380	ç	20
g	910	H	140	H	110	'	70	é	430
h	910	I	280	I	330	»	620	í	430
i	5,240	J	160	J	180	(	500	ó	430
j	460	K	70	K	35	=	140	õ	100
k	70	L	360	L	360	*	70	ú	360
l	2,740	M	280	M	280	†	70	ü	100
n	4,140	N	280	N	280	§	70	Á	35
ñ	200	Ñ	100	Ñ	80	—	280	Ç	15
o	4,650	O	380	O	360		11,690	É	35
p	1,570	P	260	P	280	5. Figures.		Í	35
q	1,850	Q	240	Q	240	1	450	Ó	35
r	4,240	R	330	R	360	2	450	Ú	20
s	5,650	S	480	S	380	3	400	Á	35
t	4,100	T	360	T	210	4	400	Ç	15
u	4,860	U	480	U	240	5	400	É	35
v	900	V	430	V	140	6	400	Í	35
x	310	X	240	X	70	7	400	Ó	35
y	580	Y	280	Y	70	8	400	Ú	30
z	280	Z	140	Z	70	9	400	ª	100
w	40	W	35	W	35	0	450	º	100
æ	45	Æ	40	Æ	20				
œ	35	Œ	30	Œ	15				
	65,790		8,085		6,695		4,150		3,590

Total number of sorts 139.

TABLE 20.

Bohemian bill of fount for 100,000 *characters,* EXCLUSIVE *of spaces and quads.*

1. Lower-case.		2. Capitals.		3. Accents.		4. Points.	
m	2,300	A	260	č	900	.	2,600
a	4,500	B	240	ď	170	,	2,400
b	1,520	C	240	ě	1,100	-	850
c	2,200	D	240	ň	150	:	360
d	2,600	E	260	ř	900	;	400
e	4,600	F	220	š	1,050	!	240
f	810	G	100	ť	170	?	180
g	510	H	240	ž	1,050	'	150
h	2,300	I	300	á	1,700	—	360
i	3,750	J	350	é	1,250	«	500
j	2,200	K	240	í	2,400	(	300
k	2,300	L	240	ó	250	[	80
l	3,750	M	270	ú	300	*	150
n	4,600	N	260	ů	600	†	50
o	5,220	O	260	ý	900	§	100
p	1,880	P	370	Č	200		
q	200	Q	60	Ď	30		8,720
r	3,750	R	240	Ě	40		
s	3,950	S	280	Ň	30		
t	4,270	T	240	Ř	100	5. Figures.	
u	3,340	U	220	Š	100	1	450
v	2,920	V	270	Ť	30	2	450
w	300	W	80	Ž	100	3	400
x	150	X	70	Á	70	4	400
y	1,300	Y	80	É	60	5	400
z	1,460	Z	240	Í	80	9	400
ff	250			Ó	50	7	400
fi	150			Ú	80	8	400
fl	150			Ů	30	9	400
&	100			Ý	40	0	450
	67,330		5,870		13,930		4,150

Total number of sorts 111.

TABLE 21.

Greek bill of fount for 100,000 *characters,* EXCLUSIVE *of spaces and quads, with sorts on smaller body marked* °, *for loose accents; loose accents extra to the number of characters.*

1. Lower-case.

α	4,200
α°	2,350
β	1,380
γ	1,120
δ	2,450
ε	4,800
ζ	550
η	1,950
η°	2,100
θ	1,000
ι	3,600
κ	2,350
λ	1,380
μ	2,850
ν	5,200
ξ	400
ο	3,220
ο°	2,100
π	2,150
ρ	2,300
σ	2,150
ς	2,600
τ	4,450
υ	2,250
υ°	2,600
φ	750
χ	920
ψ	320
ω	1,380
ω°	1,380
ϛ	150
ϙ	150
ϡ	150
	66,700

2. Accented sorts.

ᾳ	250
ᾳ°	320
έ	880
ὲ	880
ἑ	770
ἐ	1,100
ἕ	560
ἔ	560
ἓ	80
ἒ	80
ῃ	250
ῃ°	320
ί	1,450
ὶ	1,600
ῖ	1,150
ἱ	700
ἰ	1,150
ἴ	700
ἵ	530
ἳ	160
ἲ	160
ἷ	530
ἶ	530
ΐ	250
ῒ	250
ῗ	120
ϊ	250
ῥ	750
ῤ	250
ῳ	250
ῳ°	320
	17,150

3. Capitals.

Α	350
Α°	200
Β	350
Γ	350
Δ	350
Ε	380
Ε°	120
Ζ	350
Η	350
Η°	120
Θ	350
Ι	400
Ι°	120
Κ	350
Λ	350
Μ	350
Ν	350
Ξ	350
Ο	350
Ο°	120
Π	350
Ρ	350
Ρ°	120
Σ	380
Τ	350
Υ	250
Υ°	120
Φ	350
Χ	300
Ψ	300
Ω	350
Ω°	120
	9,350

4. Points.

.	2,800
,	2,600
-	750
!	200
;	450
	6,800

Totals.

1.	66,700
2.	17,150
3.	9,350
4.	6,800
	100,000

5. Loose accents.

´	3,100
`	2,500
῾	2,000
᾿	2,300
῀	2,100
῞	850
῝	500
῟	800
῎	500
¨	120
΅	120
῭	120
῁	120
῾	560
᾿	560
	16,250

Total number of character sorts on full body 85; of character sorts on small body 16; of loose accent sorts 15. Grand total 116.

TABLE 22.

Russian bill of fount for 100,000 *characters*, EXCLUSIVE *of spaces and quads.*

1. Lower-case.		2. Capitals.	
а	3,900	А	410
б	1,300	Б	250
в	3,800	В	410
г	1,000	Г	250
д	2,100	Д	250
е	6,200	Е	480
ж	700	Ж	210
з	750	З	210
и	3,800	И	250
й	1,200	Й	170
і	850	І	170
к	2,500	К	250
л	3,000	Л	340
м	2,500	М	250
н	6,300	Н	500
о	6,400	О	500
п	2,100	П	250
р	2,500	Р	340
с	3,800	С	340
т	3,800	Т	340
у	1,700	У	210
ф	420	Ф	90
х	680	Х	210
ц	680	Ц	210
ч	1,200	Ч	210
ш	680	Ш	210
щ	550	Щ	170
ъ	3,000	Ъ	250
ы	1,300	Ы	170
ь	1,200	Ь	170
ѣ	1,900	Ѣ	170
э	550	Э	130
ю	680	Ю	170
я	1,500	Я	250
ѳ	130	Ѳ	60
ѵ	80	Ѵ	20
	74,750		8,870

3. Sm. caps.	
А	100
В	70
Е	120
І	40
Р	90
С	90
У	60
Ѣ	40
	610

4. Accents.	
ё	420
Ё	20
Ё	70
	510

5. Figures.	
1	720
2	660
3	600
4	600
5	600
6	600
7	600
8	600
9	600
0	720
	6,300

6. Points.	
.	2,000
,	2,800
;	280
:	280
-	1,440
!	200
?	200
’	240
‘	400
(	240
[	120
*	160
†	80
§	80
—	440
	8,960

Totals.	
1	74,750
2	8,870
3	610
4	510
5	6,300
6	8,960
	100,000

Total number of sorts 108.

TABLE 23.

Russian italic bill of fount for 10,000 *characters,* EXCLUSIVE *of spaces and quads.*

1. Lower-case.

а	400
б	130
в	400
г	100
д	210
е	650
ж	70
з	70
и	380
й	120
і	90
к	250
л	300
м	250
н	630
о	640
п	210
р	250
с	380
т	400
у	170
ф	40
х	70
ц	70
ч	120
ш	70
щ	60
ъ	300
ы	130
ь	120
ѣ	190
э	60
ю	70
я	150
ѳ	20
ѵ	10
	7,580

2. Capitals.

А	45
Б	30
В	45
Г	30
Д	30
Е	50
Ж	25
З	25
И	30
Й	20
І	20
К	30
Л	35
М	30
Н	50
О	30
П	30
Р	30
С	35
Т	35
У	25
Ф	10
Х	25
Ц	25
Ч	25
Ш	25
Щ	20
Ъ	30
Ы	20
Ь	20
Ѣ	20
Э	20
Ю	20
Я	30
Ѳ	10
Ѵ	10
	990

3. Figures.

1	80
2	70
3	60
4	60
5	60
6	60
7	60
8	60
9	60
0	80
	650

4. Points.

.	150
,	170
;	40
:	40
-	150
!	30
?	30
’	30
»	50
)	30
]	20
—	40
	780

Totals.

1	7,580
2	990
3	650
4	780
	10,000

Total number of sorts 94.

TABLE 24.

Hebrew bill of fount, for 100,000 *characters,* EXCLUSIVE *of spaces, quads, and points.*

Name.	Character.	No.
Aleph	א	7,000
Beth	ב	1,950
Gimel	ג	2,100
Daleth	ד	3,140
Hé	ה	7,300
Vau	ו	8,400
Zain	ז	2,100
Cheth	ח	3,500
Teth	ט	1,400
Yod	י	7,700
Caph	כ	5,600
Do., final	ך	1,100
Lamed	ל	7,000
Mem	מ	5,600
Do., final	ם	2,100
Nun	נ	3,500
Do., final	ן	1,670
Samech	ס	1,450
Ain	ע	3,140
Pé	פ	1,400
Do., final	ף	980
Saddi	צ	1,100
Do., final	ץ	770
Koph	ק	1,250
Resch	ר	4,200
Sin / Shin	ש	8,400
Thau	ת	1,950
Accent	׳	2,100
Accent	״	2,100
Total		100,000

Total number of sorts 29.

Weight of type.—Type is generally made up into *pages*, about 8 inches by 4 inches; the weight of a page is usually about 8¼ lb. The weight of 1,000,000 type, exclusive of spaces and quads, in pounds, is given in table 25 for various a–z lengths. The weight of type characters per square inch is approximately 0·26 lb., or 37·5 lb. per sq. ft. The weight of type per sq. in., when composed, cannot be given as a definite figure because in most cases quads, leads, and furniture are used in making up, all of these being of a lower height-to-paper and some of them being cored and consequently of a still less weight per unit of area. The weight of spaces and quads of stereo height is approximately 0·25 lb. per sq. in., or 36 lb. per sq. ft. The weight of spaces and quads of trade height is 0·23 lb. per sq. in. and 33 lb. per sq. ft.

TABLE 25.

Approximate weight of 1,000,000 type in lb., exclusive of spaces and quads.

	Points.	Length a–z in ems.								
Modern	—	8·75	10·00	11·25	12·50	13·75	15·00	16·25	17·50	18·75
Old-style	—	9·10	10·40	11·70	13·00	14·30	15·60	16·90	18·20	19·50
Gt. primer	18	6,050	6,770	7,490	8,210	8,930	9,650	—	—	—
Two-line brevier	16	4,780	5,350	5,920	6,490	7,060	7,630	—	—	—
English	14	3,660	4,100	4,530	4,970	5,400	5,840	—	—	—
Pica	12	—	3,010	3,330	3,650	3,970	4,290	4,610	—	—
Small pica	11	—	2,530	2,800	3,070	3,340	3,600	3,870	—	—
	10½	—	2,300	2,550	2,790	3,040	3,280	3,530	—	—
Long primer	10	—	2,090	2,310	2,530	2,760	2,980	3,200	—	—
	9½	—	1,890	2,090	2,290	2,490	2,690	2,890	—	—
Bourgeois	9	—	—	1,870	2,050	2,230	2,410	2,590	2,770	—
	8½	—	—	1,670	1,830	1,990	2,150	2,310	2,470	—
Brevier	8	—	—	1,480	1,620	1,760	1,910	2,050	2,190	—
Minion	7	—	—	1,130	1,240	1,350	1,460	1,570	1,680	—
Nonpareil	6	—	—	—	910	990	1,070	1,150	1,230	1,310
Agate	5½	—	—	—	760	830	900	970	1,040	1,110
Ruby	5¼	—	—	—	700	760	820	880	940	1,000
Five point	5	—	—	—	—	680	740	800	860	920
Pearl	4¾	—	—	—	—	620	670	720	770	820

Note.—The stepped columns between the heavy lines show type which would appear in series.

In this table due allowance has been made for the commercial signs, figures and points remaining constant in set width.

On account of the high specific gravity of type-metal, about 8·2, it is necessary to make the shelves and racks for carrying a store of type of very substantial design.

When type is stored in existing buildings, especially on upper floors, it is important to ascertain that the strength of the flooring is adequate to the heavy load that it may be required to carry. In an instance that came under the notice of the authors, neglect of this simple and necessary precaution nearly caused the collapse of a steel and concrete floor properly constructed in accordance with ordinary factory practice.

TABLE 26.

WEIGHT OF FRENCH TYPE.

Approximate weight of 1,000,000 *type in kg., exclusive of spaces and quads.*

Poids approximatif de 1,000,000 caractères en kg., les espaces et cadrats non compris.

	Corps.	Length a–z in ems (*longueur a-z en forces-de-corps*).								
Modern . .	—	8·75	10·00	11·25	12·50	13·75	15·00	16·25	17·50	18·75
Old-style .	—	9·10	10·40	11·70	13·00	14·30	15·60	16·90	18·20	19·50
Gros-romain	18	3,170	3,550	3,920	4,300	4,680	5,060	—	—	—
Gros-texte	16	2,505	2,800	3,100	3,400	3,700	4,000	—	—	—
Saint-augustin	14	1,920	2,150	2,370	2,600	2,830	3,060	—	—	—
Cicéro	12	—	1,580	1,740	1,910	2,080	2,250	2,410	—	—
Philosophie	11	—	1,320	1,470	1,610	1,750	1,890	2,030	—	—
Petit-romain	10	—	1,090	1,210	1,330	1,450	1,560	1,680	—	—
Gaillarde	9	—	—	980	1,070	1,170	1,260	1,360	1,450	—
Petit-texte	8	—	—	770	850	920	1,000	1,070	1,150	—
Mignonne	7	—	—	590	650	710	770	820	880	—
Nonpareille	6	—	—	—	480	520	560	600	640	690
Parisienne	5	—	—	—	330	360	390	420	450	480
Diamant	4½	—	—	—	270	290	320	340	360	380

Note.—The stepped columns between the heavy lines show type which would appear in series.

In the case of French type, and that of other foreign countries using the metric system of weights and measures and the same height-to-paper, the weight of 1,000,000 Didot type, exclusive of spaces and quads, in kilograms, is given in table 26. The weight is 18·8 grm. per sq. cm. The weight of spaces and quads varies from 15·3 grm. to 18·3 grm. per sq. cm.

CHAPTER X.

LOGOTYPES.

"Sith wise men have Written that it is in very Heaven that Marringes are made, it is of very Hell and the old Pen-men that have come linked letters. [Logotypes ?]. For they do make a Multiplication of added Woes in seeming simplicity, piling Pelion upon Ossa, as it were, for some Mole-Hill of profit. Keep therefore thy Case simple and therewith be Happy of Heart, yen, and thereby also, will thy Credit grow to fatness and increase."

Mirrour of Pryntyng.

8-point windsor condensed (Stephenson, Blake & Co.).

THE authors of this treatise have nothing but sympathy with the spirit of the old and evidently practical printer whose piteous outcry, about the genuineness of which there can be no two opinions, voices the feeling of some long-departed chapel.

Some samples of the bewildering wilderness of ligatures, abbreviations, scribal shorthand, and other woes with which the compositor of the period was supposed to be familiar, are given in De Vinne's "Correct Composition," and not only must one pity the poor printer, but with him also the even more miserable reader. The example subjoined, fig. 122, is taken from the "Biblia Sacra Vulgata" of Bernhard Richel of Basel, printed in the year 1472.

The modern representatives of these antique contractions are very much simpler both in construction and in combination.

The subject of logotypes, or combinations of characters cast together, has not yet, so far as the authors are aware, been adequately studied in its bearing on typesetting. The very early patent (1782) of Henry Johnson was bought by John Walter, the founder of "The Times" newspaper, and was probably the only extensive application of the system ever made in practice.

Early in the nineteenth century Earl Stanhope introduced a set of eight logotypes, each in one piece, of which he gives the following numbers to be cast for a fount of 3000 m's: an 1620, in 1731, of 1035, on 897, re 1509, se 1152, th 3024, to 1095. It is also to be noticed that he proposed to alter the curve at the top of the f and to discard its ligatures.

The advantage of the use of logotypes in the case of hand or machine composition lies in the reduction of movements to be made by the hand of the operator; thus, a combination of three letters, like **the**, will save two lifts or key depressions, and a combination of four letters, like **tion**, will save three lifts or key depressions. It appears obvious that if a certain arrangement occurs so frequently that it is commoner than any individual letter of the alphabet, a saving of labour will result from the adoption of a logotype for such a combination with but little strain on the memory of the operator. On the other hand, where hand-composition is concerned, the number of case divisions will increase for each added combination, and consequently the size of the cases will be increased also.

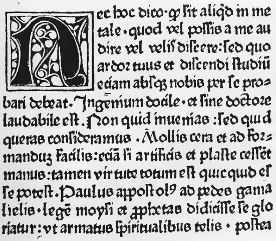


FIG. 122.—*Ligatures.*

Moreover, the number of compartments or keys to be memorized by the compositor will increase, as also will the distance the hand of the operator has to travel.

A further objection to the use of logotypes in handwork is that, owing to the larger mass of the combination, the face of any of the characters is more easily damaged, and damage to any one character necessitates replacement of the whole logotype.

In view of the absence of reliable statistics on the subject of the recurrence of the commonest combinations of characters, and also with a view to testing the accuracy of the proportions in the ordinary bill of fount, the authors, after some preliminary trials, have examined 100,000 characters (exclusive of spaces), occupying rather more than two pages of matter from "The Times" of 30 April, 1907, selected from: Leading Articles, Foreign Intelligence and Parliamentary Debate (this latter amounting to nearly 60 per cent of the whole). The following method was adopted in counting the combinations: first the matter was gone over and all the four-

TABLE 27.

Number of logotypes in 100,000 characters.

the	1933	ther	132	who	85	car	44
and	800	pro	176	able	63	ple	43
of	910	ess	171	der	82	eve	43
tion	428	us	244	he	122	ert	42
in	843	all	160	oun	81	age	40
er	806	wh	236	ance	59	rec	39
ing	536	ate	155	out	78	very	29
ed	776	ere	147	will	55	ng	58
to	716	ter	140	his	73	He	58
re	667	ill	136	int	72	tor	38
that	314	not	135	so	107	miss	26
it	546	ion	134	end	71	ble	34
ou	522	had	134	one	71	if	48
al	519	est	134	por	70	It	44
is	450	ly	201	aid	69	col	27
ould	220	com	125	per	69	Con	27
be	433	our	119	qu	103	than	19
for	285	ist	117	some	49	—	—
was	282	by	169	are	63	—	—
or	404	pos	111	man	63	—	—
ar	380	ted	106	art	62	—	—
at	366	igh	102	ough	44	—	—
ment	182	sh	153	ade	57	—	—
as	364	un	151	but	54	—	—
an	355	ence	75	Com	54	—	—
th	344	have	73	day	54	—	—
ch	336	pre	97	ever	40	—	—
ent	220	ant	97	act	49	—	—
en	311	ver	97	has	48	—	—
st	310	from	71	ace	46	—	—
The	202	ect	93	cha	46	—	—
con	196	ear	89	him	46	—	—
with	140	ish	86	its	45	—	—

letter combinations, chosen from the preliminary trials, were counted; then the three-letter combinations were taken, and, to avoid overlapping, treated in order of precedence—thus, in the word *expressed* the combination

pre was counted, but **ess** was not counted; then in the remainder the two-letter combinations were similarly eliminated.

The number of each of the combinations counted in the 100,000 characters is shown in table 27, p. 148, in which the combinations are arranged in order of importance according to the total number of separate characters employed.

From this table the number of times any combination occurred, approximately, can be obtained by adding together the figures opposite the different combinations in which it is found. Thus the combination **th** occurs in **the, that, with, ther, than,** or in all 2882 times, while **Th** occurs in **The** 202 times.

By summarizing the totals successively it is found that the first combination **the** accounts for over 6 per cent of the whole matter; the first three combinations for over 10·4 per cent; the first eight for over 20·2 per cent; the first fifteen for over 30·3 per cent; the first twenty-six for over 40·5 per cent, and the first fifty for 50·1 per cent.

It is interesting to compare the proportions of logotypes in 100,000 characters, calculated from Earl Stanhope's figures and from those of the authors contained in the preceding table.

TABLE 28.

Logotypes per 100,000 characters, roman lower-case, capitals, and points. (Comparison.)

Logotype.	Authors.	Earl Stanhope.	Logotype.	Authors.	Earl Stanhope.
th	2,882	1,710	of	910	585
in	1,451	980	ed	882	—
an	1,393	916	or	759	—
on	1,378	507	to	754	553
er	1,305	—	ng	594	—
re	1,013	854	se	—	651

The discrepancies that appear in the above table between the figures given by the authors and those calculated from Earl Stanhope's work are at once apparent. The authors, however, with all due respect to him feel that he did not go into his subject as thoroughly as he might have done, or his figures and theirs would approximate more closely. Variation in the recurrence of the same combinations is dealt with elsewhere. Certain allowance must also be made for the matter taken and tested for an average of combinations.

Logotypes are actually in use for the seven combinations æ, œ, ff, fi, fl, ffi, and ffl; they are also used for the italics of these, and for the capitals Æ, Œ, roman, italic and small capitals. In all, twenty different ligatures are actually supplied with every complete fount. All these combinations are rare, and, in most printed matter, could be abolished without seriously offending the eye or orthography; in France the ffi and ffl are no longer generally used, ffi and ffl being substituted. These combinations were originally necessary owing to the f being made to kern in the earlier type; the combined letters had to be cut specially to avoid fouling. With machine-cast characters, which usually do not kern, the necessity for the special combinations ceases to exist, and combinations such as ff and fl do not offend the eye.

Why should not the seven commonest logotypes be substituted for these, and while performing the composition of nearly 20 per cent of ordinary reading-matter, at the same time save lifting type or depressing keys to the extent of nearly 12 per cent of the total work? The answer is probably to be found in the conservatism of the printing-trade, and in the fact that the tendency is to abolish rather than to adopt ligatures. The long s (ſ) and all its combinations are still found in German, to the illegibility of which language they largely contribute. The ct and qu with several others have been generally dropped in this country, the ct alone being still occasionally supplied with some old-style faces. It is difficult to understand why the logotype qu should have gone out of use, for, with the exception of algebraic expressions and occasional quotations involving the occurrence of a very few foreign words, the q practically never occurs except in the combination qu.

TABLE 29.

Logotypes per 100,000 characters, roman lower-case, capitals, and points; variation in frequency of occurrence.

	On 40·8 per cent. Per 100,000.	On 59·2 per cent. Per 100,000.	On 100 per cent. Per 100,000.		On 40·8 per cent. Per 100,000.	On 59·2 per cent. Per 100,000.	On 100 per cent. Per 100,000.
the	1,958	1,915	1,933	in	897	806	843
and	635	914	800	er	981	684	806
of	1,040	821	910	ing	549	527	536
tion	532	356	428	ed	816	748	776

It may be asked how far does the above table of frequency of logotypes show the true proportion of logotypes in general, or how far may they have been affected by the particular character of the matter selected for the statistics. In the Leading Articles and Foreign Intelligence, 40·8 per cent of the whole, and in the Parliamentary Debate, 59·2 per cent of the 100,000 type, the first eight combinations as given in table 27 occurred in the numbers, reduced to per 100,000, compared in table 29.

The counting of the single letters gave the result shown in table 30, in which the actual number found is compared with that calculated from the bill of fount. In this table the calculated figures for the individual letters are reduced in the ratio of 100,000 to the total roman lower-case, capitals and points, that is to 812,540. In computing the number of points, it must be remembered that in the bill of fount about 10 per cent of the quantities of full point and comma respectively belong to the italic fount.

TABLE 30.

Comparison of observed and calculated frequency of occurrence of individual characters per 100,000.

	Observed.	Calculated.	Per cent.		Observed.	Calculated.	Per cent.
e	11,520	9,638	119·5	r	5,880	4,819	122·0
t	8,832	6,885	128·3	s	5,442	5,502	98·9
o	7,161	5,502	130·2	h	4,990	4,130	120·8
a	7,078	6,195	114·3	d	3,524	3,441	102·4
n	6,231	5,502	113·2	l	3,407	3,441	99·0
i	6,225	6,195	100·5	u	2,483	3,098	80·2

This shows that there was a considerable variation between the observed and calculated frequency of occurrence, and the total observed characters in the table exceeded the total calculated by some 13 per cent. This is in a great measure due to the matter selected consisting of long sentences. It is probable that if a much larger number of characters were taken and a greater diversity of printed matter selected, the result would agree more closely with the fount bill.

It has been suggested to the authors by Mark Barr, to whose brilliant and original work reference is made later, that, as the figures given in the various fount schemes are based on old and not very accurate records, it would be an interesting and instructive experiment to attach a counter to each verge-rod of a Linotype machine used in the composition of a daily newspaper—such as the "Daily Telegraph" for the English bill—and take daily readings over a period of several weeks. From the resulting figures reliable statistics would be obtainable, not only for the average frequency of occurrence of each particular sort, but also for the variations in demand for each sort.

The question of frequency of occurrence of particular letters—without regard to whether these are capitals or lower-case, roman or italic or small capitals—and the relation of these frequencies to the total number of letters, is a subject which has received a great deal of attention in connexion with cipher documents and messages and the solution of cryptograms; it is dealt with in a number of text-books relating to cryptography and, in conjunction with the frequency of individual characters, the frequency of successions of letters, or, as they are often termed, bigrams, trigrams, etc., is there considered; the resulting statistics, which have been compiled as an aid to those engaged in deciphering secret messages, are allied to, but not identical with those obtained in the investigations on the frequency of two and three-letter logotypes carried out by the authors.

POSSIBLE REFORMS IN THE ALPHABET.

Modification of the alphabet.—There are in the English language several sounds which are represented in writing and printing by combinations of consonants and in shorthand by single signs. The authors have investigated the frequency of occurrence of these, and have found that in the 100,000 characters counted the following combinations occurred which could be represented by single characters if the alphabet were modified.

TABLE 31.

Sounds represented by two-letter combinations per 100,000 *characters.*

th	2,882	wh	321	sh	239
Th or TH	259	Wh	27	Sh or SH	8
ng	594	st	490	ch	382
NG	5	St or ST	34	Ch or CH	50

The authors suggest that a saving of about $3\frac{1}{2}$ per cent in writing, typewriting, printing, and reading would be effected by adopting two new letters for th and ng respectively. It would also be very easy to design simple longhand letters to replace the two separate letters now used; this saving does not only apply to the printer and compositor, but affects equally all who write and read the English language, and, moreover, it is a change which could be introduced first in the daily press and become gradually universal—a change already predicted by H. G. Wells in his romance "When the Sleeper Wakes."

The authors do not consider that it would be easy to carry this proposal further than the two new letters mentioned, which would merely increase the alphabet by two characters. The **th** (ħ) would rank eleventh in order of demand and the **ng** (ŋ) twenty-third in this new alphabet of twenty-eight letters, the **ng** being in greater demand than **k**, **q**, **x**, **j**, and **z**. The adoption of the two new characters named could, moreover, be effected readily on nearly all composing machines by the elimination of some of the existing unnecessary logotypes, such as **ffi**, **ffl**, **æ**, and **œ**.

The average reader of books, newspapers, etc., would be none the wiser if the **ffi** were produced by single characters instead of by a logotype; it is only the printer who would detect it. Composing machines have had to be made to conform to these long-established customs of the printing trade, which in many cases had ceased to be a necessity, whereas, with a freer hand, their designers could increase the efficiency of the machines, without in any way detracting from the appearance of the composition produced by them.

A great deal of unnecessary work is done both in writing and printing. The saving that would result from the mere introduction of two new letters into the English alphabet would be very remarkable. It is a change that could be made gradually, both old and new characters being used in the same papers and periodicals at the commencement, and a gradual introduction thus taking place through all printing. These new letters could be introduced later on in typewriting, and still later in handwriting, in which the tendency in the case of the **ng**, the less common of the two proposed letters, is visible already in the handwriting of many people. The other letter whose introduction is proposed, is **th**. The use of these two new letters would alone mean a saving of at least from three to four per cent, or more than ten days' work to every daily paper in the year. The value of this saved space should at once appeal to every one who has anything to do with the advertisement departments of any of the great daily newspapers. The saving in time in the composing-room alone would be considerably over a quarter of an hour in the eight-hour day. The same saving which both fast and slow operators would effect would occur also in the case of typewriters, though in their case the saving in space would be of little or no account. Some saving to the reader, when not reading aloud, would also be effected; the eye, having once become accustomed to the novelty, taking in words composed with the combined letters faster than those printed with the present characters.

The paragraph set up, fig. 123, with the proposed new characters shows clearly what practical result will be arrived at by the change. The new characters can be read with absolute facility by people who have never seen them before and know nothing of the suggestion.

It is difficult to arrive at the figures for the earnings of the compositors, but it would appear that in the London district alone upwards of £1,000,000 per annum is paid to compositors in wages (taking only society men into account); probably in the whole of Great Britain and Ireland about £3,000,000 per annum is paid. In America, with Canada and with the other English-speaking colonies, the amount is considerably larger, so that the annual wages earned in composing the English language may

THE SAVING EFFECTED BY REFORMING THE ALPHABET.

The one thing, above all things, that seemingly is required in the printing of newspapers, is the saving of time in going to press. In the second place, the saving of time, and therefore the saving of money in composing, is of the greatest importance and ever-increasing interest to the trade. Thirdly, the mere altering or adding of a unit ensures a saving in space well worth the publisher giving it serious attention. This saving in the case of newspapers affords more space for the advertising, and in the case of the best books and the best periodicals, there would be quite an appreciable saving in paper. The introduction of the two proposed letters ħ and ŋ means a three and a half per cent. saving of matter in composing and printing throughout England and America. By dividing this saving between the operators and the proprietors, the aggregate sum gained by each of them yearly would in itself amount to a fortune.

ĦE SAVIŊ EFFECTED BY REFORMIŊ ĦE ALPHABET.

Ħe one ħiŋ, above all hiŋs, ħat seemiŋly is required in ħe printiŋ of newspapers, is ħe saviŋ of time in goiŋ to press. In ħe second place, ħe saviŋ of time, and ħerefore ħe saviŋ of money in composiŋ, is of ħe greatest importance and ever-increasiŋ interest to ħe trade. Ħirdly, ħe mere alteriŋ or addiŋ of a unit ensures a saviŋ in space well worħ ħe publisher giviŋ it serious attention. Ħis saviŋ in ħe case of newspapers affords more space for ħe advertisiŋ, and in ħe case of ħe best books and ħe best periodicals, ħere would be quite an appreciable saviŋ in paper. Ħe introduction of ħe two proposed letters ħ and ŋ means a ħree and a half per cent. saviŋ of matter in composiŋ and printiŋ ħroughout Eŋland and America. By dividiŋ ħis saviŋ between ħe operators and ħe proprietors, ħe aggregate sum gained by each of ħem yearly would in itself amount to a fortune.

FIG. 123.

well exceed £10,000,000 per annum. The saving in this item alone would, consequently, amount to about £350,000 per annum, apart from savings effected in materials in typewriting, time occupied in handwriting, etc.

The question also arises as to whether a similar saving can be effected in other languages. The authors have not been able to find any parallel case in French, but in German it would appear, from a preliminary examination, that the substitution of three new letters for the combinations **sch**, **ch**, and **ng** would enable a saving of more than 4 per cent to be effected. The Russian letter Ш should not be adopted for **sch** as it only differs slightly from the lower-case **m** in the serifs and hair-line; it would be desirable that new characters should be designed which should be very dissimilar from all those in present use. The question of legibility, however, is fully dealt with in another chapter.

One of the few examples of the practical and extensive use of logotypes in the production of a printing-surface is the use to which they have been put for shorthand printing, fig. 90, p. 103, the whole of the shorthand matter in the "Phonetic Journal" being set up from true logotypes, the term being, however, frequently used in printing for mere combinations of letters which etymologically, strictly speaking, are not logotypes.

CHAPTER XI.

LEGIBILITY.

"He that laboureth in the Craft laboureth in vain be not that which he Setteth up plainly to be observed and understood of all Men's Eyes; Nay, even of him whose Sight is somewhat marred by Smoke and Sin God us Forgive and the Setting of ale-jug to ale-jug, albeit it be done without ill Intent and in all clerkly Fellowship and Learning."

Mirrour of Pryntyng.

8-point blackfriars (Blackfriars, formerly Wicks).

"Unfortunately the needs of the reader are lightly regarded by the men who make types. They think more of the display of their own skill. The punch-cutter's straining after a hair-line that stops just before invisibility is ably seconded by the pressman who scantily inks these light-faces with a hard ink-roller, and then with the feeblest possible impression impresses them against an inelastic surface on dry and hard calendered paper. This weak and misty style of printing is vastly admired by many printers, and perhaps by a few publishers, but it is as heartily disliked by all who believe that types should be made for the needs of the reader more than for an exhibition of the skill of the printer or type-founder.

De Vinne.—"The Practice of Typography."

Long primer modern.

The large amount of time spent by millions of people in reading makes the question of clearness of type one of enormous importance, though it has hitherto been almost unnoticed by the public. It is quite as necessary that the characters should be plainly dissimilar in form and appearance as that a face should be used as large as the nature of the work will permit.

Legibility is a complex subject, since it is affected by many different factors, amongst which are :—

1. The size of the characters.
2. The amount of space between succeeding lines (or the amount of leading).
3. The amount of white between the main strokes or in the counters.
4. The length of the printed line.
5. The resemblance of some characters to others.

6. The presence of unnecessary lines or marks, ornamental or otherwise.
7. The frequency of kerns in certain characters.
8. The quality of the paper and its colour.
9. The colour of the ink.
10. The capacity of the paper for reflecting light.
11. The illumination.
12. Irradiation.

The subject has been studied by many oculists and professors of hygiene, amongst whom may be cited Dr. Sanford, Dr. Javal, of France, Dr. Cattell, of Leipzig, and Dr. H. Cohn, of Breslau.

TYPE, LEADING, AND LENGTH OF LINE FOR SCHOOL-BOOKS.

Size of type and leading.—The important influence which the size of type and the style of printing used for school-books may ultimately have on the eyesight of the people has been investigated in considerable detail. The authorities quoted describe the size of type and the amount of leading which they recommend in terms differing from those of the printer. They deal with that which they actually see and the "size" of the type quoted in their researches is the gauge of the lower-case **m**; what they term the "leading" is the distance between successive lines of lower-case small sorts, or in other words, the size of the actual body plus the thickness of the lead and minus the gauge of the lower-case **m**.

The influence of school-books upon eyesight was investigated recently by a committee of the British Association and the report based on this inquiry, to which oculists, medical officers of schools, directors of education, teachers, publishers, printers, and typefounders have contributed, contains suggestions for standardizing the typography of school-books. This report deals with the causes of myopia and other eye-defects and it discusses the technical and trade aspects of the typographical products as well as questions of paper and ink; moreover it devotes particular attention to legibility and to the sizes of type most suitable for school-books. In the report the gauge of the small sorts is defined as the "minimum height of face of short letters" and "by 'interlinear space' is meant the vertical distance between the bottom of a short letter and the top of a short letter in the next line below."

Length of the printed line.—Since the surface of the printed page is a plane, it follows that the ends and the centre of the line are at different distances from the eyes and that this difference increases with increase in the length of line. The continual change of focus required to accommodate the eye to these different distances is more trying and harmful to the vision than is its transverse movement in following from character to character. It is recommended that the length of line should not usually exceed 4 inches in books of 10-point type and upwards, and that this maximum should be reduced in proportion to the body if smaller sizes are used.

RECOMMENDATIONS OF DR. COHN FOR TYPE FOR SCHOOL-BOOKS.

It has been advocated by Dr. Cohn that larger type should be used in the books to be read by children in their earlier years, and he makes the following recommendations to which have been added the nearest ordinary type sizes and actual thicknesses of leads :—

For the first year children should read from type of a gauge "at least 2·6 mm. with leading of 4·5 mm.," in other words, the gauge of the m should exceed 0·102 in.

18-point with 4-point leads; equivalent to an 18-point face on a 22-point body.

For the second and third years they should read from type of a gauge "not smaller than 2 mm. with leading of 4 mm.," in other words, the gauge of the m should exceed 0·079 in.

14-point with 4-point leads; equivalent to a 14-point face on an 18-point body.

For the fourth year they should read from type of a gauge "at least 1·8 mm. with leading of 3·6 mm.," in other words, the gauge of the m should exceed 0·071 in.

12-point with 3-point leads; equivalent to a 12-point face on a 15-point body.

After the fourth year the size of type used should have a gauge "which should not be less than 1·6 mm. with leading of 3 mm.," in other words, the gauge of the m should not be less than 0·063 in.

10-point with 3-point leads, eqnivalent to a 10-point face on a 13-point body.

RECOMMENDATIONS OF THE BRITISH ASSOCIATION COMMITTEE.

The minimum width recommended for the characters is given in terms of the a–z length, and increases progressively with decrease of body-size from 11 ems for 24-point to 14 ems for 10-point.

The maximum length of line recommended is 4 inches for 18 point and $3\frac{5}{8}$ inches for the smaller bodies.

The examples given in the supplement to the British Association Committee's report are, in several instances, considerably larger in gauge and interlinear space than the minima recommended in the typographical table given in the body of the report. The sizes and interlinear spaces recommended are based on age-periods of the child and are as follows :—

Children under seven years should read from type of a gauge of "minimum 3·5 mm. with minimum interlinear space of 5 mm."

22-point with 3-point lead.

Children aged seven to eight years should read from type of a gauge of "minimum 2·5 mm. with minimum interlinear space of 3·6 mm."

18-point with 1-point lead.

Children aged eight to nine years should read from type of a gauge of "minimum 2·0 mm. with minimum interlinear space of 2 mm." (? 3 mm.).

13½-point with 1-point lead.

Children aged nine to twelve years should read from type of a gauge of "minimum 1·8 mm. with minimum interlinear space of 2 mm." (? 2·4 mm.).

12-point solid.

Children above 12 years of age should read from type of a gauge of "minimum 1·58 mm. with minimum interlinear space of 1·8 mm."

11-point solid.

In the third and fourth instances given the figures for the interlinear spaces appear to be misprinted in the report, and the specimens here set up have been corrected in this respect so as to bring them into harmony with the other specimens shown; the selection of these faces, as well as of those illustrating Dr. Cohn's recommendations, has involved the measurement and examination of a large number of faces to obtain examples in agreement in both dimensions.

The influence upon the style of character arising from the manner in which payment is made to the compositor.—In Great Britain the payment of the compositor is by the thousand ens, and the scale of payment is increased with reduction in body-size. Nonpareil costs some 12 per cent more for composition than is paid for founts ranging from english to brevier, and pearl 25 per cent more than for these larger bodies. The effect of this scale of payment is to discourage the use of extended faces.

This system presupposes that the a–z length is the same for all founts, and consequently the printer prefers to use those founts which will enable the maximum of matter to be composed for a given outlay. In France a much fairer system prevails, based on the filling of the measure with the alphabet repeated as far as it may go, and basing the scale of payment on the actual number of letters thus found to be contained in the line. The result is that the French faces are much more open, and can have more white between the letters, with the corresponding reaction that more white is actually allowed between the lines.

From the foregoing paragraph, the authors do not mean it to be inferred that the French do not make use of any condensed faces—for, as a matter of fact, some of the French faces are even more condensed than anything met with in display founts in this country—but that, taking the body type of French books, they are on the average composed in more-extended faces than a similar average of English works would show.

Amount of white between the main-strokes and in the counters.—The forms of character which are most easy to read are those in which an ample amount of white is allowed between the main-strokes and in the counters; insufficient attention has hitherto been paid to the importance of using faces which are not too greatly condensed, and the above specifications for type for school-books should be amplified yet further by the condition that the a–z length should not be less than 13 ems, and that the normal space between words should not be less than the en quad.

RESEMBLANCES.

Resemblance of some characters to others.—The ordinary latin character generally adopted on the Continent of Europe, in England, her colonies, and in America, is fortunately more legible than many other forms of character, but even in its most common form—the roman lower-case—it suffers from the disadvantage that some of the letters of most frequent occurrence are, in reading, easily mistaken for each other. Thus it is found that the members of the following pairs, or groups, are specially liable to be misread: **e** for **o** or **c**; **n** for **u**; **i** for **l**; **h** for **b**, and **a** for **s**. In all these cases it is evident that the similarity of form is very largely, if not entirely, responsible for the confusion which arises.

The authors have investigated a large number of cases by the following method. From careful measurements, made by means of the micrometer microscope on new type, the characters were drawn out to a scale 45 times full size; the resulting drawings for the combination considered were then superposed, and the area common to both as well as the areas peculiar to both were measured by means of the planimeter. The size of body taken in each case was 12-point; the unit of area for the dimensions being that of a square having its side equal to 0·001 inch (or an area equal to 1 millionth of a square inch). The ratio that the sum of the areas peculiar to the individual characters bears to the sum of the total areas of the two characters, which may be termed the *legibility coefficient*, was calculated. If 100 per cent is taken as perfect legibility (in the case where there is no coincidence), then the difference between the 100 per cent and the legibility coefficient may be termed the *illegibility coefficient*. To obtain an accurate idea of the influence exercised by each of the characters examined on the illegibility as a whole, the illegibility coefficient was multiplied by the recurrence of the character as given in the fount bill, and the product termed the *illegibility factor*. The sum of these illegibility factors divided by the total recurrence of the characters under consideration gives the *mean illegibility coefficient*. By this method the influence of different styles of face can be compared, provided other conditions are sensibly constant. For this reason the faces shown in the illustrations were selected for this investigation, as they had as nearly as possible the same dimensions in gauge, main-stroke, hair-line, and set width. How far these conditions result in uniformity can be measured by the ratio of the total area of the face of the character to the cross-section of the type. This figure given as a percentage has been termed the *blackness*. It is obvious that with increasing blackness, other conditions remaining constant, the coincident areas will increase and the legibility coefficients will decrease, and conversely with decreasing blackness the coincident areas will decrease and the legibility coefficients will increase. If there is no coincidence to consider, the actual legibility may be assumed to vary directly as the blackness; hence the best comparative figure will be obtained as the product of the mean legibility coefficient by the mean blackness; this the authors have styled the *specific legibility*.

In the tables which follow, the legibility of the combinations quoted above has been investigated for the following faces: modern, old-style, blackfriars, sans serif, and German *Fraktur*; a comparison of the relative merits of these for eleven of the worst characters or seven of the worst combinations was effected in this manner. The results are given in detail in tables 32 to 40, and the drawings of the superposed characters from which the measurements were made are shown in reduced size in figs. 124 to 140.

The long s (ſ) compared with f gave, in the same modern face, a blackness of 20·1 per cent, and a legibility coefficient of 2·74 per cent. This is a much lower coefficient than in any other of the latin characters and the influence on legibility effected by the abolition of the long s (ſ) can be appreciated; see fig. 124.

The modern face chosen for investigation is one prepared by the authors with serifs having the same thickness as the serifs of the old-style fount under investigation; it is, therefore, a fount which has been made

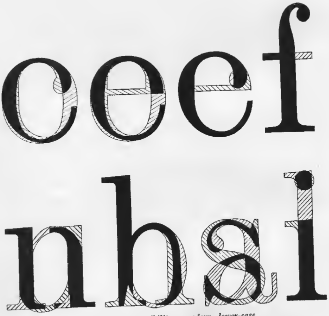


FIG. 124.—*Illegibility: modern, lower-case.*
About 14 times full size.

specially legible by this modification. If a modern face had been chosen with the thin hair-line serif, referred to as the weak feature of modern, its inferiority as compared to the old-style would have been brought out more markedly. Actually the figure found for the specific legibility of this modern face is slightly greater than that for the old-style face investigated, although the legibility coefficient is much lower.

The values of the legibility coefficients given in the tables bring out clearly the inferiority of modern as compared with old-style and of old-style as compared with a face like the blackfriars, in which legibility of the

TABLE 32.—*Illegibility of roman modern (lower-case), 12-point; fig. 124.*

The unit of area is a square with sides each one-thousandth of an inch.

1. Character	c	e	o	b	h	a	s	i	l	n	u
2. Area (0.001 in.)^2	1521	1704	1793	2504	2795	2054	1610	1343	1669	2208	2257
3. Combination of characters	ce	eo	co	bh		as		il		nu	
4. Sum of areas of characters (0.001 in.)^2	3225	3497	3314	5299		3664		3012		4465	
5. Sum of non-coincident areas (0.001 in.)^2	262	702	647	815		1857		513		573	
6. Legibility coefficient, per cent	8.1	20.1	19.5	15.4		50.7		17.0		12.8	
7. Illegibility coefficient, per cent	91.9	79.9	80.5	84.6		49.3		83.0		87.2	
8. Character	c	e	o	b	h	a	s	i	l	n	u
9. Mean illegibility coefficient of each character of group or pair, per cent.	86.2	85.9	80.2	84.6	84.6	49.3	49.3	83.0	83.0	87.2	87.2
10. Recurrence . . per cent	2.24	7.83	4.47	1.12	3.36	5.03	4.47	5.03	2.80	4.47	2.52
11. Blackness . . per cent	11.5	12.8	13.5	16.8	18.7	16.4	14.7	16.7	20.8	14.8	15.1
12. Illegibility factor . per cent	1.93	6.73	3.59	0.95	2.84	2.48	2.20	4.17	2.32	3.90	2.20

For the eleven characters the total illegibility factor, 33.31, divided by the total recurrence, 43.34, gives a mean illegibility coefficient of 76.9 per cent, or a mean legibility coefficient of 23.1 per cent. The blackness similarly treated gives a mean blackness of 14.4 per cent, hence the specific legibility is 3.33 per cent.

lower-case was specially sought. Popular belief holds the sans serif, or, as it is popularly called, block letter, to be very legible, but to printers, and especially to those who do much display work, this view is known to be erroneous. The blackness is unavoidably greater than in the other faces examined, but the legibility is more than proportionately decreased.

The results obtained by this method might be extended to the remainder of the lower-case, the characters being grouped thus: **hk**; **fj**; **vy**; **dq**; **gp**: **rt**; **mw**; and **xz**; but the influence of these on the total legibility

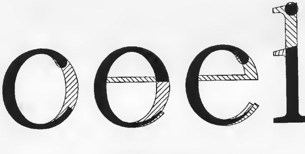


FIG. 125.—*Illegibility: old-style, lower-case.*
About 13 times full size.

would not be very great, for the combinations already investigated account for 650 out of 1000 lower-case characters.

It is apparent from the illustrations that a heavy serif adds considerably to the non-coincident areas of the **il**, **un** and **bh** pairs of lower-case characters. Absence of the serif increases the similarity of capital letters more seriously as will be seen by comparing the examples **FP**, **BR**, given in fig. 133, p. 176, with the lower-case pairs shown in fig. 127, p. 168.

The combinations **3-5** and **6-8** of figures similarly treated (fig. 129, p. 172) show the superiority of the modern form over the old-style and sans serif, even though the particular example of old-style figures given here has been modernized with a view to increased legibility.

TABLE 33.—*Illegibility of roman old-style (lower-case), 12-point; fig 125.*

The unit of area is a square with sides each one-thousandth of an inch.

1. Character	c	e	o	b	h	a	s	i	l	n	u
2. Area	1086	1437	1516	2089	2237	1541	1215	968	1240	1872	1758
3. Combination of characters	ce	eo	co	bh		as		il		nu	
4. Sum of areas of characters	2523	2953	2602	4326		2756		2208		3630	
5. Sum of non-coincident areas	538	612	469	998		1373		440		578	
6. Legibility coefficient, per cent	21·3	20·7	18·0	23·1		49·8		19·9		15·9	
7. Illegibility coefficient, per cent	78·7	79·3	82·0	76·9		50·2		80·1		84·1	
8. Character	c	e	o	b	h	a	s	i	l	n	u
9. Mean illegibility coefficient of each character of group or pair, per cent	80·3	79·0	80·7	76·9	76·9	50·2	50·2	80·1	80·1	84·1	84·1
10. Recurrence . . per cent	2·24	7·83	4·47	1·12	3·36	5·03	4·47	5·03	2·80	4·47	2·52
11. Blackness . . per cent	8·3	11·0	11·6	14·3	15·4	10·8	11·0	13·0	16·6	12·8	12·1
12. Illegibility factor . per cent	1·80	6·19	3·61	0·86	2·58	2·53	2·24	4·03	2·24	3·76	2·12

The total illegibility factor, 31·96, divided by the total recurrence, 43·34, gives a mean illegibility coefficient of 73·7 per cent, or a mean legibility coefficient of 26·3 per cent. The blackness similarly treated gives a mean blackness of 12·2 per cent, hence the specific legibility is 3·21 per cent.

The method shows plainly the influences which produce the greater illegibility in the German *Fraktur* type. Whereas, in the faces which have been compared, the minimum legibility coefficient in blackfriars is 17·1 per cent, in old-style it is 15·9 per cent, in modern it is 8·1 per cent, and in sans serif it is 10·4 per cent, but in the German *Fraktur* it falls to 2·6 per cent with the next lowest 6·2 per cent. In a 12-point face the difference between ſ and ſ is less than 80 millionths of a square inch; for a 10-point face the figure falls to 55; for 8-point to 36, and for 6-point to less than

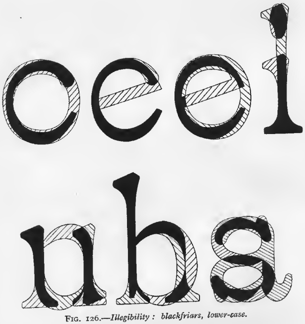


FIG. 126.—*Illegibility: blackfriars, lower-case.*
About 14 times full size.

20 millionths of a square inch. The double letters compounded of these characters add still further to the illegibility of this face; the lower-case n and u differ merely by the transference of a small oblique hair-line from top to bottom, while the thickening of the ends of the strokes and the addition of the fine unnecessary serifs in many cases render these hair-lines shorter and less easy to distinguish. Many foreigners who attempt the study of the German language are seriously troubled by the illegibility of its literature, which has been aptly described as being "cursed with a blinding lettering." Not only is the German *Fraktur* lower-case of inferior legibility

TABLE 34.—*Illegibility of roman blackfriars (lower-case), 12-point; fig. 126.*

The unit of area is a square with sides each one-thousandth of an inch.

1. Character	c	e	o	b	h	a	s	i	l	n	u
2. Area	1412	1842	2128	2306	2395	2543	1936	1348	1393	2045	1916
3. Combination of characters .	ce	eo	co	bh		as		il		nu	

TABLE 34.—*Illegibility of roman blackfriars (lower-case), 12-point; fig. 126.*

The unit of area is a square with sides each one-thousandth of an inch.

1. Character	c	e	o	b	h	a	s	i	l	n	u
2. Area	1412	1842	2128	2306	2395	2543	1936	1348	1393	2045	1916
3. Combination of characters	ce	eo	co	bh		as		il		nu	
4. Sum of areas of characters	3254	3970	3540	4701		4479		2741		3961	
5. Sum of non-coincident areas	587	1373	745	1175		1733		469		1097	
6. Legibility coefficient, per cent	18·1	34·6	21·1	25·0		38·7		17·1		27·7	
7. Illegibility coefficient, per cent	81·9	65·4	78·9	75·0		61·3		82·9		72·3	
8. Character	c	e	o	b	h	a	s	i	l	n	u
9. Mean illegibility coefficient of each character of group or pair, per cent	80·4	73·6	72·2	75·0	75·0	61·3	61·3	82·9	82·9	72·3	72·3
10. Recurrence	2·24	7·83	4·47	1·12	3·36	5·03	4·47	5·03	2·80	4·47	2·52
11. Blackness . . per cent	11·4	14·9	17·2	16·2	16·9	18·5	17·4	17·8	18·4	14·4	13·5
12. Illegibility factor . per cent	1·80	5·76	3·23	0·84	2·52	3·08	2·74	4·17	2·32	3·23	1.82

The total illegibility factor, 31·51, divided by the total recurrence, 43·34, gives a mean illegibility coefficient of 72·7 per cent, or a mean legibility coefficient of 27·3 per cent. The blackness similarly treated gives a mean blackness 16·5 per cent, hence the specific legibility is 4·51 per cent.

to latin in the case of the combinations already considered, but other pairs and groups have very small legibility coefficients; the combination 𝔪𝔴, fig. 128, has a legibility coefficient of only 12·3 per cent, 𝔯 and 𝔵 differ only by a hair-line, while other very illegible combinations are 𝔞𝔳, 𝔩𝔣𝔱, 𝔫𝔶, 𝔤𝔮, and 𝔦𝔧.

The comparative results proved so interesting that the same method was applied to the three worst combinations **CG**, **OQ**, and **BR**, and one other combination, **XZ**, of capitals in each of the roman faces above considered.

FIG. 127.—*Illegibility: sans serif, lower-case.*

About 14 times full size.

The results are given summarized in table 38, and the characters are shown combined in figs. 130 to 133. These show a nearly uniform legibility coefficient of about 15·3 per cent for the three worst cases in modern, oldstyle, and blackfriars, and a legibility coefficient of 10·2 per cent or only two-thirds as great in the case of sans serif. It may be some comfort to motorists to know that the form of the characters and figures selected for car numbering by the governments of this and other countries is less legible than many others which might have been chosen; in fact, it would be difficult to improve them in the direction of greater illegibility except by

TABLE 35.—*Illegibility of roman sans serif (lower-case), 12-point; fig. 127.*

The unit of area is a square with sides each one-thousandth of an inch.

1. Character	c	e	o	b	h	a	s	i	l	n	u
2. Area	1852	2513	2281	3155	2845	2696	2232	1180	1605	2252	2266
3. Combination of characters .	ce	eo	co	bh		as		il		nu	

TABLE 35.—*Illegibility of roman sans serif (lower-case), 12-point; fig. 127.*

The unit of area is a square with sides each one-thousandth of an inch.

1. Character	c	e	o	b	h	a	s	i	l	n	u
2. Area	1852	2513	2281	3155	2845	2696	2232	1180	1605	2252	2266
3. Combination of characters	ce	eo	co	bh		as		il		nu	
4. Sum of areas of characters	4365	4794	4133	6000		4928		2785		4518	
5. Sum of non-coincident areas	662	657	430	706		1570		425		825	
6. Legibility coefficient, per cent	15.2	13.7	10.4	11.8		31.9		15.2		18.3	
7. Illegibility coefficient, per cent	84.8	86.3	89.6	88.2		68.1		84.8		81.7	
8. Character	c	e	o	b	h	a	s	i	l	n	u
9. Mean illegibility coefficient of each character of group or pair, per cent	85.5	88.0	87.2	88.2	88.2	68.1	68.1	84.8	84.8	81.7	81.7
10. Recurrence . per cent	2.24	7.83	4.47	1.12	3.36	5.03	4.47	5.03	2.80	4.47	2.52
11. Blackness . per cent	14.8	19.5	17.5	23.3	21.0	19.5	18.6	18.4	25.0	16.6	16.7
12. Illegibility factor . per cent	1.91	6.89	3.90	0.99	2.96	3.43	3.04	4.27	2.37	3.65	2.06

The total illegibility factor, 35.47, divided by the total recurrence, 43.34, gives a mean illegibility coefficient of 81.8 per cent, or a mean legibility coefficient of 18.2 per cent. The blackness similarly treated gives a mean blackness 18.9 per cent, hence the specific legibility is 3.44 per cent.

combining German *Fraktur* capitals with the existing sans serif figures. The German *Fraktur* capitals show an average legibility coefficient of only 3·8 per cent for the three worst cases, a figure which compares with the corresponding figures for latin faces even worse than does that obtained for the lower-case. Amongst the capitals the combinations 𝔊𝔈, 𝔇𝔒, 𝔅𝔙, and 𝔉𝔍 are shown in fig. 134, page 178; 𝔄𝔘, 𝔑𝔐, 𝔐𝔚, and 𝔊𝔖 are also bad examples; these sorts are of very much greater frequency than 𝔛 and 𝔜 which have more distinctive forms.

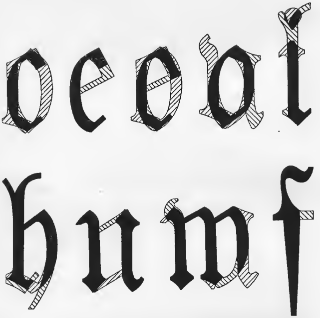


FIG. 128.—*Illegibility: German* Fraktur, *lower-case.* About 12½ times full size.

From certain improvements that are steadily coming about in many of the newer faces of *Fraktur* in Germany, the authors feel confident that influential and far-seeing forces among the Germanic peoples are modifying the form of their typographical characters in such manner as to reduce the effect of the exacting demands made by it upon one of the most valuable of all national assets: the eyesight of the people.

There is yet another consideration that ought to weigh with Germans and that is that not infrequently their literature is neglected owing to the form in which it is presented to the world, see p. 190; for difficult though

TABLE 36.—*Illegibility of German* Fraktur *(lower-case),* 12-*point; fig.* 128.

The unit of area is a square with sides each one-thousandth of an inch.

1. Character	c	e	o	b	h	ſ	f	i	l	n	u
2. Area	830	1072	1358	1827	1946	1550	1472	988	1111	1630	1634
3. Combination of characters .	ce	eo	co	bh		ſf		il		nu	
4. Sum of areas of characters .	1902	2430	2188	3773		3022		2099		3264	

TABLE 36.—*Illegibility of German* Fraktur *(lower-case), 12-point; fig.* 128.

The unit of area is a square with sides each one-thousandth of an inch.

1. Character	c	e	o	b	h	f	ſ	i	l	n	u
2. Area	830	1072	1358	1827	1946	1550	1472	988	1111	1630	1634
3. Combination of characters .	ce	eo	co	bh		fſ		il		nu	
4. Sum of areas of characters .	1902	2430	2188	3773		3022		2099		3264	
5. Sum of non-coincident areas .	242	721	726	415		79		469		202	
6. Legibility coefficient, per cent	12·7	29·7	33·2	11·0		2·6		22·4		6·2	
7. Illegibility coefficient, per cent	87·3	70·3	66·8	89·0		97·4		77·6		93·8	
8. Character	c	c	o	b	h	f	ſ	i	l	n	u
9. Mean illegibility coefficient of each character of group or pair, per cent . . .	77·0	78·8	68·6	89·0	89·0	97·4	97·4	77·6	77·6	93·8	93·8
10. Recurrence . . per cent	2·70	12·00	2·20	1·60	1·66	1·90	3·85	5·50	2·40	8·00	3·60
11. Blackness . . per cent	11·6	13·5	15·4	19·7	20·9	22·2	21·1	18·0	20·3	14·9	14·9
12. Illegibility factor . per cent	2·08	9·46	1·51	1·42	1·48	1·85	3·75	4·27	1·86	7·50	3·38

The total illegibility factor, 38·56, divided by the total recurrence, 45·41, gives a mean illegibility coefficient of 84·9 per cent, or a mean legibility coefficient of 15·1 per cent. The blackness similarly treated gives a mean blackness 16·2 per cent, hence the specific legibility is 2·45 per cent.

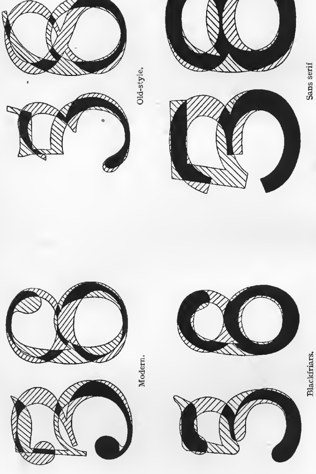


FIG. 129.—*Illegibility: figures.*
About 14 times full size.

TABLE 37.—*Illegibility of modern, old-style, blackfriars and sans serif figures, 12-point; fig* 129.

The unit of area is a square with sides each one-thousandth of an inch.

	Modern.				Old-style.				Blackfriars.				Sans serif.			
	3	5	6	8	3	5	6	8	3	5	6	8	3	5	6	8
1. Figure . .																

Blackfriars. Sans serif.

FIG. 129.—*Illegibility: figures.*

About 14 times full size.

TABLE 37.—*Illegibility of modern, old-style, blackfriars and sans serif figures, 12-point; fig 129.*

The unit of area is a square with sides each one-thousandth of an inch.

	Modern.				Old-style.				Blackfriars.				Sans serif.			
1. Figure	3	5	6	8	3	5	6	8	3	5	6	8	3	5	6	8
2. Area	2671	2237	2489	2281	1664	1832	2074	2578	2716	2686	3007	3422	4489	4681	5190	5690
3. Combination	3 + 5		6 + 8		3 + 5		6 + 8		3 + 5		6 + 8		3 + 5		6 + 8	
4. Sum of areas	4908		4770		3496		4652		5402		6429		9170		10880	
5. Do. non-coincident	2420		2637		1393		2499		1649		662		1230		2444	
6. Legibility coefficient, per cent	49·3		55·3		39·8		53·7		30·5		10·3		13·4		22·5	
7. Illegibility coefficient, per cent	50·7		44·7		60·2		46·3		69·5		89·7		86·6		77·5	
8. Blackness per cent	19·4	16·2	18·1	16·6	12·1	13·3	15·1	18·7	19·7	19·5	21·8	25·0	24·1	25·1	27·6	30·5

As the various figures may be assumed to have the same frequency of recurrence the coefficients of legibility can be compared direct.

The means are: modern 52·3, old-style 46·8, blackfriars 20·4, and sans serif 18·0 per cent respectively.

The blacknesses are: modern 17·8, old-style 14·9, blackfriars 21·5, and sans serif 26·8 per cent respectively.

The specific legibilities: modern 9·31, old-style 6·97, blackfriars 4·39, and sans serif 4·82 per cent respectively.

FIG. 130.—*Illegibility : modern, capitals.*
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FIG. 131.—*Illegibility : old-style, capitals (continued on opposite page).*
About 13 times full size.

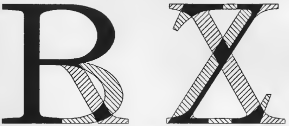

FIG. 131.—*Illegibility: old-style, capitals (concluded from opposite page).*
About 13 times full size.

FIG. 132.—*Illegibility: blackfriars, capitals.*
About 14 times full size.

much of it is, it would yet be studied and appreciated far more than it is were it not that, as a recent writer in "The Times" has well said, "it is

FIG. 133.—*Illegibility: sans serif, capitals.*
About 14 times full size.

rendered needlessly repellent by the retention to so great an extent as still prevails of a most irrational and eye-wearying mediæval script."

TABLE 38.—*Summary for latin, German and Greek founts.*

Comparison of the illegibility of capitals: roman, German Fraktur *and Greek; figs.* 130–135.

	Modern.		Old-style.		Blackfriars.		Sans serif.			German.			Greek.	
Characters.	Blackness mean.	Leg. coefft. per cent.	Blackness mean.	Leg. coefft. per cent.	Blackness mean.	Leg. coefft. per cent.	Blackness mean.	Leg. coefft. per cent.	Characters.	Blackness mean.	Leg. coefft. per cent.	Characters.	Blackness mean.	Leg. coefft. per cent
C G	15·5	13·0	11·8	13·4	19·5	13·7	22·8	13·3	𝔆 𝔊	28·7	2·5	Α Λ	15.0	3·1
O Q	19·3	12·7	16·2	12·1	24·6	11·9	25·3	6·2	𝔒 𝔔	21·1	4·1	Η Π	22·1	3·9
B R	21·0	20·7	17·2	19·8	23·7	20·0	28·5	11·1	𝔅 𝔙	20·2	4·8	Ο Θ	22·5	11·3
X Z	16·6	51·0	13·5	47·0	22·4	30·8	24·0	33·9	𝔉 𝔍	22·6	34·6	Δ Λ	17·5	32·2
Average of first 6 sorts	18·6	15·5	15·1	15·1	22·6	15·2	25·5	10·2	Average of first 6 sorts	23·3	3·8	Average of first 6 sorts	19·9	6·1
Specific legibility	2·88 per cent.		2·28 per cent.		3·44 per cent.		2·60 per cent.			0·89 per cent.			1·21 per cent.	
Comparison of the illegibility of several styles of lower-case roman, German Fraktur *and Greek compared; figs.* 124–128 *and* 135.														
Mean of 11 sorts	14·4	23·1	12·2	26·3	16·5	27·3	18·9	18·2	Mean of 11 sorts	16·2	15·1	Mean of 4 sorts	18·9	32·1
Specific legibility	3·33 per cent.		3·21 per cent.		4·51 per cent.		3·44 per cent.			2·45 per cent.			6·07 per cent.	
Illegibility of several styles of figures, compared.														
Average of 4 sorts	17·8	52·3	14·9	46·8	21·5	20·4	26·8	18·0	—	—	—	—	—	—
Specific legibility	9·31 per cent.		6·97 per cent.		4·39 per cent.		4·82 per cent.							

These improvements in the more modern *Fraktur* may be summed up generally as tending to the reduction of the redundant fine inclined serifs, to the thickening of the hair-line where this forms the sole difference between different characters, and to the exaggeration of the small peculiarities which alone enable like characters to be distinguished from each other. It is, however, a pity that the Germanic peoples cannot make up their minds

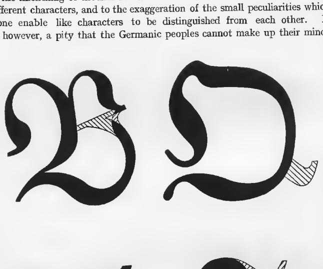

FIG. 134.—*Illegibility: German* Fraktur, *capitals.*
About 14 times full size.

at one fell swoop to do away with their beautiful, but, from a hygienic point of view, pernicious character.

Turning from these faces to the greek face, the worst examples in the lower-case, ν υ and ζ ξ, table 39, and fig. 135, compare very favourably with latin faces. It is only in a few of the combinations of capitals, Δ Λ and Θ O, that the illegibility approaches that of the latin, while, in the two cases A Λ and H Π, table 38, where the difference now depends on short hair-lines, it is so poor as to correspond to the German *Fraktur*.

FIG. 135.—*Illegibility: greek.*
About 14 times full size.

The character generally used in Russia excels even the German *Fraktur* in the illegibility of a few lower-case sorts. The **ш, щ**, and the **и, н, п, ц** combinations have been compared; the four last characters are all liable to confusion with each other, table 39 and fig. 136. The legibility coefficient of the **ш** and **щ** combination is only 1·4 per cent, being the smallest

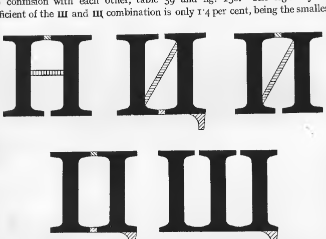

Fig. 136.—*Illegibility: Russian, lower-case.*
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found by the authors. It would be easy to improve the legibility of the Russian upright character: the **и** could be made readily distinguishable by adopting the heavy inclined stroke with the thin upright strokes of the

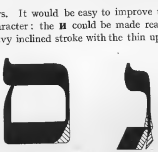


Fig. 137.—*Illegibility: Hebrew.*
About 14 times full size.

latin **N**; the tails of **ц** and **щ** could be made into ordinary descenders and the inside lower serifs of **п** shortened or removed. Russian italic is less legible than the upright character and in writing it is necessary to place additional horizontal strokes above and below several lower-case letters in order to prevent misreading.

TABLE 39.—*Illegibility of Greek and Russian, (lower-case), and of Hebrew, 12-point; figs.* 135–137.
The unit of area is a square with sides each one-thousandth of an inch.

	Greek, fig. 135.				Russian, fig. 136.						Hebrew, fig. 137.			
	(nu)	(upsilon)	(zeta)	(xi)	(pé)	(en)	(ee)	(tsé)	(sha)	(shtcha)	(gimel)	(nun)	(mem *final*)	(samech)
1. Character . . .	ν	υ	ζ	ξ	п	н	и	ц	ш	щ	ג	נ	ם	ס
2. Area . . .	2208	2445	3556	3960	2361	2449	2563	2459	3516	3615	894	968	2435	2336

TABLE 39.—*Illegibility of Greek and Russian, (lower-case), and of Hebrew, 12-point; figs.* 135–137.

The unit of area is a square with sides each one-thousandth of an inch.

	Greek, fig. 135.				Russian, fig. 136.						Hebrew, fig. 137.			
	(nu)	(upsilon)	(zeta)	(xi)	(pé)	(en)	(ee)	(tsé)	(sha)	(shtcha)	(gimel)	(nun)	(mem *final*)	(samech)
1. Character	ν	υ	ζ	ξ	п	н	и	ц	ш	щ	ג	נ	ם	ס
2. Area	2208	2445	3556	3960	2361	2449	2563	2459	3516	3615	894	968	2435	2336
3. Combination	$\nu\upsilon$		$\zeta\xi$		пн		иц		шщ		נג		סם	
4. Sum of areas	4653		7516		4810		5022		7131		1862		4771	
5. Sum of areas non-coincident	1531		1738		138		350		99		183		99	
6. Legibility coefficient, per cent	32·9		23·1		2·9		7·0		1·4		9·8		2·1	
7. Illegibility coefficient, per cent	67·1		76·9		97·1		93·0		98·6		90·2		97·9	
8. Character	ν	υ	ζ	ξ	п	н	и	ц	ш	щ	ג	נ	ם	ס
9. Recurrence, per cent	5·20	4·85	0·55	0·40	2·10	6·30	3·80	0·68	0·68	0·55	2·10	3·50	2·10	1·45
10. Blackness, per cent	17·8	18·4	27·5	30·6	16·0	16·6	17·4	16·6	18·4	18·9	13·6	14·7	20·7	19·9
11. Illegibility factor	3·49	3·25	0·42	0·31	2·04	6·12	3·53	0·63	0·67	0·54	1·89	3·16	2·06	1·42

Greek (4 characters). Total illegibility factor 7·47. Total recurrence 11·00. Mean illegibility coefficient 67·9. Mean legibility coefficient 32·1 per cent. Mean blackness 18·9 per cent; hence specific legibility 6·07 per cent.

Russian (6 characters). Total illegibility factor 13·53. Total recurrence 14·11. Mean illegibility coefficient 95·9. Mean legibility coefficient 4·1 per cent. Mean blackness 16·9 per cent; hence specific legibility 0·69 per cent.

Hebrew (4 characters). Total illegibility factor 8·53. Total recurrence 9·15. Mean illegibility coefficient 93·2. Mean legibility coefficient 6·8 per cent. Mean blackness 16·6 per cent; hence specific legibility 1·13 per cent.

In Hebrew the two worst combinations ם (mem, final form) and ס (samech), and ג (gimel) and נ (nun), give low legibility coefficients, the average of the two combinations being below 6 per cent, table 39 and fig. 137. Apart from the combinations investigated there is also great similitude

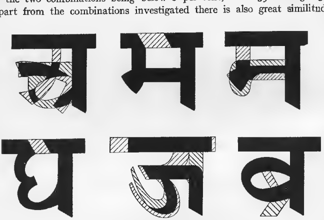


FIG. 138.—*Illegibility: devanagari characters.*
About 14 times full size.

between ב (beth) and כ (caph); ד (daleth), ך (caph, final) and ר (resch); ה (hé) and ח (cheth); ו (vau), ז (zain) and ן (nun, final); and to a somewhat less extent between some other sorts.

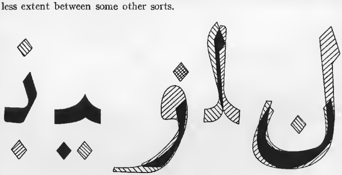


FIG. 139.—*Illegibility: arabic characters.*
About 10 times full size.

The devanagari character, which is so largely used for many of the languages of India, also suffers badly from illegibility. This is greatly due to the fact that most of the characters comprise an unbroken horizontal main-stroke and a vertical main-stroke. This characteristic is so prevalent throughout the individual characters and the combined characters as to serve as a diluent to what would otherwise be distinguishing portions of

TABLE 40.—*Illegibility of devanagari and arabic characters; figs.* 138, 139.

DEVANAGARI (fig. 138).				ARABIC (fig. 139).			
Characters.		Blackness.	Legibility coefficient.	Characters.		Blackness.	Legibility coefficient.
Value.	Form.	Per cent.	Per cent.	Value.	Form.	Per cent.	
				Initial.			
a	अ	23·0	16·5	b	ﺑ	8·5	19·3
ch	च	22·4		n	ﻧ	8·5	
bh:	भ	19·2	6·0	Medial.			
m	म	21·7	11·8	b	ﺒ	7·9	22·0
n	न	21·7		y	ﻴ	9·1	
				Normal.			
dh	ध	18·9	3·6	z	ز	5·4	8·3
gh	घ	20·4		r	ر	4·6	
				w	و	11·9	51·7
û	ऊ	19·4	19·6	Initial.			
j	ज	22·1		a	ا	9·4	62·8
				l	ﻟ	10·0	
v	व	22·6	2·0	Detached.			
b	ब	23·6	3·3	l	ل	14·1	33·5
br	ब्र	25·2		n	ن	8·5	
Average .		21·7	9·0	Average .		8·9	32·9

DEVANAGARI:— The specific legibility is 1·95 per cent. ARABIC:— The specific legibility is 2·93 per cent.

the letters; the interruption of the horizontal line occurs in only two of these which, when the character is used for the Hindi language, appear to the extent of only about two per cent. The comparisons are shown in table 40 and fig. 138.

In arabic, legibility is greatly dependent on the dots and their combinations, table 40 and fig. 139. This character, if it were freed from the complication of the small vowel signs and were made less inclined, would be one of the most legible scripts. Amongst oriental peoples, especially those who are Mohammedans, this face is so largely used that its improvement in the direction of increased legibility, easier composition, and diminished kerning, would enable it to take a very much higher rank than at present. Excessive kerning necessitates the use of soft metal, which gives a poor printing-surface, and, by the yielding of the type, decreased legibility. The influence of modern mechanical methods in diminishing this evil is a great aid to the obtaining of clean, clear printing.

The question of legibility is not merely confined to ordinary letters, whether lower-case or capitals, roman or italic, but also is affected by

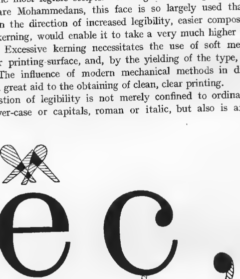


FIG. 140.—*Illegibility; French lower-case accents; points.*
About 14 times full size.

the use of the accents which are common to most Latin languages. In French, the lower-case **e** is used in three accented forms, **é**, **è**, **ê**, as well as unaccented, some other letters such as **a** and **u** are used in two accented forms, also unaccented, while the **c** is used with and without the cedilla. For the same lower-case **e** that is shown in various combinations in fig. 124, the area of which is given in table 32 as 1704 units, each a square having a length of side of 0·001 inch, or an area of one-millionth of a square inch, the respective areas of the accents, fig. 140, are: acute 240, grave 320 and circumflex 340 units; whence the ratio of the additional area to that of the original character varies from 14 per cent to 20 per cent, averaging about 17·5 per cent. The lower-case **c** of the same fount having an area of 1521 units has a corresponding area for the cedilla of 380 units or 25 per cent of the original character. The table shows that the non-coincident areas in the comparison of the ordinary character with the accented character usually differ by as great an amount as exists between the **c** and **e**.

Common to nearly all European languages are the points, and frequently very little difference exists between the full point and the comma. In the fount which has just been considered, the area of the full point or period, fig. 140, measures 214 units, which is already less than the minimum non-coincident area met with in the investigations of this fount. The difference between the full point and the comma, that is the area of the tail of the comma, amounts to only 160 units, and although this area is about 75 per cent of the area of the full point it is a difference which is small compared to the minimum non-coincident area existing in the lower-case. As a percentage difference it becomes more serious in differentiating between the colon and the semicolon, since the added tail in this case only affects the total area to the extent of 37 per cent. The difficulty in recognizing the difference between a comma and a full point is not, however, so great as the difficulty in recognizing the difference between the long **s** (**ſ**) and the **f**, because it usually happens that the full point is followed by an em quad instead of by an ordinary space; and consequently, in running matter, the full point, except when it occurs at the end of a line, can be more easily recognized by the space which follows it than by the absence of the tail of the comma.

INFLUENCE OF PARTS OF THE CHARACTER ON LEGIBILITY.

The aid afforded by the various parts of a character in securing legibility can be investigated to some extent by cutting the character in halves and comparing each half with the corresponding halves of other characters. If we take a horizontal line passing through the centre of the small sorts, a suitable halving will be obtained, and if another character of each sort is similarly divided by a vertical line into two equal halves, the tops, bottoms, lefts and rights of each can be compared. Taking an ordinary roman face, modern or old-style, we find that the number of characters which retain sufficient difference of detail to be still recognizable is as follows:—

	Top.	Bottom.	Left.	Right.
26 lower-case a-z . .	19	16	19	19
26 capitals, A—Z . .	11	22	15	22
Total . .	30	38	34	41

Thus a greater number of characters are recognizable by peculiarities at the *bottom* or on the right side. Now if a line of type is taken and cut horizontally through the middle of the small sorts, and the two halves compared, it is found that the print from the *top* half is quite easily legible while the print from the *bottom* half can only be read with difficulty, fig. 141. The reason for this can be seen at once if the frequency of occurrence of the letters is taken into consideration. If the above characters (lower-case and capitals) are arranged in order of frequency of occurrence and the first fifteen are taken, it is found that out of a total of 1000 characters these will aggregate about 650; of the 650, as many as 550 (or more than one-half the original matter) are recognizable from the top halves while only 275 (or slightly over one-fourth) are recognizable from the bottom halves. This supports the view that legibility is largely dependent on the easy recognition of frequently-occurring sorts, and that the slight difference between the lower-case **e** and **c**, in most cases only a hair-line, is a bad feature. De Vinne makes this line horizontal but much heavier. In the blackfriars

Upper Half.

This half can be read without much difficulty.

Lower Half.

The other half is relatively much harder to read.

FIG. 141.—*Comparison of legibility of upper and lower halves of type.*

face, produced under the direction of one of the authors, this line is made not only heavier, but also inclined in the manner adopted by William Morris in his golden type, thereby further increasing the legibility. A modification of this fount was introduced into America and is known as jenson; the legibility of the golden type, however, is usually marred by the practice of spacing very closely so as to obtain greater uniformity of tint in the printed page.

THE LINE FOLLOWED BY THE EYE.

Several experimenters have examined the position of the imaginary line which the eye of the reader follows in forming mental pictures of words, but no definite conclusions based on actual measurements have so far been given. The problem is one of great importance to the designer of type, because the actual impression made on the eye by the same amount of ink, differently placed relatively to the imaginary line along which the eye travels, is different.

The authors have considered this aspect of the subject, and believe that much can be learned from the resultant character which is obtained by combining all the lower-case sorts, taken in the proportions in which they occur in the English fount scheme. The resultant optical effect of the lower-case letters so combined into the geometric mean of the whole of their printed impressions is shown in fig. 142. In this figure the external rectangle gives both the body and the set of the mean resultant type stem for an investigation carried out on the 12-point old-style fount used in fig. 125; this being one of the most legible faces available. To obtain the diagram shown, enlarged drawings of the whole of the lower-case sorts and of the f-ligatures were measured horizontally for the breadth of each

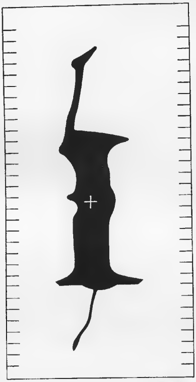


FIG. 142:—*Mean resultant character obtained by combining in their proper proportions the whole of the lower-case characters and f-ligatures of an old-style 12-point face. The centre of gravity of the character is marked by the white cross.*

stroke, and were also measured for the distance of the centre of each stroke from the left-hand side of the boundary of the type at each of the 31 ordinates indicated by the short horizontal lines. The true width of each stroke was then multiplied by the frequency of occurrence reckoned as a percentage of the whole of the sorts under investigation; thus the widths for parts of the letter **e** were multiplied by 11·56 per cent, for **t** by 8·26 per cent, for **a** by 7·44 per cent, and so on. The sum of all the reduced widths so obtained for the abscissæ at each of the horizontal lines marked at the sides of the figure, gave the corresponding mean width of the inked impressions. The position of the centre of each of these different dimensions was obtained by treating each measured part of the impression as having a reading-value proportional to the product of its width multiplied by its frequency of occurrence. By the usual engineering method of taking moments about a given point, in this case on the left-hand boundary of the type of the respective characters—that is about a point in a line corresponding to the left-hand boundary of fig. 142—by the summation of these moments and by the division of the total by the aggregate reading-value of all the sorts, that is by 100, the position was found for the centre of each of the mean widths previously obtained. Some two thousand individual measurements and over two thousand calculations were involved in obtaining the illustration of the resultant mean figure for the lower-case characters.

The preponderance of blackness due to the small sorts can be clearly seen, as can also the relative magnitude of the blackness due to the ascenders and descenders respectively; the influence of the latter is so small that if the figure were reduced to 36-point the line representing the descenders would be of the minimum thickness capable of printing an unbroken line. The outer lines give the body and the set of the resultant type.

The position of the centre of gravity of the area is shown by the intersection of the white cross-lines; it is situated above the centre of the gauge of the small sorts, which it divides approximately in the ratio of 5 : 4.

A comparison of this figure with fig. 141 shows that the eye does not follow the line of maximum blackness, but travels along a line passing either through the centre of gravity of this figure or above it; those features of the type which distinguish one character from another being more apparent in the upper than in the lower portions of the small sorts. Reference to fig. 125, p. 164, which was prepared from the same type face, shows some instances of this as well as one of the two ambiguous cases (**h-b**, **i-j**) in which the upper half of an ascender fails to determine the character.

OPERATIONS INVOLVED IN THE PROCESS OF READING.

Dr. J. McKeen Cattell, of the Psychological Laboratory of the University of Leipzig, in his article on "The Inertia of the Eye and Brain," published in "Brain," has made an important contribution to the subject of legibility.

He has analysed the time taken for the complete process of reading, divided into the various operations involved by the eye and brain respectively, and has further investigated the sensitiveness of the retina to various colours. He found the eye most sensitive to orange light, the sensitiveness decreasing through blue and yellow to red, green, and violet, the eye being less than one-fourth as sensitive to violet light. He then investigated the sensitiveness of the retina for letters and words, using a similar method of exposure through a drop-shutter. He made some 15,000 observations and found that the sensitiveness of the retina in the same observer was by no means constant. In his tests he took separate letters and words of from four to eight letters, and obtained the relative times in which different kinds of letters were legible. He found that small latin letters were slightly less legible than capitals, and that the german letters were considerably less legible than the latin letters, the same applying to words in English and German set in the respective characters. He sums up his observations as follows :—

"Reading is one of the largest factors in our modern life, but at the same time a thoroughly artificial act. Here, as everywhere in nature, the organism shows its power of accommodating itself to its environment, but the large percentage of children who become shortsighted and weak-eyed, and suffer from headaches, gives us sharp warning, and puts us on our guard, lest these diseases become hereditary. Considering the immense tension put of necessity upon eye and brain, it is of the most vital importance to relieve them by using the printed symbols which can be read with the least effort and strain. Experiments are not necessary to show that books (especially school-books) should be printed in large clear type, but experiments, such as I have described, may lead us to determine the most favourable type. It seems probable that the use of two varieties of letters, capital and small, is more of a hurt than help to the eye and brain. All ornaments on the letters hinder, consequently the German type is injurious. The simplest geometrical forms seem the easiest to see. The lines must not be too thin ; we seem to judge the letters from the thick lines, and it is doubtful whether it is advantageous to use thin and thick lines in printing. From all these considerations it seems that our printing-press has not improved on the alphabet used by the Romans. Our punctuation marks are hard to see, and, I think, quite useless. It seems to me far better to replace (or at all events supplement) them by spaces between the words, corresponding in length to the pauses in the thought, or, what is the same thing, to the pauses which should be made in reading the passage aloud. Such a method of indicating to the eye the pauses in the sense would not only make reading easier, but would teach us to think more clearly."

In the opinion of the authors this proposal has many merits, but it is subject to one grave disadvantage. The spacing of the different lines of printed matter must necessarily vary in order to keep the length constant, and any such system would require that the space used to denote the pause for the comma should, at least, be equal to a noticeable increase on the widest ordinary spacing, and a substantially larger maximum would be required to correspond to the long pause given for the period.

Dr. Cattell further observed that not only are some type harder to see than others, but the different letters in the same alphabet are not equally legible. He made a further series of experiments on capital latin letters in which each letter was used 270 times. Out of the trials **W** was found the most easily legible, being read 241 times, whereas **E** was only read correctly 63 times. It is unfortunate that, as in the case of many other eye specialists, the capital letters should be chosen for such experiments instead of the more frequently-occurring lower-case sorts, since the ratio of occurrence of lower-case to capitals, in the English language as printed, is generally greater than nine to one.

Dr. Cattell goes on to say :—

"The great disadvantage of having in our alphabet letters needlessly difficult to see will be evident to every one. If I should give the probable time wasted each day through a single letter as **E** being needlessly illegible, it would seem almost incredible ; and if we could calculate the unnecessary strain put upon eye and brain, it would be still more appalling. Now that we know which letters are the most illegible, it is to be hoped that some attempt will be made to modify them. Our entire alphabet and orthography needs recasting : we have several altogether useless letters (**C**, **Q** and **X**), and there are numerous sounds for which no letters exist. In modifying the present letters, or introducing new forms, simplicity and distinctness must be sought after, and experiments such as these will be the best test.

"Experiments made on the small letters show a similar difference in their legibility. Out of a hundred trials, **d** was read correctly 87 times, **s** only 28 times. The order of distinctness for the small letters is as follows : **d k m q h b p w u l j t v z r o f n a x y e i g c s.** As in the case of the capital letters, some letters are hard to see (especially **s**, **g**, **c** and **x**) owing to their form ; others are misread, because there are certain pairs and groups in which the letters are similar. A group of this sort is made up of the slim letters **i j l f t**, which are constantly mistaken the one for the other. It would not, perhaps, be impossible to put λ in the place of l, and the dot should certainly be left away from **i** (as in Greek). It seems absurd that in printing, ink and lead should be used to wear out the eye and brain. I have made similar determinations for the capital and small German letters, but these should be given up. Scientific works are now generally printed in the Latin type, and it is to be hoped that it will soon be adopted altogether. At present, however, it is impossible to get the works most read, Goethe's works, for example, in Latin type."

It is interesting to compare the results arrived at from observations by Dr. Cattell with those obtained by the authors as the result of direct measurements of the characters themselves.

Another condition, which appears to have been almost entirely absent in the tests carried out by the distinguished experimenters whose researches the authors have mentioned above, is that produced by adjacent letters or combinations of letters, particularly those which immediately precede and follow the character under examination for legibility. For example, the effect produced by the vertical main-strokes of **d** and **b** in the combination **dob** would tend to give a very different average result when read from the same distance as the same letters placed in the order **bod**. The same reasoning would obviously apply to all those combinations which have formed the subject of the authors' investigations.

In making these remarks the authors have no thought whatever of belittling the extremely valuable research work already carried out, but only have in mind the desirability of further research on legibility, especially that of the lower-case sorts, of one or two of the faces most commonly in use and in some of the combinations in which characters are most liable to be confused with each other.

ILLUMINATION AND REFLECTION.

The quality of the paper, its colour, and the colour of the ink.—The quality of the paper has an important bearing on legibility, because a rough surface will of necessity take the surplus ink irregularly from the bevelled edges of the characters and thus produce an irregular appearance in the same sorts; on the other hand, excessive smoothness is inseparable from the reflection of light, which has grave disadvantages. The best effect is secured by having the greatest contrast, and for this reason the ink should be perfectly black and dead in colour, and the paper as white as possible. Yellow and grey tend to diminish the contrast and are unfavourable, while pink and red are actually harmful to the sight. In the search for a distinctive colour which should be the least harmful to the eyes, the late Sir George Newnes consulted many of the highest authorities, and finally adopted on their recommendation the light green shade of paper on which the "Westminster Gazette" has for many years been printed. In cases where much writing has to be carried out on forms printed on coloured paper, it is advisable that the tints selected should be light and should be chosen from the green to the violet end of the spectrum. Connected with the problem of colour of paper is that of the colour of ink, which should be chosen as dark as possible, and for the sake of contrast should contain the complementary colour when intended for use on coloured paper. Printing in light blue, or green, on white paper should be avoided, as the contrast is insufficient.

Reflection of light, and illumination.—The question of reflection of light from the paper has still greater importance now that artificial light is so much used in reading. A highly-surfaced paper is required for printing the half-tone and process blocks with which many high-class papers, magazines and books are illustrated; in some instances the illustrations are printed on separate sheets or plates of high-surface or art paper so as to permit of the use of a non-reflecting paper for the subject matter of the work. The increase in the use of high-surfaced papers demands that the lighting of all rooms used for study should be as diffused and as uniform as possible.

Irradiation.—This factor also plays an important part in the legibility or illegibility of various forms of character and styles of type, but its effects are largely spread over and accentuate the reactions due to the other

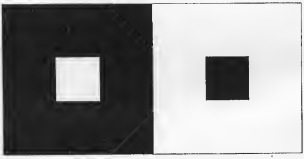


FIG. 143.—*Irradiation producing illusion of size.*

causes enumerated above. It produces illusions in respect to size of figure and thickness of line which can be seen in fig. 143, in which the squares are of the same size though the large black square appears to be smaller

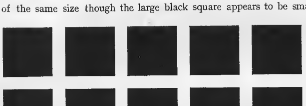


FIG. 144.—*Irradiation producing illusion of tint.*

than the large white square and the small white square larger than the small black one.

Another disturbing effect produced by black areas closely spaced on a white ground is that shown in fig. 144; on looking at this it will be seen that misty grey patches appear to form at the intersections of the white lines.

CHAPTER XII.

PUNCH-CUTTING.

> "*Letter-Cutting is a Handy-Work hitherto kept so conceal'd among the Artificers of it, that I cannot learn any one hath taught it any other; But every one that has used it, Learnt it of his own Genuine Inclination.*"
>
> *Moxon's Mechanick Exercises.*

10-point blackfriars italic (Blackfriars, formerly Wicks).

So true is the quaint old quotation given at the commencement of this chapter, that but one other writer besides Moxon himself is known to the authors as having dealt technically with punch-cutting. It seems hardly credible that up to the end of the nineteenth century the only two books that deal fully with this important matter, the very basis of all typography, should be that of Moxon in 1683 and that of Fournier in 1764. Fournier, an original copy of whose beautiful work the authors have the good fortune to possess, states that in France up to his time no description of punch-cutting had been written; and he was apparently unaware of the existence of Moxon's work in English, for he says: "L'Art de la Gravure des Caractères n'a jamais été décrit."

A great deal of attention, which he rightly characterizes as of no practical value, had been given to the designing of letters upon geometric principles, these principles themselves being based on the proportions of the human form. In 1240 was published the striking mathematical and arithmetical work of that wonderful wanderer, Leonardo of Pisa, the knowledge contained in it being drawn from Arabian sources; and following him at a considerable interval came Lucas de Burgo or Paciolus. There is little doubt that these writers exercised considerable influence on the mathematical researches of Leonardo da Vinci when that marvellous genius in A.D. 1500, or possibly before that date, was making his series of studies of lettering and the design of letters based on arbitrary proportions of the human form combined with geometric figures. Albrecht Dürer on his second journey to Venice in 1505 probably became cognizant of Leonardo's work, and he subsequently spent much time and labour in the elaboration of the same idea. From this period onwards many authors, notably among them Geofroy Tory, a bookseller in Paris in 1526, yet further developed the idea, and by him and his successors it was carried to impossible lengths. Fournier rightly says that the judgment of letters should be by eye and taste, and that the idea of reducing their design to arbitrary geometric rules is absurd, and still more absurd the reduction of the larger squares and circles of the earlier designers to sizes so minute as to be beyond handling by aught save the imagination. All through this mass of drawing, of letterpress and of lettering, one looks in vain for any practical hints for the reduction of designs to useful steel, and for any practical suggestion whatever as to their further use for the production of punches or for any description of the process it would be needful to employ.

Punch-cutting.—In the process of cutting a punch by hand, the end of a piece of steel about 2 inches long and $\frac{1}{4}$ inch square (in the case of pica and smaller bodies) is filed up square to two adjacent faces which have been squared up. This face is ground true on an oilstone by means of the jointer or stone-facer of hardened steel shown in fig. 145. The character

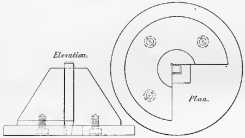


FIG. 145.—*Jointer or stone-facer for punches.* Half size.

is then marked out on the face of the punch with a scriber and the counters struck in by means of counter-punches used by hand with a hammer. The punch is kept true on the face by occasionally rubbing on the oilstone in the stone-facer, and the sides are trimmed off with gravers and engraving tools. The production of the work requires the continued use of a magnifying eye-glass, combined with the artistic ability to produce the correct curves, and the accuracy to work to a limit of 0·0003 inch. There are not many good punch-cutters, and it can be easily understood that a punch-cutter capable of working to this degree of accuracy earns about £4 to £6 per week. Moreover, the amount of work finished by this method is not large, and the punches of a fount so cut by hand are found to cost on the average about fifteen shillings each: though to the engineer who has purchased a small complete alphabet of 27 punches with a set of 9 figures for 5*s.* or 6*s.*, this cost, without further explanation, appears absurd. As the engraving of the punch is proceeded with, the face is smoked and an impression taken on a piece of fine-surface paper alongside an impression similarly taken from the corresponding standard character, the **H, o, m,** or **p,** according to the character which is being cut. The smokes are examined with the magnifier and the work continued till the result agrees to the desired extent. Since the punch is the first stage in the process, and from it a matrix must be obtained, in which again the type is cast, the problem is one of cumulative error. In the case of the punch, the very thin film of deposited carbon, forming the smoke, enables a higher degree of accuracy to be obtained than prevails with the inked impression made from the type. The hand-cut punch when finished has a long taper, from $\frac{1}{2}$ inch to $\frac{3}{4}$ inch in length, and the bevels of the actual strike are seldom constant in slope, fig. 146. Moreover, the face does not occupy a definite position relatively to the sides of the shank. Owing to the great expense of cutting punches by hand, the hand-cut punches for the vowels and the **n** are usually ground

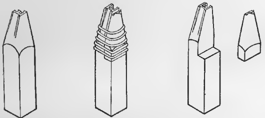


FIG. 146. FIG. 147. FIG. 148.

Hand-cut punch; with accent punch attached; and with accent punch detached.

away flat on the back to enable them to be used in conjunction with separate punches for the accents. This first step towards economy in punches gives very unsatisfactory results. Figure 147 is a reproduction of an illustration in Fournier's classic work, which plainly shows that this practice was well known in his day.

Punch-cutting by machine.—The history of punch-cutting by machinery is not difficult to trace. According to De Vinne, Darius Wells, a printer of New York, abandoned printing in 1827 for the manufacture of wood type. To abridge the tedious work of cutting away, by means of hand tools, the counters and shoulders from the drawing on wood as had been done hitherto, Wells made use of a simple tool which he called the router. This was a flat-faced and half-round steel bit, still known by the same name, made to rotate at a high speed. The bit was suspended vertically, over the wood to be cut, by attachments made for raising it or depressing it at will. The block of wood to be made into a type was firmly fastened under the router, and the operator moved the cutter spindle round the pattern until every part of the counter and shoulder was removed.

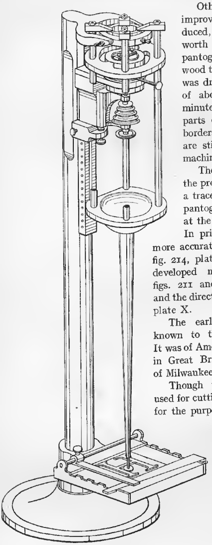


FIG. 149.—*Original Benton punch-cutting machine; from patent specification.*

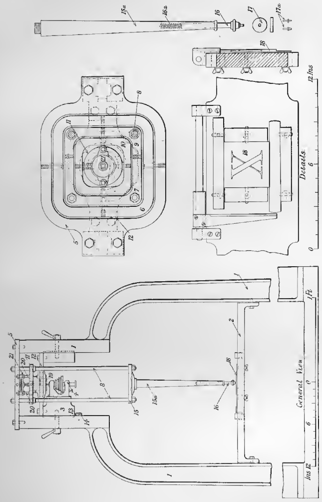
Other machinery, with various improvements, was gradually introduced, and in 1834 William Leavenworth of New York adapted the pantograph to the manufacture of wood type. The router in this case was driven at the very high speed of about 14,000 revolutions per minute, and cut the superfluous parts out of the design. Letters, borders and ornaments of all kinds are still made with Leavenworth's machine, or improvements upon it.

The routing machine used for the production of wood type carries a tracer at the remote end of the pantograph and a high-speed cutter at the copying centre of the frame. In principle it is the same as the more accurately made engraving machine, fig. 214, plate XIII, the still more highly developed matrix-engraving machines, figs. 211 and 212, plates XII and XI, and the direct-cutting pantograph, fig. 164, plate X.

The earliest punch-cutting machine known to the authors is the Benton. It was of American origin and was patented in Great Britain by Linn Boyd Benton of Milwaukee in 1885.

Though this machine was originally used for cutting master-type in type-metal for the purpose of producing matrices by electro-deposition, it was subsequently improved, and, known as the Benton-Waldo, was used for the cutting of steel punches, and is still in use. To Benton, therefore, undoubtedly belongs the credit of priority in this field.

The machine is an adaptation of the pantograph, but instead of the model and its reduction being in one plane, the punch is arranged vertically over the model or former. The machine, fig. 150, consists of a vertical



Enlarged view of details and follower-stem.

FIG. 150.—*The Benton-Waldo punch-cutting machine.*

frame 1 which carries the table 2 on which the formers are secured. The frame is also fitted with a slide 3 in which the watchmaker's lathe-head 4 can be placed into position. Several of these heads are required for each machine, and they must be made interchangeable so that the axes of the milling, the roughing, and the finishing cutters all agree within the permissible error. At the top of the frame is fixed the top gimbal-plate 5 in which is pivoted the outer gimbal-ring 6. At right angles to the fixed axis of the outer gimbal-ring and in a plane passing through that axis are the centres of the inner gimbal-ring 7 to which the four slide-rods 8 are secured. These slide-rods are ground true and parallel and are a sliding fit in the lower outer gimbal-ring 9, the holes in which are fitted with bushes lapped true. The lower inner gimbal-ring 10 is pivoted to the outer gimbal-ring and also to the sliding head 11, the axes of the centres being parallel to those of the upper gimbal-ring. The sliding head is fitted with large flanges above and below the adjustable slide-frame 12, the surfaces being ground

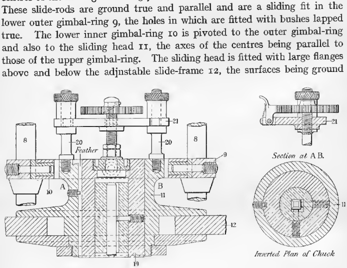


FIG. 151.—*The Benton-Waldo machine; detail of sliding head and chuck.* Half size.

true and parallel. The slide-frame has large vertical bearing-surfaces on the sides of the frame, and can be rigidly clamped at any desired height. The height is usually adjusted by bringing the frame down on a gauge 13 of the requisite size placed on the stop 14. The four slide-rods 8 are rigidly connected at their lower ends to the follower-head 15, to which is secured the follower-stem 15*a*. The upper part of the follower-head is cup-shaped; it catches the shavings which fall from the tools and so keeps the former 18 clear. The lower end of the follower-stem is bored up with an axial hole in which slides the follower-carrier 16; a spring 16*a* keeps the follower-carrier pressed down on the former 18. The end of the follower-carrier below the button fits into the holes in the larger followers 17, of which there are some twenty ranging from 3 inches to 0·13 inch in diameter; the end of the follower-carrier is 0·10 inch in diameter, and some ten followers 17*a* of smaller diameter fit inside the axial hole in the follower-carrier which then compresses the spring 16*a* to a greater extent. The sliding of the follower-carrier in the follower-stem ensures exact proportionate movement of the punch when the axis of the follower-head is inclined to the vertical.

The sliding head, fig. 151, is bored and lapped axially with the lower gimbals, and the chuck of hardened steel 19 fits in this hole ; it is prevented from rotating by a ground and lapped feather fitting without shake. On each side of the chuck are distance-pillars 20 shouldered at the top ends to receive the bridge piece 21 carrying the chuck setting-screw. The chuck setting-screw is fitted with a divided wheel ; the divisions are figured on the top and milled in the edge as nicks by which a spring latch locks the wheel to the bridge, and each division corresponds to 0·00025 inch of depth. Thus the chuck can be instantly removed, the punch inspected and accurately replaced as the work proceeds. Owing to the high degree of accuracy required, these machines formerly cost some £800 each. The authors recently found, however, that it was possible to

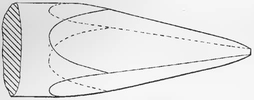


FIG. 152.—*Roughing or chisel tool for punch-cutting machine.* 20 times full size.

reduce this sum considerably, while obtaining the same degree of accuracy, in their improved punch-cutting machine recently patented.

The form of milling cutter common to all the different punch-cutting machines described, is shown in fig. 153. It is parallel and about 0·06 inch in diameter. The other cutters used are the roughing and finishing cutters. These are of peculiar shape, the four faces being cylindrical ; the cutting edges, which are formed by the intersection of each pair of cylindrical surfaces, are therefore elliptical. In the roughing cutter, which has a small, chisel edge, fig. 152, two opposite cylindrical faces have their axes in a plane different from that of the other pair. In the finishing cutter the axes are all in one plane and a pointed symmetrical cutter results, fig. 156. To obtain the cutting edges accurately true to position, a hardened steel rocker-plate is used in conjunction with an oilstone slip. The rocker-plate is secured against its upper surface in the rocker frame, fig. 154, so as to admit of repeated regrinding to flatness. The oilstone slip is moved to and fro on the hardened steel surface which is cut away to clear the cutter. Both the rocker and the lathe-heads fit interchangeably on a watchmaker's lathe-bed. The heads are divided into four divisions, so that each face of the tool can be brought uppermost, and while the oilstone is applied the elevating screw is worked up and down by one finger of the operator, so that the plane of the oilstone is successively tangential to each portion of the cylindrical surface which forms the face of the cutter. To obtain the chisel face of the roughing cutter, the position of the lathe-head relatively

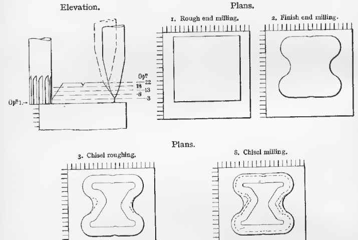


FIG. 153.—*Operations of punch-cutting.* About 4 times full size.
The figures preceding the titles give the number of the operation performed.

to the rocker is varied slightly for two of the opposite faces by inserting a thin distance-piece between the head and the stop on the rocker.

The punch is cut in the following manner. Pieces of steel are cut off to a given length, annealed and ground true and square on two adjacent sides and on the end. To save work on the punch-cutting machine the ends of the blanks are rough-milled to certain simple forms, according to the

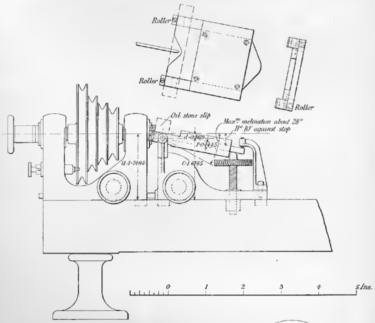


FIG. 154.—*Rocker sharpening appliance for the cutters used on the punch-cutting machine.*

body of the fount required. The punch is held in the chuck against these true faces of the stem by the pressure of two grub-screws, and then is rubbed down truly flat on an oil-stone, the chuck acting as the stone-facer described above. The first operation in the punch-cutting machine, after setting it to the proper reduction ratio for the fount, is to mill round the outline to the depth of strike desired; a follower is used of the proper diameter to prevent the mill cutting away any of the beard. For this operation the parallel end-mill is used.

The roughing cutter is next used, and two or three cuts are taken round the periphery of the punch; this finishes the beard next to the shoulder. The depth of cut is then reduced

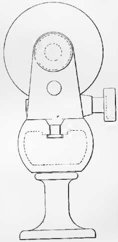


FIG. 154.—*End elevation.*

and a smaller follower used, the depth, corresponding to each diameter of follower, being obtained from a table which is prepared for each body ; thus a series of approximations are made to the plane face of the beard, fig. 153 elevation. Some twenty-two cuts in all must be taken round the outside of the character, and some of these also inside the counter, the finishing cutter being used at the end of the process in order to obtain the outline at the surface of the punch. Figure 153, operations 8 to 22, plans, shows the path of the point of the cutter at five different depths, while the elevation shows how an approximation to a uniform bevel is obtained. By suitably choosing the distance by which the chisel end is advanced in the

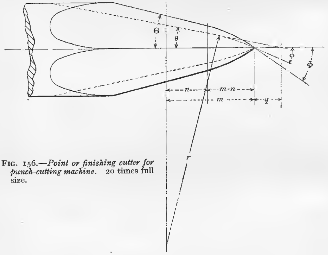


FIG. 156.—*Point or finishing cutter for punch-cutting machine.* 20 times full size.

sharpening, it is possible to obtain a cutting edge which closely approximates to a straight line for a length of about 0·011 inch.

The steel punch in three states : roughed out with the mill, cut out in the counters, and dressed to give a non-rubbing strike, is shown in fig. 155, plate V.

The dimensions of the height of the centre of the lathe and of the rocker being known, the various dimensions of the point cutter shown in fig. 156 can be obtained as follows :—

Let the height of the centre of the lathe $a = 1·7464$ inches,

the height of the centre of the rocker plate $c = 1·6145$ inches,

the height of the rocker-plate top when horizontal $b = 1·7590$ inches,

and let the minimum inclination from the horizontal, θ, given to the plate when sharpening be the angle $11° \ 10'$. This dimension, however, is not really important.

Then the details of the point cutter and the position of its vertex in relation to that of a square pyramid having the vertical angle between two opposite faces equal to θ can be determined as follows :—

r the radius of the cylindrical face of the cutter $= b - c = 0{\cdot}1445$ inch,

d the height of the lathe centre above the rocker centre $= a - c = 0{\cdot}1319$ inch,

$m = \sqrt{(r^2 - d^2)} = 0{\cdot}0590$ inch,

$n = r \sin 11° \, 10' = 0{\cdot}0280$ inch ;

hence $m - n = 0{\cdot}0310$ inch and

$m - n + q = (r \cos 11° \, 10' - d) \cot 11° \, 10' = 0{\cdot}0501$ inch ;

whence $q = 0{\cdot}0191$ inch.

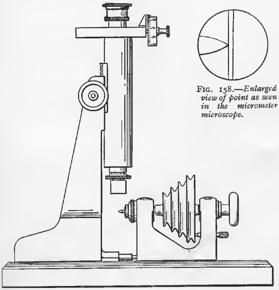


FIG. 158.—*Enlarged view of point as seen in the micrometer microscope.*

FIG. 157.—*Micrometer microscope measurer for position of point of tool.*

NOTE.—The amount of error introduced by the wear of the sharpening appliance is measured and added to the constants on the table of settings worked to on the machine.

The angle ϕ between the tangent plane at the vertex and the horizontal can be found, since $\tan \phi = 0{\cdot}445$; hence $\phi = 24° \, 0'$ and over the cutting edges $\tan \Theta = \sqrt{2} \tan \theta$; hence $\Theta = 15° \, 30'$ and $\tan \Phi = \sqrt{2} \tan \phi$; hence $\Phi = 32° \, 20'$.

From these particulars it is possible to draw the point of the cutter to a large scale, such as 1000 times full size, using the dimension q to obtain the distance between the vertex of the pyramid formed by the tangent planes and the point of the cutter, and the dimension $m - n$ to obtain the position of the normal section at contact of the tangent planes. The curve can then be treated as an approximation to a parabola and drawn through points obtained by offsets from the tangent; then by taking sections a series of points on the cutting edge of the chisel tool can be obtained.

By completing the work it is possible to obtain the conditions giving a form of cutting edge for the chisel tool approximating to a straight line much more closely than could ever be obtained in practice; and further, the inclination Φ of the finishing portion of the cutting edge to the axis can be made such that $\tan \Phi = 0{\cdot}500$, or $\Phi = 26^\circ\ 24'$.

This angle enables all subsequent calculations to be greatly simplified, since the alteration in diameter of the cutter at a given distance from the lathe-stop is equal to the distance that the vertex has receded from its normal position.

The authors have designed a bifilar microscope, figs. 157 and 158, for the purpose of comparing the position of the cutter point after sharpening, with the normal position which it should occupy, the one hair of the field of the microscope retaining its normal position and the movement of the micrometer cross-hair giving the correction for the table of settings.

The finished punch must be examined under the microscope to see that no error has been made in the cutting. The next operations are hardening and tempering. These do not appreciably distort the character itself, but they introduce errors of three kinds into the punch, and these would prevent it being held perfectly true in the striking-press. The face becomes out of square to each of the originally true sides, and the line is no longer square to these sides. To justify the punch, a small vice, swung on gimbals, has been designed, the two movements of inclination being each operated by a separate micrometer screw. To use the vice the errors of the punch are measured on two adjustable squares, in each of which the face of the punch is set true by a micrometer screw giving identical readings for the same angles as those operating the vice adjustments respectively. The swing vice is secured to the table of an ordinary surface-grinding machine, and one side of the stem of the punch is ground true to the face. The next side is similarly treated, and the depth of cut taken is so arranged as to justify the character relatively to these two sides. The trueing up of the remaining two sides to size then requires no special skill, a batch of punches being ground up together on a magnetic chuck.

Other improvements in punch-cutting machinery were brought out by Mark Barr for the English Linotype Company about the year 1900. His machine shows some useful and important improvements upon the earlier form of punch-cutter. Ball-bearings and ball-slides were used for ensuring optical contact without friction; this was the method introduced by this able inventor after extensive tests made for the Linotype Company in which it was proved that the failures of many instruments of precision were due to the presence of an oil-film between the surfaces.

A device which is specially noteworthy in connexion with the tool-

PLATE V.

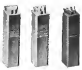


FIG. 155.—*Machine-cut punch.*
Roughed round, cut out in counter and finished.

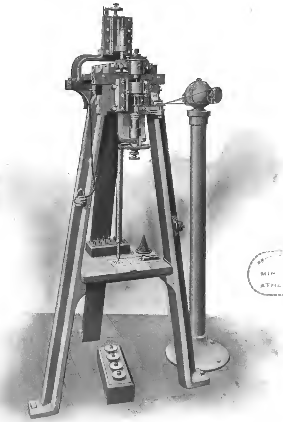


FIG. 159.—*Barr or Linotype punch-cutter.*

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PLATE VI.

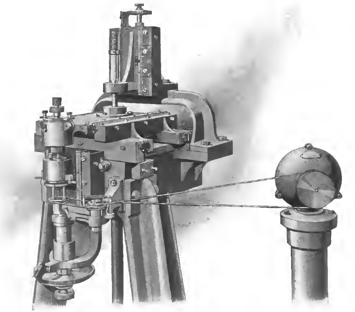

FIG. 160.—*Barr or Linotype punch-cutter; details.*

To face plate VII.

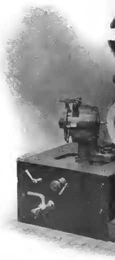

FIG. 161.—*Ba*

PLATE VII.

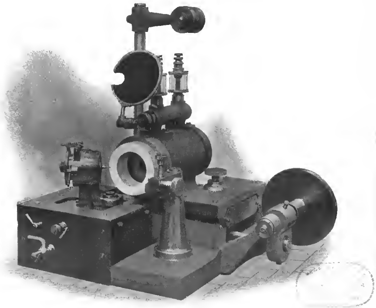

Fig. 161.—*Barr or Linotype automatic cutter-grinder.*

[*To face plate VI.*

PLATE VIII.

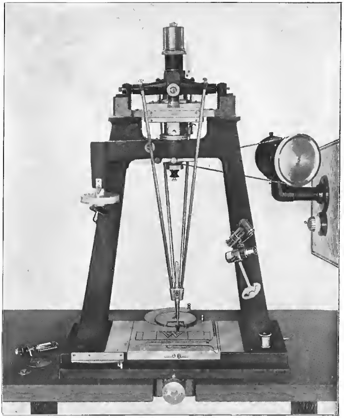

FIG. 162.—*Pierpont or Monotype punch-cutter.*

To face page 205.]

feed micrometer, is a microphonic attachment with a telephone circuit so arranged that the operator can adjust the position of the tool to 0·00003 inch. By means of the microphone, it is claimed that the newly-ground tools can easily be put into the exact position of the tools that preceded them, and further, that the operators can use the device in order to listen to the cutting operation of the tool, and consequently the progress of the cutting can be followed by the operators as easily as the progress of work on big and heavy machines can be followed by listening to the sound of the cutting tool. The grinding of the tools also received attention at the same hands, and an automatic tool-grinder was produced for grinding the tool-form to shape. The influence of the shape of tool-form on the alteration in the setting numbers was also investigated by Mark Barr, who prepared graphical diagrams to facilitate the establishment of tables of setting numbers for any desired ratio of reduction. The mathematics of the subject were carefully dealt with by the same authority, and a form of tool was adopted which is substantially the same as that adopted by the authors and shown by them in fig. 156.

The machine is illustrated in figs. 159, plate V and 160, plate VI, and the automatic cutter-grinder is shown in fig. 161, plate VII.

A great amount of inventive skill has been devoted to the design of punch-cutting machines intended to operate in the same manner as the engraving machines used for the reproduction of medallions, busts, and other relief surfaces; that is to say, having controlled movements in three dimensions instead of in only two dimensions. By means of a suitably-tapered tracing point, a former of sufficient depth, and a cutting tool which is an exact reproduction on a reduced scale of the shape of the tracing point, it is possible, by properly-designed mechanism, to adjust the depth of the cut of the tool by the depth to which the tracing point is carried on the former or model, and in this way it is hoped that a continuous cutting operation can be performed in the counters and the crotches of the letters instead of cutting a succession of contours as is the case in punch-cutting machines. The introduction of this third system of linear movement into the construction of the machine is one, however, which results in an amount of complication altogether disproportionate to the small advantages which might be gained. The engineering and mechanical difficulties involved in making a punch-cutting machine to work in two dimensions only, with six interchangeable lathe-heads all capable of working to a total error of 0·00025 inch when used in conjunction with each other, is sufficient to deter those who have had much personal experience in the operation of these machines from undertaking any further introduction of gimbals, slides, or adjustments.

The Monotype or Pierpont punch-cutting machine, a front view of which is shown in fig. 162, plate VIII, is designed upon the same general principle as the Benton-Waldo, the common ancestor of all punch-cutting machines, but modified and improved so as to obtain a greater output with less-skilled labour. The formers, like those of the authors, are made with the letters properly placed relatively to their exterior, so as to produce a punch with a correctly-located face and one which will consequently require the minimum of justification ; the definite positioning of the former is obtained by means of a triangular projection from the side clamping piece, which engages with a notch of corresponding shape and size in the side of the former when this is clamped in place. The set of followers required for a particular size is carried in a holder which rotates step by step as each follower is used. The micrometer head by which the punch is raised after each cut has been made, is constructed with peripheral notches to receive a spring-pin, these notches being placed at the correct angles to correspond both to the ratio of reduction for which the machine is set, and to the follower to be used for the cut ; consequently it is only necessary to move the index-plate one notch for each change of follower.

The graduations of the adjusting collar are made in terms of maximum gauge, from the top of the highest ascender to the bottom of the lowest descender of the face ; the micrometer head index-plate and the set of followers are changed for each change of reduction ratio.

The finish of the punch is determined by examination of the tool after the cutting is completed. If the edges of the tool are perfect it can be assumed that the work is correct.

In order to make it possible to produce founts in which the set width is proportionately increased or diminished throughout, while the body-size remains constant, a compensating device is used. The tools are ground on a special appliance, diamond dust being used for finishing them ; as is usual in such operations, the tools are measured under the microscope before being put to work.

The punch-cutting machine, shown in fig. 163, plate IX, designed and patented in 1910 by the authors, is in daily use for the production of commercial punches ; it differs in important essentials from any of those described. Considerable experience in the construction and working of Benton-Waldo machines had made it clear that the chief sources of loss of time in operating were due to the position of the micrometer adjustment for the depth of cut, the difficulty of reading the setting of the wheel controlling this position, the absence of suitable arrangements for positioning the formers on the table, and the want of uniformity in the ratio of change of size of the tracing points. Further waste of time in operating these machines arose from the difficulty presented by the mode of securing the bridge-bar of the micrometer for setting the chuck, and the impossibility of examining the work while in progress.

In the machine designed and built by the authors the chuck is fitted on the point, line and plane system, so that one of the most costly features of the Benton-Waldo chuck, namely the extremely accurate fitting of the key and key-way, upon which the position of the chuck largely depends, is superseded by a far simpler and equally accurate method.

The micrometer screw is placed alongside the chuck, the axes of both being parallel, and the nut, working on the micrometer screw, is cut with helical teeth and is controlled by a helical wheel carried on a horizontal spindle working in bearings fixed to the sliding head of the machine. The end of this spindle is provided with a graduated wheel of large diameter, and is so placed that the divisions to be read are directly in front of the eye of the operator. This enables the work to be carried on continuously by the operator without necessitating his rising from his seat for the purpose of looking down through the gimbal-rings at a small divided setting-wheel carried above the chuck head in a position somewhat difficult of access.

In the authors' machine special attention has been given to the accurate positioning of the formers on the table. This has become of greater importance now that the faces are almost without exception cut to standard line, which necessitates a change of position of the former relatively to the centre of the body on which the character will fall in different sizes.

Moreover, for certain reasons connected with the positioning of the punches in the striking process and the fact that a standard allowance of side bearing is made in the matrices, it is necessary to provide accurate position of the face relatively to two faces of the punch-blank. The one set of conditions produces an irregular effect upon the alteration of position of the former or model, whereas the other set of conditions produces a proportionate change of position on the bed of the machine in order to keep that portion of the punch-blank, corresponding to the body-size required, in its proper relative position with respect to the two trued faces of the punch-blank. To enable the machine to deal with these conditions, the table is made recessed with a system of packing-pieces and vice-jaws, thus allowing the former to be placed accurately into the required position for the particular body-size for which the punch is to be cut. Special provision is made for cutting accented characters by fitting an extra pair of vice-jaws for securing the separate former carrying the accent. Squares are fitted to the machine for the transference of the standard line from ordinary characters to accented characters, and squares are also provided of a novel form, with transparent blades ruled with lines, for enabling the sides of the punch to be milled as closely as may be desired to the periphery of the character when the punches are required for the production of non-dressing matrices or machine matrices similar in style to those used in the Monotype machine.

It may be here remarked that when all punches were cut by hand it was the practice to use the capitals of one fount as the small capitals for another, but under modern manufacturing conditions this has proved to be a mistaken economy.

The want of uniformity in the ratio in change of size of the followers or tracing points caused some irregularity in the appearance of work cut from the same former in different body-sizes. The authors adopted a system of followers in which the sizes increase uniformly from the smallest to the largest in geometrical progression. In order to examine the work in progress, in the Benton-Waldo machine, it was necessary to slack back the two screws securing the bridge-bar and to lift the chuck and bridge-bar clear of the machine. It also required considerable skill to machine out the counters properly with this arrangement for securing the chuck. To examine the work, it was necessary to remove the chuck, with the punch in place in it, to the bench and to examine it under a microscope. In the improved machine a microscope with a reflector and electric illumination is so arranged that under normal conditions it is swung on pivots to one side clear of the machine, but when it is required to examine the work it can be brought round against a stop, in doing which it automatically switches on the electric current necessary for illuminating the object, and the eye-piece comes into such a position that the operator can examine the face of the work without leaving his seat. The method of securing the chuck is also simplified; the chuck is held in place against the micrometer by a spring-bolt controlled by a grip-handle which enables the chuck to be released instantly and removed from the machine when desired, without the necessity involved on the Benton-Waldo machine of slacking the two bridge-screws. In addition to the machine being more substantially constructed throughout, there are other minor advantages all tending to the increased comfort and convenience of the operator and therefore to greater outpnt.

Formers.—The genesis of the former is to be sought in the somewhat primitive plant used for the production of wooden type. In the manufacture of wooden type, model letters were, in the first instance, drawn for all the characters on cardboard, and these were then neatly cut out to serve for patterns. Later, sheet-brass patterns were used instead of these cards, and after them came cast-brass patterns with elevated edges.

The first formers for the Benton-Waldo machine known to the authors, and indeed, the formers still generally used in that machine, are prodnced by electrotyping in the following manner. Type-metal plates of equal and uniform thickness are coated with a wax composition which is shaved off on a machine to the thickness required for the raised portion of the letter. The character is drawn on paper to an enlarged scale, and reduced by means of a pantograph, the tool of which is lowered so as to pierce the wax and push its way through it, the first tracks which it makes being kept a small distance away from the finished line. After the character has been roughed out the vertical wax surfaces are rubbed true by going round the enlarged letter with the outside of the tracer pin touching the line on the drawing. The burr on the wax is dressed off on the shaving machine; the wax is examined and any holes or defects made good; it is then black-leaded and electrolytically coated with copper to a thickness of

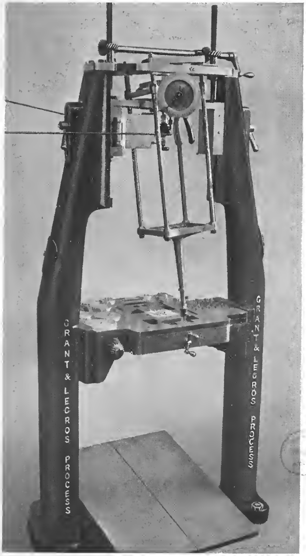

FIG. 163.—*Grant-Legros punch-cutter.*

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PLATE X.

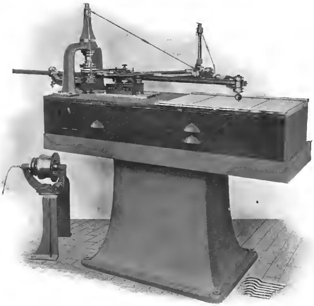
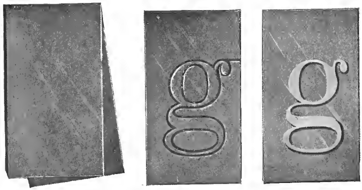


FIG. 164.—*Barr or Linotype direct-cutting pantograph for formers.*



(*a*) The hard-brass plates before hydraulic soldering.
(*b*) After cutting and riveting through letter.
(*c*) The finished pattern.

FIG. 165.—*Linotype; production of former; Barr's process.*

To face page 209.]

about 0·03 inch. The copper shell is removed by melting out the wax, its rough edges are trimmed, and it is then tinned inside and filled with lead. The filled formers are milled off on the back to thickness, and squared up on the justified edges so that the character is truly in place relatively to these edges.

The authors understand, on excellent authority, that formers in the Mergenthaler Linotype Company's Works in Brooklyn, New York, are made on a somewhat different system.

A blank of plaster composition, similar to that used for engraving in certain line-engraving processes, is cut away by a revolving cutter carried on the pantograph, the tracer pin of which is caused to follow the outline of an enlarged drawing previously prepared. The plaster blank so cut is then placed in a mould and a cast made from it in type-metal; this cast, produced under conditions comparable with those obtaining in a type-foundry, or rather in stereotyping, requires but little, if any, treatment before it can be used on the table of the machine.

The English Linotype Company has adopted a process invented by Mark Barr. In this process two strips of special brass, accurately drawn and milled to size, are soldered together with a special solder, of low melting-point, of which cadmium forms an important constituent. The soldering is performed under hydraulic pressure so as to avoid heating the brass unduly and thereby impairing the good cutting-quality for which it is specially selected. The milling cutter, carried on a pantograph of exceptionally substantial construction, fig. 164, plate X, is used to follow the outlines of the character which is enlarged from twenty to two-hundred times full size. After the outline of the character has been milled round, with the result that the removal of the superfluous metal would leave the character in relief on the backing-plate, holes are drilled through this relief and the backing-plate, and the relief is riveted to the backing-plate to prevent change of position in the subsequent operation. It is essential, in the cutting operation, for the point of the cutter to penetrate the solder without going beyond, so that on gently warming the plates the character remains in place as a relief and the superfluous metal, becoming detached, can be removed, fig. 165, plate X.

To obtain the requisite accuracy of rotation of the cutting tool, and to maintain this accuracy under the condition of the high speed at which it was necessary for the tool to rotate, a special form of cutter head was devised by Mark Barr in which tractrix bearings were used. The peculiar property of wearing uniformly over the length of the bearing possessed by the surface generated by the rotation of a tractrix about its axis proved effective in use and enabled the cutter heads to run, practically, without repair. It should be noted that this result was obtained by this gifted inventor by means of a novel and highly ingenious appliance for originating an extremely close approximation to a true tractrix curve.

The Monotype, the Typograph, the Monoline, and the Victorline companies, who are or were all large producers and users of formers so far as is known to the authors, employ the old Benton-Waldo electrotyping methods already described.

The American Type Founders Company, though employing the old electrotyping method for the production of their formers, make use of a rather interesting form of enlarging pantograph with a microscopic attachment. Directly beneath the field of the microscope is a small bed-plate or holder on which the character to be copied is secured. The point of intersection of the cross-hairs of the microscope, having been focussed on the outline of the character, is made to follow it, with the result that the pencil point of the extension arm of the machine reproduces the character as an enlarged drawing. The bed of the holder which carries the original character can be swivelled to any angle with the plane of the pantograph, by which means the style of the letter can be changed to extended or condensed. This machine is stated to have a range of production from 0-point to 96-point.

The pantograph used by the American Type Founders Company in the cutting and making ready of their waxes as a preliminary to the electrotyping process differs from those already described. In it the wax-coated plate is held in a horizontal position at the top of the machine. Immediately under the tracing needle, which works on the face of the wax plate in an inverted position, is a mirror to enable the operator to follow the movements of the needle while copying the outlines.

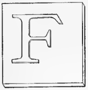


FIG. 166.—*Grant-Legros former.*

Cement formers.—A new process for making formers, patented by the authors, may be briefly described as follows:—

A pantograph is used to trace from the enlarged drawing, and its work is facilitated for the operator by the use of a series of specially-designed curves of the form of logarithmic spirals, fig. 167. These curves are also used in the preparation of the enlarged drawings. Each of these drafting curves is made to fit the drawing and to reproduce it either concave or convex, as may be desired. A series of logarithmic spirals of gradually-increasing obliquity is drawn, and the curves either used as single lengths or subdivided into two or more lengths for convenience of handling. Each of these sections is marked with a distinctive reference letter. Each of the curves is graduated along its length, and, by a well-known property of the logarithmic spiral, the division of the curves into a series of equal parts will give the radius at each point so marked. By combining two or more of these curves on a drawing, any desired degree of approximation to an existing curve can be obtained: and, by writing against points on any curve so drawn, the reference letter taken from the curve used and the radius at that point obtained from the graduation on the edge of the curve, it is possible, without loss of time, to select and place correctly the curve in question either on the inside or the outside, as may be desired, when using the tracing point of the pantograph.

A further advantage arising from the use of these curves is the facility which they afford for enlarging or reducing any curved figure proportionately; this is a property which is of great value in preparing those formers of similar shape but larger size used for the lower-case sorts of the smaller bodies.

The curves used by the authors are graduated to correspond to the scale used on their drawings, so that a truly rational system of working

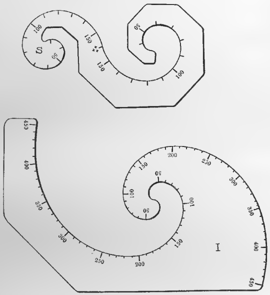


FIG. 167.—*Grant-Legros logarithmic spiral curves.*

with curves is obtained, with the result that an unskilled operator, by merely following instructions, can reproduce the original curve without trial and error, and consequently at much greater speed. By the use of a pantograph and of these curves, an intaglio letter is rapidly cut into a layer of wax previously cast on a glass or metal plate of true square form. The interior of the counters is removed from the characters, and the wax, which, unlike that used in the previously-described processes, is a homogeneous substance, is planed true and finished. The glass or metal plate with the finished wax is then placed into a wooden or metal frame surrounded by parallel prisms of glass, or metal, ground accurately to shape and locked up in the frame. Carefully-gauged cement composition is then placed in the cell so formed, and shaken down into the corners of the lines by mechanical agitation. When this has been done the former is allowed to set. It is then removed from the locking frame, placed face downwards on two parallel slips of metal supported on a flat surface in such manner that the relief of the character does not rest on the slips or on the supporting surface. Two other packing-slips of greater thickness and of the appropriate size are placed one on each side of the former. Plaster composition in a fluid form is then poured on to the back of the former and, before the composition has time to set, a slab of oiled or soaped glass is pressed on the plastic mass until it comes into contact with the packing-slips. On setting, the glass is removed and any projecting composition trimmed off, no skilled accuracy on the part of the operator being required for this. The result is that the former obtained is accurate for dimensions, position, and thickness relatively to those faces by which it is secured against the stop-pieces on the table of the punch-cutting machine. Though, from the description of the various processes employed, the manufacture of these formers may seem long, yet the individual operations take each but a short time to perform, and the total time and material involved in obtaining the complete former are very considerably less than those required for the production of a former having the necessary accuracy, by any of the other processes known to the authors.

All formers should be produced so that they are justified relatively to two sides corresponding to the trued sides of the punch-blank which bear against the interior faces of the chuck on the punch-cutting machine. The height adopted for the character in formers is usually from 0·06 inch to 0·08 inch, but the same standard must be retained throughout, as it is the upper face of the former which actually determines the ratio of reduction. The base of the former when electrotyped is about 0·010 inch thick when finished after filling with type-metal or lead.

In the case of accented sorts, owing to the limited area available for placing the former on the table of the Benton-Waldo machine, in which but little provision is made for adjustment, the upper part of the character-former is cut away and the accent-former is made on a narrower strip of metal so that it can be correctly placed on the bed of the machine. Special narrow accent-formers are required for the **i** owing to its small set width. A blank piece of equal size to the accent-strip is required for the production of the non-accented sorts. With the exception of those required for the i the accents can be made interchangeable.

A few of the formers, such as the mathematical signs, can be conveniently made on ordinary machine-tools out of two thicknesses of metal riveted together, but for the majority one of the other methods described is generally employed.

In the case of the cement formers used in the authors' process, these have the same height of the character above the base, namely, 0·08 inch, but the thickness of the base including the plaster backing is 0·5 inch. In this case the formers for accented letters are not made smaller than the standard size, but the position of the character is altered so as to come near the top of its former and the accent is correspondingly placed at the bottom of its former which is also of standard size.

For some purposes it is required to use the punch-cutting machine for engraving, as, for example, in cutting out hollow punches or engraving the drags for moulds or other similar work. In this case the formers are so made that the character or design appears on them in intaglio and the whole of the surrounding surface is of the height of the top of the character in the normal form.

Pantograph.—The drawing of the character is usually made five times the size of the former to be produced from it, and carries lines corresponding to the edges of the former when finished; it is fixed in position on the table of the pantograph by reference to these lines. The tracing pin of the pantograph is a plain cylindrical pin, and the tool which develops the character in the wax is also a plain cylindrical pin having the same ratio of diameter to the tracing pin as the ratio of reduction of the pantograph. It is essential that the pantograph should be free from back-lash in all its joints, that it should be extremely rigid, and that the lengths of the arms should be equal so that no distortion is introduced into the design. It is also necessary that the marking point should be capable of being raised above the upper surface of the wax blank and lowered again whenever required; this can be done in a simple manner by means of an arrangement of jointed shafts operated by a handle carried on the pantograph arm adjacent to the tracing point.

Drawings.—The drawings of the characters are usually made to a scale from 20 to 100 times the size of the character to be produced. For simplicity in working, it is well to adopt the principle of producing the drawings of such size that they represent the character either enlarged, or reduced, to a pica or 12-point body. By this means one style of drawing-paper can be prepared suitable for all sizes of type, the alterations from size to size being effected by calculating the dimensions, with but little effort, by means of the slide-rule.

The drawing-paper used by the authors is of special quality and selected for its small coefficient of alteration of size under varying conditions of dampness. It is lithographed with horizontal and vertical scales and with lines corresponding to the exterior of the former blanks and of the type body according to scale. Furthermore, two of the vertical lines are marked with points which show the position which the standard line would occupy when the body to which it refers is enlarged to correspond with its reference lines on the drawing, fig. 168. When the range for which the former is required to be used is known, the highest and lowest positions of the line can be ascertained from these marks; whether the face is to be cut in all or only in the even sizes has to be taken into account. From this range it is possible to obtain directly the amount of allowance which it is necessary to make at the top of the former and at the bottom, respectively, when preparing the drawing, so that the character when finished does not come too close to the back or front of the body.

The preliminary work of obtaining the dimensions of the particular face or character which is being reproduced or designed consists in the production of rough sketches of the letters, with dimensions, giving thicknesses of the strokes, amounts of side-wall, lengths of serifs, and such other details as may be necessary. Where an existing face is being reproduced, the authors find it best to use the bifilar microscope, with two cross-slides for carrying the object type, as affording the most accurate and direct

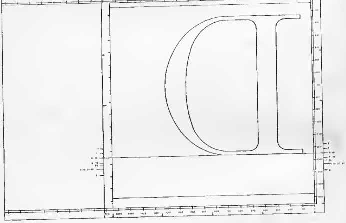


FIG. 168.—*Grant-Legros process; enlarged drawing of character.*

means of obtaining the data required. By the use of the double micrometer slide carrying the type, the question of spherical aberration in the microscope is, of course, eliminated, but the bifilar micrometer can be used without sensible error for independently measuring the thicknesses of strokes and other small peculiarities simultaneously with the taking of the main dimensions. So far as the authors can ascertain, they are alone in using this method. Others working in this field use optical devices that give enlargements of the character which are of necessity neither exact nor sharp in outline. These require further correction by skilful manipulators to standardize the resulting drawing for gauge, thickness of stroke, form of character and position to be ultimately occupied on the body of the type to be produced.

The hand and size of the character as compared to 12-point body varies through these and the following operations thus :—

1. Drawing	inverted	90 times full size.
2. Wax former mould	inverted	18 " " "
3. Former	erect	18 " " "
4. Punch	inverted	natural size.
5. Matrix	erect	" "
6. Type	inverted	" "
7. Printing	erect	" "

The ratio of reduction in the punch-cutting machine is, of course, greater for the smaller bodies, thus for 8-point the former is 24 times full size, while for 6-point it is 36 times full size.

In the case of newspapers and many books two more reversals occur, between the operations numbered 6 and 7 above : a mould in flong, which somewhat resembles *papier mâché*, is taken from the type and then a stereotype is cast from the mould thus produced.

CHAPTER XIII.

MATRICES.

"Therefore to proceed Methodically, he first slightly Files down the Bunchings out that the Punch made in the Sides of the Matrice . . ."

Moxon's Mechanick Exercises.

10-point cheltenham bold expanded (American Type Founders Co.).

Matrices, which may be defined as the depression formed in the piece of metal that serves as the end of the mould in which type is cast, would, prior to the advent of the modern typecasting and composing machine, have been comparatively simple to describe. Now, however, owing to the requirements of these machines, the subject has been rendered much more complex, for not only has the conformation of the matrix changed, but in many instances the very material which was primarily used in its production has been replaced by alloys and metals more intractable than the original copper. To this complexity of material has also been added complexity of shape.

The finest matrices known to the authors are made of solid rolled nickel with the character impressed by machine-cut punches; but matrices, slightly inferior, and of a somewhat less reliable description, are sometimes made by depositing nickel electrolytically to the full thickness of the matrix, or to a lesser thickness subsequently backed up with copper. Matrices are also sometimes made with the strike portion of nickel let into a copper bar. Most of the composing-machine matrices are stamped in sheet brass, not always of a very high quality; others are stamped in a tough bronze, into the composition of which aluminium sometimes enters. Instances of these are to be found among machines of the linotype and monotype classes. Some composing machines have a composite matrix of steel and nickel or bronze, an instance of which is afforded by the Grantype. The commonest forms of matrix, namely, those used in simple typecasting machines, are made of copper, rolled or deposited; the electrolytic deposition of copper not presenting the same difficulties as that of nickel. Matrices for rubber type are sometimes made of aluminium; for instance those used for the Addressograph. Matrices have even been and still are produced from soft iron by means of hydraulic pressure. *Papier mâché* or flong has also been used for the manufacture of matrices. Many of the impression class of machines use this material, which, of course, is used on a large scale in the production of curved plates for cylinder printing-presses; these flong matrices are known to the trade as moulds. It would be difficult to enumerate all the materials used for moulds or matrices, the list extending from wood, horn shavings, slate dust, steatite, sodium silicate, and plaster of Paris, to earthenware, porcelain, and various sulphur compounds. In fact, man's ingenuity has ranged the whole realm of nature to press materials into his service for the purpose. Some of the patents taken out in connexion with this matter are perhaps among the most curious within the entire range of the subject of curious patents.

The early matrices were struck with a punch, fig. 146, p. 195, which had its edges bevelled all round at more or less equal angles usually not very constant, because in performing the work of cutting the punch by hand the engraver was apt to reduce the angle of slope when approaching the finished line. Type cast in such matrices had a projection on both sides, fig. 15, p. 19, and in the case of capitals, or ascenders, one at the back, and in the case of descenders, one at the front, all of which required to be dressed off before they could be used for composition. The first dressing operations were performed by rubbing down the type by hand on a rubbing-file, which was a large surface of steel, measuring about 14 inches by 2 inches by ½ inch thick and cut with teeth like a float. The subsequent dressing operations were performed by mounting the type in lines in a dressing-bench and taking a cut along those sides from which metal required to be removed, as already described. This, of course, could not be done with the two projections sidewise of the type unless any top and bottom projections had previously been removed, because such type could not be locked up in the dressing-rod.

A step taken to get over this difficulty was that introduced a good many years ago by Caslon, who machined off the two sides of the matrix to the set width of the type to be cast, and then made up the sides with packing-pieces of the correct width for the side-bearing required, riveting the three pieces of metal together to form the complete matrix. In any such operation in which the metal forming the matrix is subjected to subsequent hammering, it is of course necessary that the justification should be completed after the work of riveting has been performed.

Only at a much later date was it discovered that instead of removing the excess of type-metal by a subsequent dressing operation, it was possible to produce non-dressing matrices by grinding away those parts of the punch which, if left, formed these parts of the depressions containing the excess of metal. A difficulty introduced by so grinding the punches is that certain sorts are rendered very liable to break owing to the pressure exerted from the interior by the matrix-metal in flowing into its final form. One of the essentials of good matrix-metal is that it should flow properly in striking; bad striking metal will not give the proper depth of counters, as shown in fig. 169, nor will it give a strike fitting the punch so closely as to permit of casting non-dressing type. This quality of flowing under local pressure is analogous to that required in other stamping and pressing operations of which cartridge-case making is an example. The difficulty of broken punches arose largely from the depth of strike usual and necessary under the old conditions of printing, which depended upon the old method of inking, and to a certain extent upon the fact that in the early days of printing nearly every printer was his own ink manufacturer, and frequently not very expert at the business.

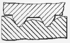


FIG. 169.—*Bad striking metal: section.* Scale: 5 times full size.

The balls used for printing were made of circular pieces of pelt or leather stuffed with wool and nailed to the ball-stocks. In preparing these, the printer had to perform even the currier's work of dressing the hide to a suitable surface and softness. In an old pressman's directions, quoted in Savage's "Dictionary of the Art of Printing," we find the following:—

"Making Balls is a nasty job: there is an old proverb in the trade, that 'the devil would have been a pressman, if there were no Balls to make;' that is, the printer's devil."

It will be obvious that the surface was rough and inaccurate, and, when coated with ink of unequal consistency would tend to fill any cavities of shallow depth in type; that this was the case may be found from the care given to keeping these balls in what was considered proper condition. In relation to this matter, Moxon in his work gives "*Ball-knife.*—An old blunt-edg'd Knife, that *Pressmen* lay by, to scrape their *Balls* with."

DEPTH OF STRIKE.

The modern conditions of inking, in which composition rollers are used for picking up a finely-ground and evenly-mixed ink from a true metal surface, are of course totally different; and it is more largely a question of the surface of the paper than one of the printing-surface which decides the quality of the impression. Thus it is found in practice that a depth of strike of only 0·02 inch is adequate for the bulk of newspaper work, and even less depth is common in the process and half-tone blocks printed on a high-surface, or, as it is frequently called, art paper. The depth of strike of ordinary matrices varies as shown in table 41.

In consequence of the care now expended on the punch, the actual impression made in the matrix when the punch is struck is practically as accurate as the punch when the mass of the matrix-metal is large, but in some cases the metal in the centre of the strike rises under the action of the internal stresses caused by striking, with the result that the character when cast is hollow in the face. This difficulty may be dealt with successfully,

TABLE 41.

Depth of strike of ordinary matrices.

The height of moulds here given includes allowance for contraction.

Typefounder or matrix manufacturer.	Body-size.	Height of mould.	Depth of strike.	Depth of counter.
	Points.	Inch.	Inch.	Inch.
H. W. Caslon & Co., Ltd.	6 to 12	from 0·886 to 0·860	from 0·034 to 0·060	from 0·012 to 0·024
	18 to 72	from 0·860 to 0·832	from 0·060 to 0·088	from 0·026 to 0·060
Miller & Richard	6 to 12	from 0·882 to 0·860	from 0·038 to 0·060	from 0·010 to 0·022
	18 to 72	from 0·860 to 0·806	from 0·060 to 0·114	from 0·022 to 0·062
Stephenson, Blake & Co.	6 to 12	from 0·888 to 0·869	from 0·032 to 0·051	from 0·012 to 0·025
	18 to 72	from 0·868 to 0·827	from 0·052 to 0·093	from 0·025 to 0·060
R. H. Stevens & Co., late V. & J. Figgins	6 to 12	from 0·885 to 0·875	from 0·035 to 0·045	from 0·010 to 0·023
P. M. Shanks & Sons, Ltd.	6 to 18	from 0·885 to 0·860	from 0·035 to 0·060	from 0·010 to 0·030
	24 to 30	0·860	0·060	0·040
The Blackfriars Type Foundry, Ltd.	6 to 18	0·880	0·040	0·020
American Type Founders Co.	6 to 12	0·887 0·878	from 0·033 to 0·042	from 0·015 to 0·023
	18	0·856	0·066	0·042
	24 to 72	from 0·847 to 0·832	from 0·073 to 0·088	from 0·020 to 0·070
Grant, Legros & Co., Ltd.	up to 6	0·8865	0·0335	from 0·010 to 0·020
	7 to 14	0·878	0·0420	from 0·010 to 0·020
	16 to 30	0·8615	0·0585	from 0·010 to 0·030
	36 to 72	0·842	0·078	from 0·035 to 0·080
Nuernberger-Rettig	5 to 14	0·890	0·030	
	18 to 48	0·860	0·060	

in some cases, by drilling a hole transversely in the matrix-blank below the centre of the strike, as shown at *a* in fig. 177.

FORMS OF TYPE-MATRICES.

The form of the matrices varies greatly with the machine in which they are used; the simplest form, generally of copper, is that shown in fig. 170,

FIG. 170.—*Ordinary matrix.* Full size.

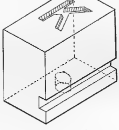


FIG. 171.—*Nuernberger-Rettig matrix.* Enlarged.

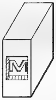


FIG. 172.—*Bhisotype matrix.* Full size.

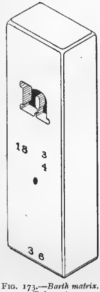


FIG. 173.—*Barth matrix.* Enlarged.

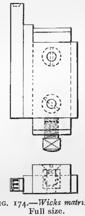


FIG. 174.—*Wicks matrix.* Full size.

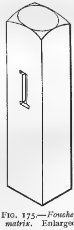


FIG. 175.—*Foucher matrix.* Enlarged.

and is used in the ordinary typecasting machine for casting one character at a time.

The matrices of the Nuernberger-Rettig typecaster, fig. 171, and of the Bhisotype machine, fig. 172, are struck in rectangular blocks of copper or other metal.

The Barth matrix shown in fig. 173 is an example of a matrix produced on a matrix-engraving machine; the flat top of the counter of the **n**, in the example shown, is machined parallel to but below the bearing surface of the matrix.

The Wicks matrix, fig. 174, is struck in the end of a stem of brass which is machined all over as described on p. 234 *et seq.* The matrix is provided with a steel jacket secured to it by two screws and is fitted with a hardened steel screw for setting the height-to-paper of the character to be cast.

The Foucher matrix, fig. 175, is almost identical with the ordinary English matrix, except that the strike is placed more nearly central to the length. In France it is usual to justify the matrix for depth of strike only and not for line and set; contrary to English and American experience it is considered desirable to trust to the judgment of the typefounder to correct for possible wear of the matrix.

FIG. 177.—*Monotype matrix.* Full size.

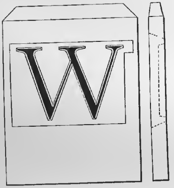


FIG. 176.—*Thompson matrix.* Enlarged.

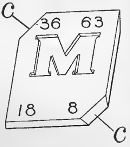


FIG. 178.—*Monotype, large-work matrix.* Full size.

The Thompson matrix, fig. 176, is produced by electrotyping to fill a cavity provided in a brass plate fitted in place on the fusible or master type. The internal edges of the cavity are bevelled to ensure the retention of the stereotyped deposit and prevent its withdrawal from the body of the matrix by adhesion to the type when in use.

The Monotype matrix, fig. 177, is struck in the end of a small block of bronze of square section. The form of the Monotype large-work matrix is rectangular, with two opposite corners bevelled off for registering in the die case as shown in fig. 178.

The Dyotype matrix, fig. 179, is of trapezoidal shape, and has semi-circular grooves on two of the opposite sides for the retaining pins which lock the matrices in place in the matrix-wheel of the machine. The strike occupies a position on the outer surface of the wheel so built up.

The Linotype matrix, fig. 180, is struck in the edge of a sheet brass stamping, and in its simplest form the matrix carries one strike only.

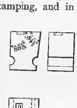


FIG. 179.—*Dyotype; single matrix for fifty divisions.* Full size.

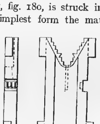


FIG. 180.—*Linotype; single-letter matrix.* Full size.

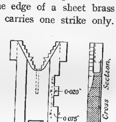


FIG. 181.—*Linotype; two-letter matrix for upper magazine of English machine.* Full size.

In this case the strike is comparatively shallow, and only 0·025 inch in depth; it is struck at the bottom of a routing 0·050 inch deep in the English matrices, so that the routing and strike together give a depth of 0·075 inch.

The Linotype two-letter matrix, fig. 181, carries two strikes, each at the bottom of a routing of the same depth as in the single-letter matrix. In

FIG. 182.—*Linotype; rule-block matrix.*

the majority of cases the two strikes are of the same character, but of different style of face, or are italic and roman, respectively.

When used on double-magazine or multiple-magazine Linotype machines, a means is provided for separating the different founts of matrices, prior to the operation of distributing them into the different magazine channels, by the use of a supplementary nick or nicks at the foot of the matrix, corresponding to the different magazines, as shown in fig. 181.

Since the nick arrangement at the top of the Linotype matrix is symmetrical, a further modification of the matrix is possible in the form known as the Janus or two-faced matrix, in which both front and back of the matrix carry casting strikes.

The Linotype rule-block matrix, fig. 182, is made in one piece, to be dropped by hand into the raceway; it is spaced out at each end so as to centre on the slug to be cast. It is struck either with a plain rule or with one of numerous ornamental rules.

The Linotype vertical figure tabular matrix, fig. 183.—This form of matrix is used for tabular work, and the figures are struck into the matrix at right angles to the normal position: the matrix is used for setting up columnar work, the compositor reading the column from top to bottom and the slug produced being inserted into the matter at right angles to the

FIG. 183.—*Linotype; vertical figure tabular matrix.* Full size.

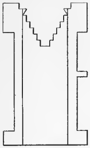


FIG. 184.—*Linotype; slot-rule matrix.* Full size.

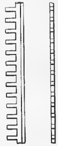


FIG. 185.—*Linotype; serrated columnar rule.* Full size.

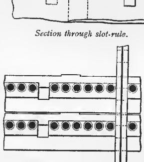
running matter. The object of this is to do away with a difficulty which arises in the justification of the line by means of wedge-spaces where columnar work is used in juxtaposition to ordinary matter.

The Linotype slot-rule matrix shown in fig. 184, is made with a projection in place of the usual strike. To enable it to pass through the raceways some small alterations or substitutions are made in the machine. The composition of the matter is so arranged that the rectangular holes in the slugs, which are left on the withdrawal of the matrices, come vertically under each other in columns; and the serrated rule, also shown in fig. 185, is inserted in these and planed down in the usual manner. The rules are made with serrations of different pitch to suit different body-sizes of slug. The slugs with a rule in place are shown enlarged in fig. 186.

Another ingenious device adopted in the Linotype machine for columnar work is the use of matrices struck each with a short vertical rule, the depth of strike being considerably increased at one end. The effect of this is to produce a slug which has the ends of each of these short sections of the continuous vertical rules required somewhat raised above the normal height-to-paper, fig. 187. When the matter is locked up, a small tool consisting of a grooved roller, capable of rotating in a handle, is run up and down the column and throws down these points so as to form a continuous vertical

Section through slot-rule.

Section through slug.



Plan showing cavities and rule in place.

Fig. 186.—*Linotype; columnar continuous rules and slugs.* Enlarged.

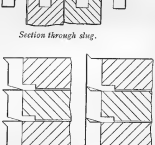


Fig. 187.—*Linotype; tabular rule-slugs, before and after using the roller.* Enlarged.

printing-line; the method is, in fact, a development of the process employed for long past by the founders of bronze statues, for securing the complete obliteration of the joint which would otherwise be apparent where arms or other much-overhung portions of a statue, or group, are cast detached and subsequently fitted into their places.

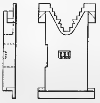


Fig. 188.—*Stringertype matrix.* Full size.

The Stringertype matrix, fig. 188, is struck on the flat side of a brass stamping similar to that used for the Linotype matrix. It is machined with a notch on one side for setting the mould to the appropriate width required for the character it bears.

The Victorline matrix presents no points of novelty over the Linotype matrix, the lines of which it has closely followed and with which it is interchangeable; the same description holds good for the *Intertype matrices*.

The Grantype matrices, figs. 189 and 190, differ according as the machine in which they are composed is being used to cast lines of individual type or slugs. Figure 189 shows the matrix used for casting slugs. In this instance the strike is formed at the bottom of a routing, as in the case of the Linotype and similar matrices. It can also be either a two-letter matrix or one suitable for columnar work, as may be desired. The Grantype matrix used for casting lines of individual type is shown in fig. 190, in which it will be seen that the strike is formed on the end of a prominence in a manner somewhat similar to that adopted in the Wicks matrix. The matrix proper carries fixed to it a similarly-shaped piece of metal having a projection, usually equal in set width to the type to be cast, and of such length that it entirely fills the mould between consecutive type, thereby enabling the latter to be separated completely when the continuous tang formed in the operation of casting is sheared from the ends

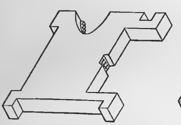


FIG. 189.—*Grantype; slug matrix.*

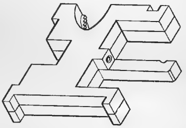


FIG. 190.—*Grantype; loose-type matrix.*

of the type. The matrix is accordingly a composite matrix, the portion carrying the strike being of bronze and the other part of harder material.

The Rototype matrix is of disk form with a central hole and a polygonal edge for receiving the strikes; it has a hole drilled through on one of the radii joining the centre to a vertex of the polygon. The exterior is slotted at the vertices, as shown in fig. 191. These holes serve for carrying the matrix and for setting it into position in the casting portion of the machine.

The Oddur matrix-disk, fig. 192, is of the form of a flat ring let into a disk which carries a central boss on the back, pierced with a square hole to fit the matrix-setting shaft of the machine. A copper ring is electro-deposited on to the electrotyped nickel matrices which are from 0·020 to 0·030 inch thick; this ring is then turned, fitted and pinned to an annular recess in the matrix-disk, as shown in the section.

The Monoline matrix.—The Monoline machine uses a combined matrix, fig. 193, having several strikes on one face of a long bronze bar routed to the appropriate depth, as in the case of the Linotype. Opposite to each strike is a similar routing used for carrying the matrix when in the casting position.

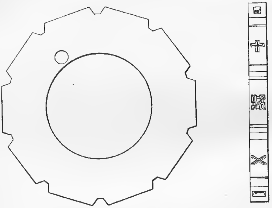


FIG. 191.—*Rototype matrix.* Enlarged.

The hole is provided for registering the matrix on the machine.

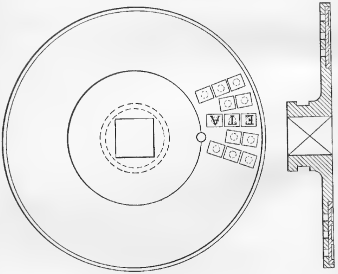


FIG. 192.—*Oddur matrix-disk.* Enlarged.

The eighty characters are arranged in sixteen gronps of five each; three of the strikes only are shown in the figure.

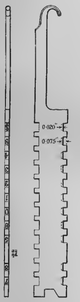


FIG. 193.—*Monoline matrix.* Scale: full size.

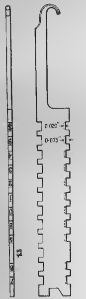


FIG. 193.—*Monoline matrix.* Scale: full size.

FIG. 194.—*Typograph; single-letter matrix.* Scale: full size.

FIG. 195.—*Typograph: two-letter matrix.* Scale: full size.

The Graphotype matrix is of rectangular form and its grid resembles that of the Monotype machine, but with the matrices electrotyped in one piece as in the case of the Oddur matrix-disk just described.

The Typograph matrix, fig. 194, is struck in one face of a bar of rectangular section; this bar has, let in and silver-soldered to it, an eye of steel by which it is suspended from a steel wire throughout the operations of composing, line-justifying, casting, and distributing. As the matrix never leaves the wire, distribution is a very simple matter; the whole of the upper portion of the machine rocks on an axis and is balanced by a spring so that a very small force only is required to tilt the top of the machine comprising the magazine, escapement, and keyboard until the magazine is at so low a level that the matrices slide back into place along the polished steel wires from which they are suspended. The matrices may be of two kinds; in the single-letter machines they have a rigid eye at the upper end and are cut away to a hooked form at the lower end, fig. 194, and in the two-letter machines, they have two notches at the lower end on the same side as the strike and two parallel notches on the opposite side above the strike, fig. 195. In the former case the matrices are pulled down to justify for alinement, the upper surface of the hooked end being used for this purpose. In the case of the two-letter matrices, fig. 194, these slide along the upper surface of one or other of the back parallel notches, and the justification for alinement is obtained by the gripper pressing the matrices upwards by means of one or the other of the front notches so that the lower face of one of the parallel rear notches bears against the setting bar which has been clear in the groove during the period of composition. The matrices do not bear against the faces used for alinement either during composition or distribution, consequently the tendency to wear and so to produce irregularity of alinement is reduced to a minimum.

SPACE AND QUAD MATRICES FOR ORDINARY TYPECASTING MACHINES.

The space-matrix used in the ordinary typecasting machine is usually a plain piece of copper, or bronze, of rectangular section and of the appropriate dimensions for the particular space to be produced; but in some cases, to facilitate the ejection of the space from the mould, a rectangular depression slightly smaller than the body of the space is struck to a depth of about 0·02 or 0·03 inch.

Quad-matrices are usually struck with shallow figures corresponding to the body-size of quad cast from them. Prior to the introduction of the point system, they were frequently struck with the name or initials of the founder and later with the body-size either in full as PICA, or abbreviated, as BREV.

NON-DISTENSIBLE SPACE AND QUAD MATRICES FOR TYPECASTING AND COMPOSING MACHINES.

Typecasting and composing machines generally make use of some non-distensible space and quad matrices. These are necessary for all work involving the use of figures, such as tabular matter, for which the em quad, en quad, and quarter-em quad or middle space are required. The em quad is also needed for such purposes as quadding out, or filling out the white at the end of a paragraph to the width of the measure. The quad and space matrices of the various machines as a rule resemble the ordinary letter-matrices used in the individual machine to which they belong except for the fact that they carry no strike and that, in certain cases, where the construction permits, that portion of the matrix, which in a letter-matrix

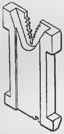


FIG. 196.—*Linotype; non-distensible space or quad matrix.*

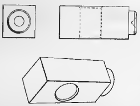


FIG. 197.—*Monotype; low-quad, steel space-matrix.* Enlarged.

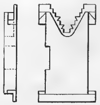


FIG. 198.—*Stringertype; quad-matrix.* Scale: full size.

would normally carry the letter, is increased or reduced in height according as the space or quad to be cast is required to be lower or higher. In some instances of matrices with multiple strikes, for example, the Monoline, one of the units forming the composite matrix, when this is of the correct set width, is itself a quad or space matrix, fig. 193.

The Linotype non-distensible space or quad matrix, fig. 196, differs from the ordinary letter-matrix, not only in the absence of the strike, but also in the absence of the routing. The same remarks apply to the non-distensible space and quad matrices of the Typograph and to the space, or quad, unit of the Monoline. In the Monotype, casting high spaces and quads, a single blank matrix of bronze serves for the casting of quads, or spaces, of all widths: it is described in its proper place with the matrix-grid, and requires no illustration here. The Dyotype, Rototype, and Oddur quad-matrices follow the Monotype.

The Monotype low-quad matrix, fig. 197, is of steel, and carries a projecting cylindrical portion which raises the centring-pin of the machine to actuate the low-quad mechanism.

The Stringertype non-distensible space or quad matrix, fig. 198, affords another instance of a space or quad matrix which differs from the letter-matrix only in the absence of a strike.

The Grantype non-distensible space or quad matrices, figs. 199 and 200, differ from the letter-matrices not merely in the absence of the strike, but, in the case of the individual-type matrix, in the length of the prominence,

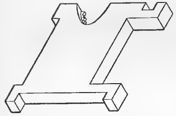


FIG. 199.—*Grantype; non-distensible space or quad matrix; slug.*

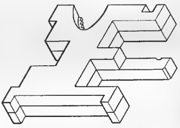


FIG. 200.—*Grantype; non-distensible space or quad matrix; individual-type.*

which may be short or long according as stereo or trade height spaces or quads are required to be cast.

DISTENSIBLE SPACE MATRICES FOR TYPECASTING AND COMPOSING MACHINES.

The Linotype distensible space-matrix, fig. 201, frequently called the space-band and also known as the wedge-space, consists of two main opposing wedge-shaped pieces dovetailed together, yet sliding freely and fitting sufficiently well to avoid trouble from metal getting between the two parts. A stop-pin is fitted at the end of the slide to prevent the parts from becoming separated when the matrix is lifted out of the machine.

The Monoline distensible space-matrix, fig. 202, is built up of three steel sliding parts, the outer two of which are secured to each other by riveting, and the widening is performed by springing these sides apart by the long wedge formed by the third or sliding part, which is moved upwards between them.

The Stringertype distensible space-matrix, fig. 203, is similar in many respects to the Linotype space-matrix, but is tapered on one side of the long wedge-piece so that this not only decreases in thickness towards its upper portion, but also in width, this decrease being used indirectly for effecting the setting of the mould on the machine in the earlier models.

The Typograph distensible space-disk, fig. 204, is of circular form made up of three pieces; the main piece *a* is plain on one side and on the other

is formed with a helical
projecting arm turns free
acts in making up the v
to the main part so that

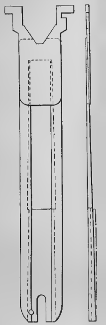


FIG. 201.—*Linotype; wedge-space matrix, or space-band.* Scale: full size.

part when both helical
boss by a cover-plate *c*
The Grantype dist
fig. 205, consists of t
on each other in a ma
external outline of the
lifting, and transferrin

is formed with a helical face and a cylindrical boss; a loose plate b with a projecting arm turns freely on this boss; the portion of this plate b_1, which acts in making up the variable space, is also made helical on the face next to the main part so that the outer face is parallel to the back of the main

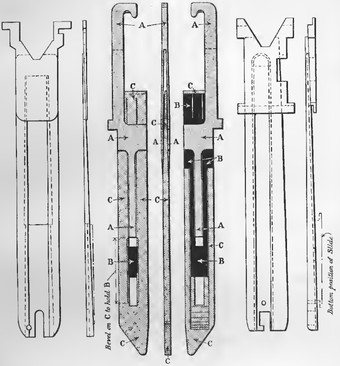


FIG. 201.—*Linotype; wedge-space matrix, or space-band.* Scale: full size.

FIG. 202.—*Monoline; wedge-space matrix.* Three views showing the three combined sliding pieces, A, B, C. Scale: full size.

FIG. 203.—*Stringertype; wedge-space matrix or space-band* Scale: full size.

part when both helical surfaces are in contact; the plate is retained on the boss by a cover-plate c riveted to the main portion.

The Grantype distensible space-matrix for the slug-casting machine, fig. 205, consists of two pieces of metal dovetailed together, and sliding on each other in a manner similar to that of the Linotype matrix; but the external outline of the matrices is altered to suit the conditions of carrying, lifting, and transferring in the machine of later date.

The Grantype distensible individual-space matrix, fig. 206, is formed of two wedge-shaped pieces of metal, dovetailed together, as in the previous instance; one of these carries a projection for filling the mould

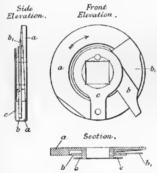


FIG. 204.—*Typograph; distensible space-disk.* Scale: full size.

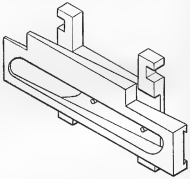


FIG. 205.—*Grantype; distensible space-matrix; slug.*

and the other an overhung prominence entering a notch in the projection and leaving a plane surface, which forms the top of the space cast in the mould, of variable width according to the elevation of the wedge.

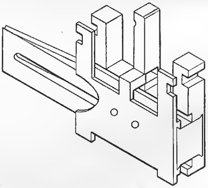


FIG 206.—*Grantype; distensible space-matrix; individual-type.*

The Bellows compositor matrices are of rectangular shape; they are struck in brass and measure 0·500 inch by 0·9375 inch. The depth of strike is 0·060 inch. Each fount has distinguishing cuts on the reference-letter side; each fount, regardless of size or face, has its

FIG. 207.—*Bellows or Electric compositor matrices with slug.*

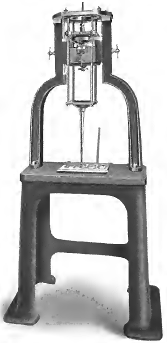


FIG. 212.—*Matrix-engraving machine; American Type Founders Co.*

To face page 233.]

own combination of cuts, and the fount distinguisher can be set so that no other fount can pass it. The space-matrices are similar to the ordinary matrices except that they have no character-strike.

It is claimed for this machine that the justification adopted in it, which does not make use of wedge-spaces or space-bands, gives a longer life to the matrices, and that the space-matrices themselves are practically indestructible. The distribution of matrices in the Bellows machine, which was originally carried out by means of electricity, is now carried out very ingeniously on the same principle but by mechanical methods. Distribution is effected by means of a series of holes, eight in each matrix, which encounter certain pins in the distributing mechanism; this throws open the proper gate for its particular magazine-channel to each matrix in succession. The distributing speed is high. Figure 207, plate XI, shows a number of Bellows matrices with a slug. The distribution system of the Bellows matrices being somewhat peculiar, is described here with the matrices.

MATRIX JUSTIFYING.

Justifying is the operation of fitting or machining the surrounding metal so that the face of the strike, which is at the bottom of the depression

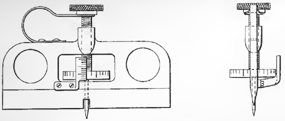


FIG. 208.—*Needle-point micrometer depth-gauge.* Scale: full size.

in the matrix, is accurately placed relatively to the exterior. The matrix is tested by taking a trial cast, comparing this with a standard letter, usually the lower-case **m**, and measuring it with various appliances for depth of strike, position and truth of alinement and parallelism to the surface of the metal.

To perform the work of justifying, several delicate measuring instruments are necessary. For measuring the depth of strike a needle-point micrometer, fig. 208, is used; for measuring the face a bevel-edge or lining micrometer, shown in fig. 209, with a blade 0·1000 inch wide is used, the measurements being made on the punch. Great care is required in the use of this appliance, or the knife-edges of the blade may be damaged by contact with the metal being measured. Two readings are obtained by moving the blade back till it just shuts off the light reflected from a portion of the face of the punch, or of the type, in one direction and then repeating the operation for the opposite side of the punch or type, making due allowance for the width of the blade when dealing with the figures obtained.

Squares are used for testing the face, the type being sighted against the light in two directions at right angles to each other. In the case of the simple matrix shown in fig. 170, p. 220, which is usually finished throughout with the file and by hand, the trial and error method suffices, but in matrices of elaborate form such as the more complex Wicks matrix, fig. 174, p. 220, a number of different milling operations being necessary, a number of successive measurements are required. The trial type must be

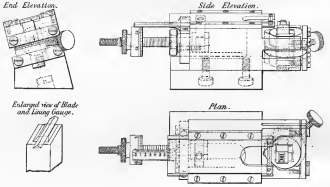


FIG. 209.—*Micrometer measurer for punches and type.* Scale: half size.

measured, and the matrix stem bent and twisted to bring the strike true for squareness of face and line.

Cuts are then taken off the sides of the matrix and off the base; trial type are again taken, and the matrix further corrected if found necessary; finishing cuts are taken, and finally the matrices are gang-milled to length and end-milled to body. With hand-cut punches some twenty-three operations were necessary; with machine-cut punches the number was reduced to about seventeen; the various operations are shown in fig. 210. The work of justification is very highly skilled and a good justifier earns big wages; it is therefore of great importance to reduce this work to a minimum. The reduction in number of operations was largely effected by rigidly holding the punch close to the face, by rigidly holding the matrix close up to the strike, by supporting the matrix-metal on all sides, and by accurately setting the punch in position before striking. The saving in justification was effected by elimination of some of the earlier roughing operations.

In the case of matrices which are required in large quantities for matrix-composing machines, the adjustment of the striking press must be made by the justifier, and when set the product must be controlled from time to time. The larger the number of matrices to be struck and justified, the more important it is that the punches should be accurately justified

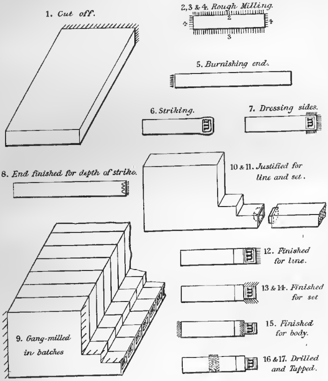


FIG. 210.—*Wicks rotary typecaster matrix; operations in machining.* Scale: full size.

and accurately set in the press. In the earlier matrices made for the Wicks machine a light, overhung, hydraulic striking-press, weighing only about a hundred pounds, was used; for the later matrices made in quantity, a stamping-press with symmetrical slides and a central plunger was used, weighing about a ton and a half, the extra rigidity contributing greatly to a saving in justification.

ENGRAVING MATRICES.

A method of manufacturing matrices has been introduced in the last few years, in which the operation is performed by a small high-speed cutter carried on a pantograph; a hollow former is used and the process is the converse of that used in the punch-cutting machine.

The matrices produced by this method, however, except when cutters of extremely small diameter are used, must have a uniform bevel all round; they cannot be used for producing non-rubbing type unless they are subjected to a machining operation and fitted with side strips as described above, or reduced to the same section as the type to be produced, in which case they must be fitted and secured in a hole of the same section pierced in a blank.

The Ballou engraving machine for matrices, fig. 211, plate XII.—The problem of engraving the matrix is much simpler than that of cutting the punches. The character for the hollow former can be cut out of metal plate like a stencil and then secured to the backing by riveting or soldering. The follower may be of constant diameter, but must be sufficiently small to allow it to follow the outline in the hair-lines. The shape of the cutter can be that obtained by grinding a small amount off two of the opposite faces of a square pyramid, so that these faces meet in a line, the length of which is in the same ratio to the follower as the reduction ratio to which the machine is to work. The depth of cut is constant, the flat surface of the main-stroke being obtained by traversing ten or more times to and fro over the length. The complex settings of the Benton-Waldo machine are here unnecessary, and since the material to be cut is soft the cutter lasts a long time without sharpening, and the sharpening itself is a comparatively simple matter. The machines when set and adjusted by skilled mechanics can be operated by girls.

A similar machine known as the Dedrick was introduced about 1899. It was arranged to operate simultaneously on four matrices.

When a matrix is engraved the actual depression corresponding to the strike of the punch has the same appearance as the surface run over by an end-mill; it looks like the engine-turning on the case of a watch, and must be subsequently polished to obtain a similar appearance of face to that given by any struck, or electro-deposited, matrix.

Perhaps the most highly-specialized form of engraving machine is that used by the American Type Founders Company to engrave some of their larger matrices. This machine in its early form was designed by Linn Boyd Benton, and was the predecessor of the original punch-cutting machine patented by him in 1885. Like its brother, the punch-cutting machine, it has developed through various forms under the supervision of its original inventor, and is shown, in the shape used to-day in the United States, in fig. 212, plate XI.

The limits of accuracy in its working parts are stated to be within

FIG. 211

PLATE XII.

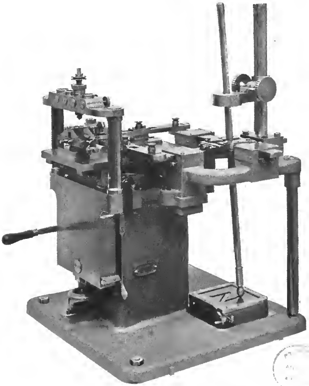


FIG. 211.—*Ballou matrix-engraving machine.*

[*To face page* 236.

PLATE XIII.

[To face page 237.]

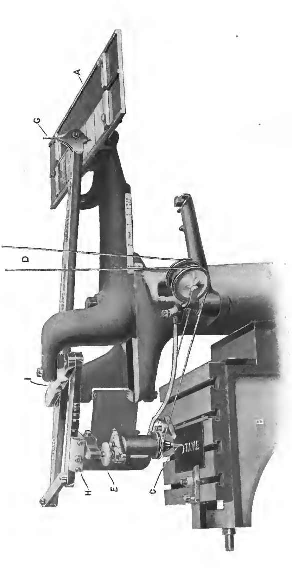


FIG. 214.—*Engraving machine; Taylor, Taylor & Hobson.*

0·0002 inch, and practi
throughout in its const
The pattern or forme
typed former or model.

The matrix cutter
shows the faces of the
to 0·080 inch in width,
the finer ones for the ou
by means of a flexible
per minute.

A grinding machin
or broken. This mac
with a longitudinal feed

FIG. 213.—*Matri*

or other abrasive whee
single trunnion bed wh
through an arc of 90°,
tool for the matrix dra
On the top of the slide
on one end; the hollov
the ring end against t
machine for the length
the depth of cut. Dur
away, and to prevent c
point with a microm
the wheel is brought
relative position of the
the tool always to the
face is obtained by me
tool of any desired fac
face is placed between t

0·0002 inch, and practically the same careful workmanship is demanded throughout in its construction as in the case of punch-cutting machines. The pattern or former still used with it is the old-fashioned electrotyped former or model.

The matrix cutter used with the machine is seen in fig. 213, which shows the faces of the chisel cutting edge. These vary in size from 0·001 to 0·080 inch in width, the heavier faces being used for the roughing and the finer ones for the outlining of the characters. The cutting tool is driven by means of a flexible shaft at a speed of from 8000 to 10,000 revolutions per minute.

A grinding machine is used when the edge of the tool becomes dulled or broken. This machine consists essentially of a light steel spindle with a longitudinal feed motion. On the end of this spindle a small emery

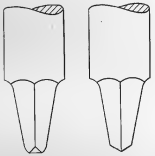


FIG. 213.—*Matrix-engraving cutter; American Type Founders Co.*

or other abrasive wheel is mounted. The slide-rest is constructed with a single trunnion bed which enables it to rotate at the will of the operator through an arc of 90°, with stops, one of which controls the angle of the tool for the matrix draft and the other determines a curvature on the end. On the top of the slide-rest there are two bevelled ways with a fixed stop on one end; the hollow tool-spindle is held in position on these ways with the ring end against the stop. The ring end is the determining point in this machine for the length of the cutting tool, and in the engraving machine for the depth of cut. During the grinding operation the abrasive wheel wears away, and to prevent change in the size of the cutting tool, a fixed diamond point with a micrometer adjustment is used, being so arranged that the wheel is brought to touch it in passing, thus ensuring the same relative position of the side of the wheel with the tool, and the grinding of the tool always to the same size and contour. Any desired width of tool face is obtained by means of hardened steel measuring-blocks, and when a tool of any desired face is ground, the block for that particular width of face is placed between the end of the ways and the travelling rest is brought against it by means of a screw feed, which sets the axis of the cutting tool in its correct position.

The accuracy of the grinding is tested by a microscopic inspection of the cutting tool. Across the centre of the face or lens of the microscope a fine scale is arranged, reading to 0·0005 inch, and the edge of the tool is brought into alinement with the scale; this makes it easy to obtain an accurate reading.

The matrix is justified by means of a specially-designed facing machine, with inserted-tooth face cutters, which is driven by a clutch, and is held by means of a clamp on the table of the machine, directly under a microscope which has two cross-hairs at right angles to each other and one hair adjustable to any angle, so that the parallelism and position of the letter can be fixed relatively to the cutter.

There are many other engraving machines; for instance, that of Taylor, Taylor and Hobson, fig. 214, plate XIII, which is largely used for engraving die-blocks for printing biscuits, chocolate, and a great variety of other work.

ELECTROTYPING MATRICES.

The easiest method of making matrices for the simple typecasting machines is by electrolytic deposition of copper. A type of the desired character can be surrounded by two pieces of type-metal of similar form to the mould or a single piece of the size required for the matrix can be cast round it, in a suitable mould, and the face of the matrix is thus obtained true in the first place; the rough deposited sides of the matrix are subsequently filed, or machined true.

The cast with the face of the character projecting from it is called a *fusible;* it is made in a *fusible-mould* which is described in another chapter of this treatise. A number of fusibles are generally arranged in a frame in two or more rows, each being separated from its neighbour by a division strip of ebonite, or other insulating material. The deposition of copper from a solution of copper sulphate must be effected slowly if the resulting matrices, about 0·35 inch thick, are to be sound and tough. For this reason it was usual to use a Smee battery; but this had the disadvantage of a dropping voltage. A dynamo giving a voltage nearly equal to the maximum of the Smee battery produces as good a result more rapidly. The belief in the superiority of the battery over the dynamo for this particular class of work is one of many superstitions, dear to the hearts of those who find something intrinsically excellent in antique methods simply because they are old-fashioned.

For the matrices used in the later forms of typecasting machinery electrolytic copper is not generally hard enough to stand the wear, and the rough deposited surfaces require too much and too troublesome machining. The Grah process for depositing matrices in nickel, which has been used by the authors, produces matrices much harder than the copper hitherto in use. This process may be of considerable importance in the manufacture of matrices in the future in places where the more economical and rapid method of production afforded by punch-cutting and matrix-striking plant of modern design is not available. There are, however, practical difficulties in the carrying out of this process which may seriously militate against its complete commercial success.

A process has been invented by A. S. Capehart for electro-deposition, which has the advantage that the intaglios, corresponding to the strike in a punch-struck matrix, could be placed in the bars or plates after these had been machined to the necessary degree of accuracy, whereas in the ordinary electro-depositing processes used in typefoundries the matrix-bar or plate had to be machined, or justified to shape, after the intaglio had been formed or put into place. By this system the twelve intaglios required for each matrix-bar, in a line-casting machine like the Monoline, were electro-deposited in the edge of the bar after this had been machined to the requirements of the casting machine. It was found in use, however, that the thin copper edges would not stand the machine-handling and contracted, giving rise to fins between the letters. With compound matrix-plates, presenting flat surfaces to the mould, as in the Graphotype grid or the Oddur disk, this would not occur, nor would it take place in the case of individual intaglios under conditions where the thin edges of the intaglio were protected by the mechanism holding the matrix in position.

DEPTH OF STRIKE OF COMPOSING-MACHINE MATRICES.

It will be seen from the table of depth of strike of typecasting and composing machine matrices given below that the different makes of these matrices vary greatly in their depth of strike. It would be a matter of great advantage to both the builders and users of this class of machine if some fixed standard suitable to both sides could be agreed upon. It is certainly a matter for regret that one's foes, so to speak, should be of one's own household, when it is found that the depth of strike on the American Linotype matrix differs from that of its similar and almost identical near relative, the English Linotype matrix. How this much-to-be-desired consummation is to be effected with machines made in so many different countries and under such widely different conditions, it is not for the authors to suggest, but the longer the period during which this reform is postponed, the greater will be the ultimate confusion to be overcome before the rectification is adopted, for it must be remembered that this difference in depth of strike involves a corresponding difference in the height of the mould. The case is somewhat parallel to that of the different gauges adopted by railways in different countries, though there is much more excuse for the railway engineer owing to the wide variation in the conditions which he has to meet, than there is for the engineers who settled the depth of strike of at least the American and English Linotype machines.

TABLE 42.

Depth of strike of composing-machine matrices.

The height of moulds here given does not include allowance for contraction.

Machine.	Height of mould.	Total depth of strike.	Depth of routing.	Maximum depth of counter.
	Inch.	Inch.	Inch.	Inch.
American Linotype	0·875	0·043	—	—
English Linotype	0·843	0·075	0·055	0·018
Victorline	0·843	0·075	0·055	0·018
Monoline	0·863	0·055	0·037	0·012
Bellows compositor	—	0·060	—	—
Typograph	0·878	0·040	0·025	0·015
Oddur	—	0·030	—	—
Dyotype	0·882	0·036	none	0·018
Rototype	—	0·038	none	—
Stringertype	0·882	0·036	none	0·016
Monotype (type)	0·870	0·050	none	0·028
,, high space	0·870	none	none	none
,, low space	0·770	—	—	—
Grantype	1·003	0·040	0·125 (projects)	0·016

In actual practice the height of the moulds is made slightly larger than the figures given in this table, an allowance being made to compensate for the contraction of the type-metal.

CHAPTER XIV.

MOULDS.

"We fill up the silent vacancy that precedes our birth by associating ourselves with the authors of our existence."
Edward Gibbon. Memoirs of my Life and Writings.

Long primer condensed sans No. 5 (Stephenson, Blake & Co.).

Moulds.—The simplest form of mould consists of two halves which are nearly alike. Both are built up of pieces of hardened steel ground and lapped true, and screwed together. The mould thus made is of definite size for body, but variable for the width of set, the parts being fitted with stops which close on the matrix and obtain from it the correct set width; the width of each matrix being therefore the set plus a constant. In the direction of the height-to-paper of the type, the mould is wider than the length of stem, so as to provide for the gate for the injection of the molten metal. In one half of the mould are inserted the raised beads for producing the nicks in the type, and in the counterpart grooves are ground and lapped to fit the raised beads which are exposed in the mould for a greater length as the set width of the type to be cast is increased.

A hand-mould of very early pattern is shown in fig. 215. This has a slight improvement upon the earliest form in the addition of a matrix-lifter for freeing the matrix from the type. The matrix is returned to place by the action of a spring, and the hooks shown are for use in removing the type by its attached tang from the mould.

The authors have found that type-metal under the conditions prevailing in typecasting will flow into an opening between surfaces varying from 0·0005 inch where the surfaces are water-cooled internally, to 0·0002 inch (and even less) where the mould is allowed to become warm. This inflow of metal will cause difficulty in ejecting the type, and will give it a fringe, fin, or ragged edge. In moulds of the kind just described, where no provision is made for continuously cooling the mould, the type cast in the mould before it has attained the working temperature are not accurate for size; the speed is limited to that at which the mould does not overheat unduly, and in practice it is kept from overheating by stopping the machine from time to time and cooling with a wet rag. Some idea of the difficulty and expense of mould making may be gathered from fig. 216, which shows a

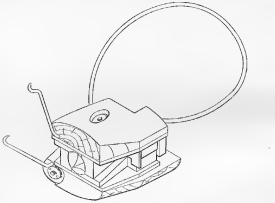


FIG. 215.—*Early hand-mould.*

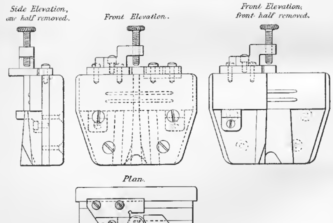


FIG. 216.—*Justifier's type-mould.* Scale: half size.

justifier's mould for type with two nicks, though one is the usual number in such moulds. The justifier's mould shown is fitted with a screw for securing the matrix in place. In the older pattern of justifier's mould a curved wire spring, fig. 215, was generally used to secure the matrix against the end of the mould. The one half of the mould consists of at least five pieces while the counterpart carries in addition the beads and the stop. The beads for forming the nicks contribute greatly to the difficulty, since the hole is only a part of a cylinder in one of the pieces of hardened steel which must be finished before the hole is lapped out, and the wire, which is made a gauge fit, must have its axis parallel to the surface within the degree of accuracy required for tightness as regards the melted metal.

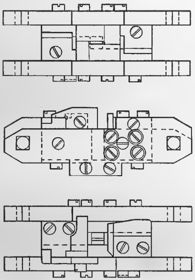


FIG. 217.—*Pivotal-machine mould.* Scale: half size.
Tang end elevation; plan; matrix-end inverted elevation.

As the mould undergoes some alteration of form when heated, and is subject to some change due to wear, the fit when new requires to be within 0·0001 inch.

The Pivotal-machine mould, the next to be considered, is shown with both halves in place in front elevation, plan and back elevation, in fig. 217. The halves of the mould are shown separately in perspective views in fig. 218 in which the upper view shows the top half of the mould as seen from the front of the machine, the middle view shows the bottom half of the mould seen from the same side, and the lower view shows the top half of the mould inverted and seen from the opposite side with that part in front which forms the tang and comes in contact with the nipple-plate of the casting machine.

Figure 219 shows the details of a mould and gives the names of the various parts whose nomenclature has remained unchanged for at least two hundred and fifty years.

A different mould is required for each body, but the mould is adjustable

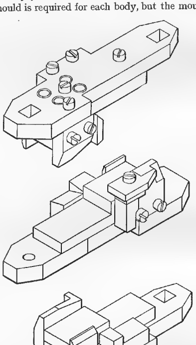


FIG. 218.—*Pivotal-machine mould halves.* Scale: half size.
Top half; bottom half; top half inverted.

for those variations in set width which occur in a fount of type; different moulds are also required as the nicks differ for different faces of the same body, and a suitable mould is consequently necessary for each separate arrangement of nick. Different moulds are also required for spaces and quads owing to the fact that they are lower in height-to-paper, and these again may differ if the spaces and quads are required of stereo height or of trade height; the position of the nicks in spaces and quads is not material as the body-sizes only require to be distinguishable.

In some instances it is possible to use the same mould for both quads and spaces, such moulds being known as *combination moulds*. In certain cases, however, it is necessary, owing to the liability of metal getting under the long nick-wire, that separate moulds should be used for casting the wider quads, that is those above an em in set width. When this is done the nick projects from the body less than an em and no corresponding groove is formed in the body of the counterpart; the resulting nick is, therefore, of short length, running only part of the way

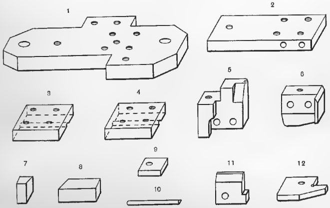


FIG. 219.—*Pivotal-machine type-mould; details.* Scale: half size.

1. Back plate (bottom half).
2. Carriage.
3. Body (top).
4. Body (bottom).
5. Bottom register.
6. Top register.
7. Slip.
8. Break.
9. Lining brass.
10. Nick-wire.
11. Wing.
12. Stool.

across the quad, and the mould cannot be closed to cast a quad narrower than the nick-wire permits. It will be seen, therefore, that the number of moulds required in a foundry turning out many faces of type and of the ordinary range of sizes is very great and represents a large capital outlay.

Mould-making as a trade is over 300 years old, and as in the case of lapidaries' work, the finishing is usually done by means of lead laps; the skill attained by the workmen in this trade is very remarkable.

The kind of mould previously considered is in each case built up of component parts permanently secured to each other by screws. With the object of effecting economy in the large number of moulds required in a foundry, owing to the range of each such mould being limited to a single body and a single arrangement of nicks, several makers have produced moulds in which some parts are made interchangeable with the object of enabling others to be substituted for them and so to effect a change of

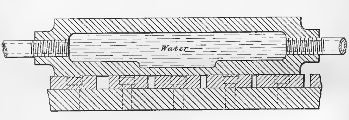


FIG. 220.—*Wicks rotary typecaster; soft moulds.* Scale: full size.

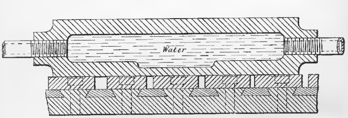


FIG. 221.—*Wicks rotary typecaster; hard moulds.* Scale: full size.

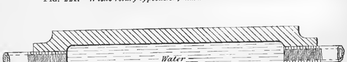


FIG. 222.—*Wicks rotary typecaster; angle-base moulds.* Scale: full size.
Sections of Wicks moulds and top cover showing arrangement for water-circulation and the different methods of mould construction adopted.

size of body. It would be invidious to particularize here about this matter, but in the authors' opinion the finest quality of foundry type has hitherto only been continuously cast in that form of mould in which the parts retain their relative positions in each half and which is limited to the casting of a single body-size. The saving to be effected by the effort at interchangeability is largely discounted by the additional expense of the parts, the difficulty of dealing with ordinary wear, and the time and skill undoubtedly required for effecting the necessary change of the mould parts for each change of body.

The fusible-mould is of very different construction. Its parts are so arranged as to slide together and to embrace the stem of the type about which the fusible is to be cast. An adjustable stop is provided for so setting the face of the type that it projects by the proper amount from the face of the fusible when cast, and allows a sufficient addition to the depth of strike of the matrix to permit of justification. The fusible when cast is about 0·35 inch thick, and is similar to the matrix with the differences that instead of bearing a strike the type face projects from it, and that it is slightly larger in all its dimensions to allow for the removal of sufficient metal from the matrix to permit of this being cleaned up when justified.

MOULDS OF THE WICKS MACHINE.

The inventor and the engineer, however, are beset on all sides with novel and peculiar difficulties when they are called upon to design and make moulds different in form and construction from those to which mould makers are accustomed. In the following pages some account is given of steps taken to surmount them. *The Wicks mould*, illustrated in figs. 220, 221, and 222, p. 246, and in the chapter on casting machines, in figs. 301 and 302, pp. 312–3, will serve as an instance. In this machine the moulds take the form of 100 radial grooves in a disk 20 inches in diameter. The groove, three inches in length, forms three sides of the mould—the back and sides of the type. The stem of the matrix, fig. 174, p. 220, slides in the mould; the top cover *c*, fig. 301, which is fixed, and under which the mould passes, forms the remaining side of the body—the front of the type—and the shield *q*, through which the molten metal is injected, forms the foot.

The error introduced by the 10-inch radius of the foot is very small. A pica em quad has for sagitta of the arc forming its base a length of only 0·00035 inch, which is less than the permissible height-to-paper error in type.

The first attempts to build a mould not proving successful, the next step taken was an attempt to mill and lap out the grooves in the disk. This also failed to give satisfactory results, and recourse was again taken to building up the mould. The construction of the mould-wheel in this form was as shown in fig. 220; it was built up of a cast-iron wheel in which an annular groove formed the water-space, fig. 301; this was covered by a cast-steel foundation ring, turned all over, the latter being secured by studs to the upper surface of the cast-iron wheel.

The upper surface of the foundation ring was turned flat and scraped true; the wheel was then mounted on a division-plate and dowel holes drilled through a jig carried on the central column of the division-plate. Dowel pins were driven into the holes in the foundation ring and the segments, also drilled in the jig, pressed down into place; tapped holes were also necessary in the segment to enable it to be drawn off the dowels for grinding and for lapping the sides. To obtain squareness in the parts of a mould, the diamond square, fig. 223, was used; for straightness of the faces the knife-edge triangular straight-edge, fig. 224, was used; and, to measure the width of the mould at various parts of its length, folding-wedge gauges divided on the upper sides, in such a manner as to form

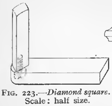


FIG. 223.—*Diamond square.*
Scale: half size.

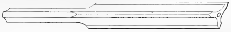


FIG. 224. *Knife-edge straight-edge.*
Scale: half size.

together a vernier reading to 0·0001 inch, fig. 225, were used. The segments were made of cast steel and left soft. Allowance for grinding was made on the thickness of the segments, and the aggregate top surface ground true in place. This wheel gave fairly satisfactory results, but the top of the segments wore rapidly under the top cover which was kept in contact by spring pressure. The next improvement was to adjust the top

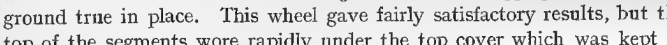


FIG 225.—*Folding-wedge gauges or measuring type-moulds; taper* 1 *in* 100.
Scale: full size.

cover by means of folding-wedges and a screw adjustment so arranged that the cover could be brought down into contact with the segments and then backed off about 0·0002 inch to 0·0003 inch. This did not, however, stop the wear of the segments owing to the difficulty of lubricating sufficiently and yet obtaining perfect type. The next step consisted in milling dovetailed grooves in the foundation ring, and in fitting the hardened steel base pieces which were secured by dowel pins, fig. 221. The whole surface of the foundation ring was then ground true in place on its column, transferred to the division-plate and hardened steel segments were fitted. These segments were secured by dowels and screws as in the case of the soft segments just described. This wheel was extremely costly to make, and when put to work showed appreciable wear in so short a period of time that the amount of type produced before the wheel required new segments would not have been sufficiently large to ensure commercial success.

A number of machines had now to be constructed in a limited time, and the problem was dealt with in the following manner. The surface of the foundation ring was turned and ground true in place on its column, and the mould was built up of two segments as shown in fig. 222. The angle-base segments were of annealed cast steel and produced by the following operations, illustrated in fig. 226: (1) cut roughly to length; (2) and (3) rough gang-milled all over; (4) reduced over part width by

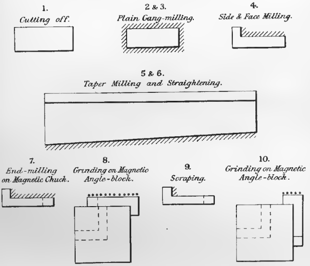


Fig. 226.—*Wicks rotary typecaster; angle-base operations.* Scale: full size.

milling; (5) tapered by milling in batches; (6) straightened; (7) end-milled in the angle on magnetic chuck; (8) ground on back on magnetic angle-block; (9) scraped straight on short vertical face; and (10) ground to set width on magnetic angle-block. The top-segment operations consisted in (1) cutting to length; (2) and (3) rough gang-milling; (4) tapering; (5) straightening; (6) and (7) grinding on flats; (8) and (9) grinding on edges. Both top and bottom segments were at this stage about $\frac{1}{2}$ inch longer than necessary for the reason that the bottom segment, if made to the standard dimension from the centre of the mould to the edge at the periphery of the wheel, would fail to make up the width should the next preceding segment be narrower in the set width of the mould of which it formed the base.

The surface of the ordinary magnetic chuck, fig. 227, is probably familiar to most mechanical engineers, but for the class of work now in question it was frequently necessary to grind segments on the edge; also, owing to the high degree of accuracy required, the surfaces of the vice on which the segments were placed required regrinding whenever the magnetic

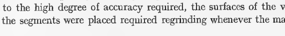


FIG. 227.—*Magnetic chuck; plan.*

vice was replaced after being removed from the machine. Two kinds of magnetic angle-blocks were designed and are shown in fig. 228. These have proved useful for a number of purposes. The blocks each consist of

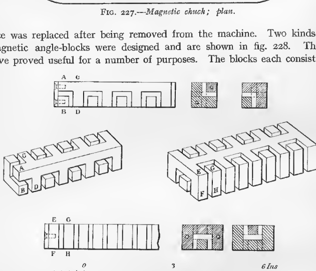


FIG. 228.—*Magnetic angle-blocks.*

Side views with white-metal filling. Isometric views without filling. B has no magnetic connexion with ACD except through the work held; the same relationship applies to EF and GH.

two soft mild-steel bars, of good permeability, milled out to ⌊ or ⊔ shape and cross-milled with cuts which leave space for the complete separation of the two pieces of mild steel. The ends are secured by brass plates and screws, and the whole of the interspace is run up with white metal. The block is placed on the magnetic chuck, so that its poles respectively come over the poles on the chuck. The exterior can then be ground true, in place, on the surface grinder.

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Each division is compared w

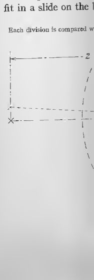

FIG. 229.

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in diameter or less t
$4\frac{1}{2}$ inches at a distance
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amount.

1. In the first r
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Some idea of the difficulties that had to be faced and overcome may be gathered from a consideration of the methods employed in correcting the division-plates for producing the Wicks machine.

The division-plates were in the form of a circular disk with a central boss scraped to fit a central column. The divisions were 100 in number and cut in the periphery of the disk with the ordinary dividing gear supplied with one of the best makes of milling machine. The form of division was such that the working face of each was radial and the other face inclined to the tangent, fig. 229; the locking bolt was accurately ground and lapped to fit in a slide on the base of the division-plate. At an early stage in the

Each division is compared with the arc 0^g-4^g of the theodolite circle by aid of a distant object X.

Scale $\frac{1}{8}$th.

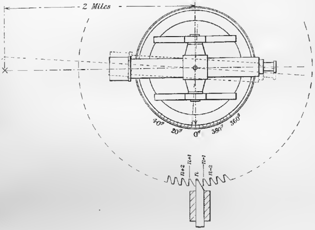

FIG. 229.—*First method of correcting division-plate.*

manufacture of the Wicks machine it was found that the division-plates were not sufficiently accurate for the grinding processes on the segments to be carried out so completely that segments could be manufactured to stock as components. The maximum error permissible, so that the segments could be prepared up to the stage at which lapping would begin, was found to be about equal to an error of 0·0007 inch at the periphery of a circle 20 inches in diameter or less than 15 seconds of arc. This corresponds to about $4\frac{1}{2}$ inches at a distance of one mile and to ensure the result it was considered necessary to make the measurements to less than one-fourth of this amount.

1. In the first method employed a theodolite was used with two micrometer microscopes reading to 10 seconds centesimal. One side of

the plain end of a lightning conductor on a chimney about two miles away was used as the distant object, and the angle moved through from one setting of the division-plate to the next was obtained by direct reading on the graduated circle of the theodolite with the micrometer microscope, the reading obtained being of the form :—

4·000 grades ± difference.

After taking the reading the theodolite was reset to zero, set on the distant object, and the plate moved another tooth ; the second angle was then measured. By this means the total of the readings should have equalled 400 grades, but the average errors of personal equation and of the standard arc of the theodolite were found to be equal to about 0·00045 grade (4·5 seconds centesimal).

It was then possible to determine the actual difference from the standard angle for each angle moved through by the division-plate, and, by continuously summing the differences, the maximum positive error—or, from the workshop point of view, the lowest tooth—could be determined. The excess of the maximum positive error above the sum of errors at any particular tooth gave the cut to be removed from that tooth.

The method devised for performing this work consisted in mounting the division-plate on a horizontal spindle between centres on a milling-machine, and applying a constant torque by means of a wire fastened to the periphery of the boss, passing over a pulley and loaded with a weight.

A micrometer screw was fitted so that it could be engaged with the flat radial surface of any tooth in succession. An angle-mill mounted on the spindle of the milling-machine could be fed across the face of the tooth to be reduced. This micrometer screw was set into contact with a different tooth of the plate, so that the cutter came inside the gap corresponding to the tooth to be reduced ; the micrometer screw was then slacked back till this tooth, following it under the action of the weight, just touched the revolving mill. The mill was then traversed to one side and the micrometer screw was turned through the amount desired to be removed plus a constant. This constant was 0·001 inch which represented the least amount that could be removed with certainty by a cutter without risk of refusal and consequent glazing of the surface.

The single distant-object method of measurement did not require any particular accuracy in centring the theodolite on the division-plate. It proved however a very troublesome method in practice owing to the rapid and frequent variations in light and atmosphere near London, and further owing to the yielding of the clay strata under the passage of trains on adjacent railways.

2. As several division-plates were required, a different method was next tried, fig. 230, in which the chief troubles noted above were diminished. The same centesimal theodolite was used. Two pieces of fine piano-wire were stretched by suspended weights from a slide and slide-rest some 200

yards from the instrument. The wires were blackened, a clean white paper background was placed behind them, and the suspended weights were immersed in water to damp out any vibration. The screw of the slide-rest was worked till the readings obtained, using the same side of each of the two wires, gave a close approximation to the desired angle of the division-plate (4·000 grades).

In this case it was necessary to set the theodolite more nearly central with the division-plate, an eccentricity of 0·06 inch only being permissible.

The mode of operation was as follows :—

(*a*) The bolt being inserted in the space n of the division-plate of the

Each division is compared with the angle subtended by the two fixed wires L and R at the centre O

Scale $\frac{1}{8}$th.

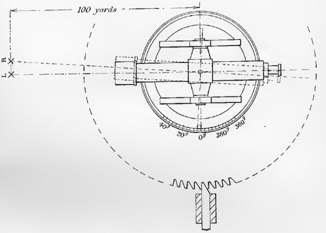

FIG. 230.—*Second method of correcting division-plate.*

theodolite, the telescope was first set on the left wire L and the reading L_n noted.

(*b*) The telescope was then turned on the right wire and the reading R_n noted ; thus by difference the angle LOR was obtained $(R_n - L_n)$.

(*c*) The plate was turned till the bolt engaged in space $(n+1)$ and the reading of the left wire L_{n+1} was taken.

(*d*) The telescope was turned and another reading of the right wire R_{n+1} was obtained ; from these again the angle LOR was obtained as $(R_{n+1} - L_{n+1})$.

Thus the angle LOR was measured 100 times and from these measurements its error was obtained.

If d and e are the differences between 4·000 grades and the readings of the left and right wires respectively, then the readings are of this form (where n is the starting point) :—

$$\begin{aligned} L_n &= (n)\ 4{\cdot}000^g + d_n & R_n &= (n+1)\ 4{\cdot}000^g + e_{n+1} \\ L_{n+1} &= (n+1)\ 4{\cdot}000^g + d_{n+1} & R_{n+1} &= (n+2)\ 4{\cdot}000^g + e_{n+2} \\ L_{n+2} &= (n+2)\ 4{\cdot}000^g + d_{n+2} & R_{n+2} &= (n+3)\ 4{\cdot}000^g + e_{n+3} \end{aligned}$$

and
$$R_n - L_n = 4{\cdot}000^g + e_{n+1} - d_n = 4{\cdot}000^g + \delta - \eta_{n+1}$$

where δ is the mean error of standard angle and η_{n+1} is the error in the theodolite arc over the portion used from space n to space $(n+1)$.

Now taking the alternate readings,

$$\begin{aligned} L_{n+1} &= (n+1)\ 4{\cdot}000^g + d_{n+1} \\ R_n &= (n+1)\ 4{\cdot}000^g + e_{n+1} \end{aligned}$$

and subtracting, we get $L_{n+1} - R_n = d_{n+1} - e_{n+1}$ where η, the error of the theodolite arc, is eliminated, and if a represents the actual error of the angle from space n to space $(n+1)$,

$$a = d_{n+1} - (e_{n+1} - \delta).$$

The actual arithmetical work can be reduced to about six columns of figures and the corrections are obtained without difficulty.

The degree of accuracy attained can be judged by the following result after three series of corrections had been applied. In this table the errors at the circumference of a wheel having a radius of 10 inches are expressed in millionths of an inch :—

TABLE 43.

Errors of division-plate after applying three series of corrections.

Errors.	0 to 70	70 to 140	140 to 210	210 to 280	280 to 350	350 to 420	420 to 490	490 to 560	560 to 630	630 to 700	700 to 770
Number of divisions	10	21	15	19	7	7	7	6	4	0	4

The table shows that the errors had only just been reduced to the desired amount after the division-plate had been corrected three successive times.

3. The next method devised, fig. 231, gave far better results, and did not involve the necessity for making so large a number of observations without interruption.

The column of the division-plate was fitted with centres, and a long bar of mild steel was suspended between them. This bar was forked at its outer end some 30 inches from the centre. A set screw and bolt were provided for springing open the forked part or closing it. Each arm of the fork was drilled and a plug of silver wire inserted in each; a very fine radial line was drawn on each silver plug with a diamond. A micrometer microscope was arranged on a fixed support fast to the base of the division-plate so that the horizontal lever could swing under it. A stop was fitted on the division-plate with an adjusting screw with a long stem to enable the horizontal lever to be set so that either of the lines on the wires could be brought to zero; the lever was kept under a constant pressure against the screw-end by means of a weight and fine cord. A device was provided for enabling the stop to be moved through an angle of approximately 4 grades after the reading had been taken. The gear was boxed in so that variations in

Each division is compared with the standard angle LOR by the micrometer microscope.
Scale $\frac{1}{8}$th.

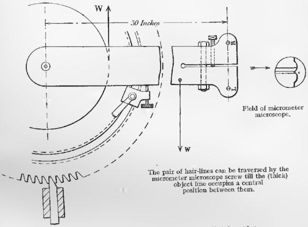

FIG. 231.—*Third method of correcting division-plate.*

temperature, and radiation from the operator, did not affect the readings appreciably.

The method adopted was as follows: in the plan of the lever, R is the right-hand radial line and L the left. The line R was brought under the micrometer microscope and set to zero, then the plate was moved one tooth and the reading on the line L was taken, the reading being the difference between the angle LOR and the angle moved through by the plate. After the reading had been taken the stop and lever were moved so as again to bring R to zero; the plate was then moved another tooth and the next reading of L was taken.

The readings of R were always zero. The readings of L gave the differences d_1, d_2, d_3 . . . from the standard angle.

Moreover, since the plate moves through 400 grades when it completes its revolution,

$$\Sigma\ d_1 + d_2 + d_3 + \ldots d_{100} \text{ should} = 0.$$

Actually it was found to be equal to Δ, and $\frac{\Delta}{100} = \delta$ was the error of the standard angle between the lines on the silver plugs.

The corrected differences $d_1 - \delta$, $d_2 - \delta$, $d_3 - \delta$ . . . were then tabulated as $D_1, D_2, D_3 \ldots D_{100}$ and their summation made continuously thus :—

$$D_1,\quad D_1 + D_2,\quad D_1 + D_2 + D_3,\quad \ldots D_1 + \ldots D_{100},$$

the calculation being of a form which makes checking very easy.

These totals were then each multiplied by a constant so as to reduce them to the scale of the micrometer adjustment for milling. The new values were $\sigma_1, \sigma_2, \sigma_3, \sigma_4 \ldots \sigma_{100}$, of which the maximum value σ_m corresponded to the lowest tooth; adding 0·001 inch to this and subtracting $(\sigma_m + 0{\cdot}001)$ from each term in succession, the negative value obtained gave directly the amount of cut to be taken.

The results obtained are given in the following table, in which the error in millionths of an inch at the circumference of a 10-inch radius wheel is given in the top line, and the number of teeth falling between the limits is given in the succeeding lines, as shown by measurement after the first, second and third cuts had been taken.

TABLE 44.

Errors of division-plate after each correction; expressed in millionths of an inch at a 10-inch radius.

Measured error.	0 to 100	100 to 200	200 to 300	300 to 400	400 to 500	500 to 600	600 to 700	700 to 800	800 to 900	900 to 1000	1000 to 1100	1100 to 1200	1200 to 8300
After 1st cut	15	18	22	16	10	7	4	0	2	3	1	0	2
After 2nd cut	10	20	17	14	13	10	4	4	3	2	1	0	2
After 3rd cut	16	26	30	16	9	2	1						

The methods adopted may appear troublesome and complicated, but actually the calculation was merely of a simple arithmetical character. These division-plates, it should be remembered, were not light measuring apparatus, but had to serve for carrying numerous drilling and other jigs, and required sufficient surface to bear setting hundreds of times each day in continuous regular work.

After having been ground true on its upper face and periphery, on its own spindle, on a specially-constructed grinding machine, the foundation ring of the Wicks machine moulds was mounted upon one of the division-plates so prepared. It was then ready for the next operation.

Assembling.—The first operation consisted in drilling and tapping the foundation ring; the drilling was performed by aid of a jig carried on the division-plate and the tapping was done by an automatic tapping-head. The drilling-jig was then removed and a segment which had been clamped on the plate and drilled by aid of the setting-jig was put into place; each segment was numbered when put into place; the setting-jig had gauge surfaces a constant distance, C, from the centre of the mould; gauges were used for the setting of a width equal to $C - \frac{1}{2}$ (*set*). The setting-ring was then put on the outside of the wheel and secured roughly true by means of four set-screws; this ring carried 100 screws, each of which served to adjust a segment in place by sliding it along the preceding segment; and as each was brought to position, it was then clamped by a temporary clamping-plate and screw at the inner end. The setting having been completed, a sensitive drill, used in conjunction with the drilling-jig, drilled the necessary holes in each segment, namely, three clearing holes for the holding-down screws, one hole for dowelling the angle-base to the foundation ring, and one hole dowelling the top segment to the angle-base, one forcing-screw tapping hole for removing the angle-base from its dowel; and, in every tenth segment, a seventh hole for clearing the supporting stud of the matrix guide-ring. The angle-bases could now be removed from the wheel, cut to length, and the burrs removed; the tapping could be performed and the straightness checked; if found necessary the short vertical face was again scraped. The setting-ring was then raised and clamped roughly true so that the centres of the screws came opposite the top segments. The bottom segments were replaced on the wheel and secured by temporary screws through the clearing holes. One angle-base being dowelled to the wheel, a top segment was placed on this and another top segment on the next consecutive angle-base, each top segment having been lapped true on its vertical faces. The top segments were pressed towards the centre of the wheel by the setting-screws, and the width of the mould formed by them was measured by means of the folding-wedge gauges, fig. 225, p. 248. The angle-base was then forced off its dowel and lapped on the vertical face, until the mould obtained was a gauge fit throughout its length. Each mould was thus finished in turn and the top segments as finished were dowelled to the bottom segments, each being numbered when put into place. The top segments were then all removed, and the angle-bases secured by temporary screws with thin flat heads; the wheel was transferred to its own central column on which the foundation ring had been ground true. The tops of the angle-bases were now ground true in place, the top segments replaced and also ground true, the depth of the mould or size of body being thus obtained. The wheel was then ground true on the periphery and the shield scraped to fit. The under side of the wheel was also ground true, to give a bearing for the lower bearing-surface carried by the shield. These adjustable folding-wedges are shown in section at o_3, o_4, in fig. 301, p. 312.

The soft wheel, however, did not meet all requirements. The body-size could be restored a large number of times by grinding the tops of the angle-bases and the tops of the segments; but the top segments became worn after a considerable period, so that the less important dimension, the set width, became large; the greatest difficulty of all to be overcome was the provision for the nicks in the body. Experiments made on a wheel with soft segments demonstrated the possibility of casting the nicks instead of milling them, and thus obtaining type more free from burr or fringe, with a nick

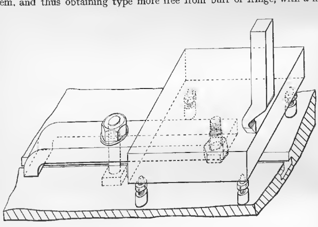

FIG. 232.—*Method of planing cast-iron lapping-block.*

more acceptable to the compositor, and with less risk of breakage of the thin sorts.

The necessity for hard top segments now became apparent. In making these the first five operations were the same as in the case of the soft segments. The sixth operation consisted in drilling in a jig, in which the segment was set into place with allowance for grinding, according to the sizes of the preceding and succeeding moulds of both of which it formed part. The seventh operation was cutting to length, and the eighth hardening. The tempering was performed by heating in an oil-bath at a temperature of about 320° F. for some four hours. By this method the hardness could be adjusted with great nicety and equality for the whole of the wheel. The inner ends of the segments, into which the hole for the dowel pin had not yet been drilled, were softened. The segment was then rough ground on both flats, rough ground on the edges, reground on the faces after an interval of time for recovery, reground on the vertical faces, and finally lapped on these faces.

The wheel being assembled, the nick-grooves were ground in with a fine emery wheel turned to shape on the edge to give the required section and depth. The beads in the top cover were produced in the following manner: the top cover was mounted on the circular rotary table of a vertical milling-machine; a small cutter-spindle, driven by an electric motor, was used to mill out a groove of the required width for the bead, at the correct distance from the axis of the wheel. The bead was made of hardened steel wire ground and lapped cylindrical and subsequently ground flat on two faces to fit the milled groove tightly. At the one end the milled groove was tapered by hand to allow the bead to be removed. The final fitting was done by lapping the face of the wire opposite the bead. The curvature of the groove in the top cover was so slight that the nick-wire could be sprung into place without difficulty. The nick-wires are shown at *e*, in fig. 301, p. 312.

The lapping-block used for lapping mould segments was planed in the planing machine in such manner as to produce a slightly convex surface; the result was obtained in the usual way by supporting the block at each of its corners respectively on jacks, and holding the plate down by means of a set-screw screwed into its under side, and passing through a holding-down plate, which could be screwed down tightly so as to spring the block to the desired extent. The arrangement is shown in fig. 232, and is equally applicable to solid cast-iron laps or to lead laps cast upon an iron backing.

TYPECASTING AND MATRIX-COMPOSING MACHINE MOULDS.

Within the limited space of this treatise the authors cannot describe in detail the moulds of all typecasting machines, but only leading or well-known examples of them with the mention of noticeable peculiarities or differences in some of the many others that exist, together with examples of the slugs, individual type, or lines of individual type produced by them. These are shown in figs. 240–244 and 248–250, pp. 265–268, and plate XIV; a comb of type is shown in fig. 253, p. 269.

The mould of the Monotype machine, fig. 233, is built up of several pieces. In the foundation plate of the fixed part is the hole for the injection of metal from the pump; this hole is coned to fit the end of the pump-nozzle which is elevated into place before starting the machine. To the foundation plate is secured an intermediate plate, and on the top of this are fixed two body-blocks which form respectively the back and front of the type; between these blocks, through which water is circulated, slides a rectangular plate of the same section as the type measured from foot to shoulder. The position of this body-slide is regulated by means of wedges, as described below, so as to give the required set width to the type to be cast. A vertical plate is secured to the end of the foundation plate opposite to the mould, and a hardened steel bearing-plate is secured to this by dowels. In the space between this bearing-plate and the face of the body-blocks the slide travels to and fro for each character cast. The slide itself is built up of a number of pieces, two of which, fixed to the main portion, form the front and back of the tang of the type, fig. 11, p. 13; a tang-slide working between these forms another side of the tang. The fourth side of the tang is formed by the vertical face of the intermediate plate between

Perspective View of Mould.

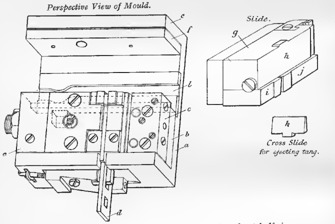

FIG. 233.—*Monotype mould; single-blade.* Scale: about half size.

a. Foundation plate.
b. Intermediate plate.
c, c. Body-blocks.
d. Body-slide or blade.
e. Vertical plate.
f. Hardened steel bearing-plate.
g. Slide or cross-block.
h. Main portion of slide.
i, j. Tang-pieces secured to main portion of slide.
k. Tang-slide or jet-piece.
l. Cam-groove.

the foundation plate and the body-blocks. The slide is guided by the projection of the tang pieces below the body-blocks; the tang-slide is moved by a projection fitting in the cam-groove milled out of the foundation plate.

The operation of casting is performed as follows: the slide comes to rest with the tang opening opposite the mould; the body-slide moves to the set width required, which corresponds to the position of the matrix-grid; the matrix-grid descends on to the top of the mould and is brought to true position by means of the conical hole in the back of the matrix, fig. 177, p. 221. The pump-plunger makes its stroke and fills the mould and tang. The matrix-grid or case is lifted and the slide moves to the right, shearing off the tang from the type and the jet; as the slide continues its movement the tang-slide moves towards the body-blocks, ejecting the tang through the hole in the intermediate plate. When the slide has travelled clear of the type, the body-slide ejects the type from the mould into the type carrier which delivers it to the galley; the slide then returns to the casting position. The whole cycle is repeated for each type cast; during the cycle three types are in progress; the first is being determined, the second is being cast, and the third is being delivered.

An objection that was often raised against the Monotype in the past was

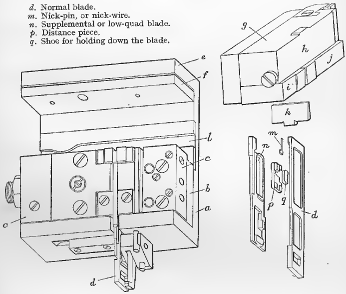

FIG. 234.—*Monotype mould; low-quad, double-blade.* Scale: about half size.

its inability to cast low quads and spaces; this difficulty has now been overcome by making the body-slide of two parts, fig. 234, capable of moving together when type are required and independent in their movement for spaces and quads, in such manner that the top part of the body-slide, of a depth equal to the difference in height between the quad and the shoulder of the type, is moved to its forward position after ejecting the last type cast, and that the lower part moves to occupy the position required for casting a space or quad of the desired width. The top part of the body-slide in this position forms the top of the mould and is supported by the pressure of the matrix-grid during the casting period.

A question that is sometimes raised is that of the relative advantages of the vertical or horizontal positions for the axis of the mould. In the opinion of the authors the matter is of but little practical importance as excellent type can be cast under either condition; it is however somewhat remarkable that the only noteworthy examples among casting machines in which the type is cast with its axis vertical are the Monotype and Graphotype machines, in both of which a rectangular matrix-grid is used.

The mould of the Stringertype machine is similar to that of the Monotype in its general arrangement of mould-blocks and of the body-slide, which can be set to variable position by a spring-controlled movement. After the line of matrices has been received in the assembling-box, it is filled out by the elevation of the wedges of the space-matrices; these are pushed up by a table, L-shaped in plan, which maintains the lower ends of the space-matrices at the same height while passing before the mould. The matrices are then presented one by one in front of the mould, which closes to the set width given by the notch, the pump injects metal into the mould, which then opens, and one part, acting as an elevator, vertically raises the type with its tang to the receiving race, into which it is pushed by a horizontal pusher. By an ingenious arrangement of the mould, the tang joins the type above the feet, two V-notches being left, one at each side, fig. 9, p. 13; the tang can thus be readily broken off, and the rough fractured part is left clear above the feet. The breaking is done automatically by the machine before delivery, the tangs falling clear down a chute.

The moulds of the Dyotype casting machine are, in construction, somewhat similar to those already described in the Monotype and the Stringertype machines, each of which has a movable body-slide. In each of these moulds the body-slide is adjusted to give the appropriate set width of the character to be cast.

There are two moulds m_1, m_2, fig. 235, in the casting machine, and a collector-slide c which has a to-and-fro movement over them. This collector-slide forms one side of the mould; it also contains two slots s_1, s_2, of the same section as the type, into which the type is received when the collector-slide has moved (after the casting has been effected), so as to bring one of these slots over a body-slide b_1, b_2. Each slot is in turn then brought over the elevator-slide e placed centrally between the two moulds, and this moves the type successively out of the collector into the guide-clip, from which it passes to the composing-stick.

The body-slide of each mould, like that of the Monotype low-quad mould, is made in two portions which move together, with their upper surfaces at the same level, when type are to be cast; when a space is to be cast the portion nearest the face does not move, but acts as the matrix end of the mould, so that spaces are cast of trade height instead of shoulder height as in other machines of this class.

The two moulds are closed simultaneously by the collector, and the two type are cast at the same moment. At the end of its movement to the left the collector-slide pauses and receives the type cast in the left-hand mould m_1; it pauses again when it has brought this type over the elevator e; the type received from the left mould is now ejected into the

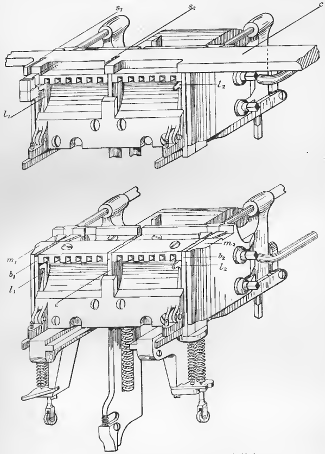

FIG. 235.—*Dyotype moulds.* Scale: about half size.

guide-clip and the type from the right mould m_2 is received in the right slot s_2 of the collector, to be removed by the elevator e when the next successive type is being received in the left groove of the collector-slide.

It appears that the idea of the inventor of this machine is to exceed the limitation imposed by the use of a single mould and to be able to cast up to twice the speed so obtainable, but of course there is some attendant complication in arriving at this result owing to the doubling of a large number of the parts which are essential for each mould.

The Linotype mould is shown in place in the mould-wheel in fig. 236 and also separate in fig. 237, plate XIV. As in the case of the moulds

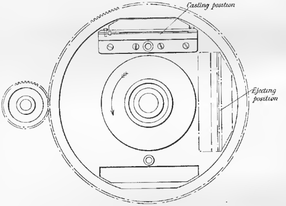

FIG. 236.—*Linotype; mould and mould-wheel.*

already described, it is built up of several pieces of hardened steel. In its ordinary form the Linotype mould casts a continuous slug; for

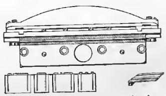

FIG. 238.—*Linotype; adjustable sectional mould.*

certain purposes where two or more short lengths of slug are required to be cast simultaneously, the sectional mould, shown in fig. 238, is used. The gear by means of which the mould-wheel, with the mould *in situ*, is rotated—in the first instance, through 270° from the casting to the trimming and ejecting position, and, in the second instance, through the remaining 90° to its normal or casting position—is shown in fig. 239.

The special features of the Linotype mould are, however, best shown by the drawing of the type-slug cast from it, shown untrimmed in fig. 240. The cross-projections at the foot of the slug prevent the slug from being

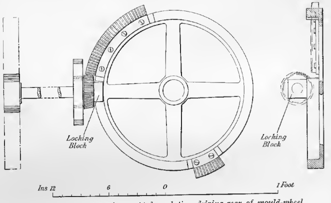

FIG. 239.—*Linotype; interrupted-revolution driving-gear of mould-wheel.*

sucked forward through the mould when the matrices are withdrawn from the face. These projections are removed by the end-trimming knife during the partial revolution of the mould-wheel; to prevent the nozzle

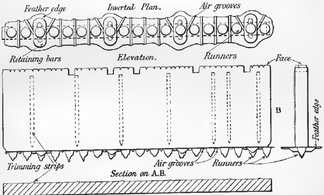

FIG. 240.—*Linotype; slug as cast in mould before trimming.* Slightly enlarged.

from drawing the slug back, each end of the mould is formed with a small projection at the foot. The grooves in one long face of the mould form raised ribs on the back of the slug; in ejection from the mould these pass through between the trimming-knives which shave them down, and ensure correct body-size when the slugs are placed in column; the trimmed and finished slug is shown in fig. 241.

When the Linotype machine is required to produce slugs of large body-

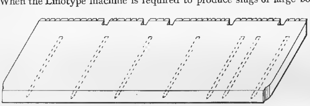

FIG. 241.—*Linotype; finished type-slug.* Slightly enlarged.

size, up to 36-point, another special form of mould with attached blocks for forming recesses in the slug is used with the double object of effecting economy in metal and reducing the time required for cooling. The ribs left between the recesses are trimmed as in the smaller bodies. Figure 242

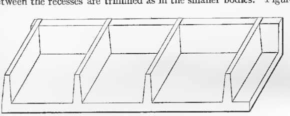

FIG. 242.—*Linotype; large-work recessed slug.* Scale: full size.

shows a large work recessed slug, and fig. 243, plate XIV, shows this form of slug used for Arabic.

The mould of the Victorline machine is very similar to that of the Linotype, but the mould-wheel itself is water-cooled by means of passages

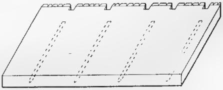

FIG. 244.—*Monoline; finished type-slug.* Slightly enlarged.

communicating with ports in the hollow spindle of the mould-wheel; the flow of cooling water is controlled from the operator's chair by a tap adjacent to a visible outflow.

The mould of the Monoline machine is in many respects similar to that of the Linotype, with, however, the great difference that it is not contained in a mould-wheel, but remains in place in the machine.

The operations of casting, trimming, and ejecting the slug from the mould are effected somewhat similarly to those of the Linotype. Figure 244 shows a finished type-slug of the Monoline.

The mould of the Typograph machine.—Owing to the form of the space-disk, the Typograph mould, shown in section in fig. 245, is made concave

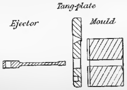

FIG. 245.—*Typograph; mould, tang-plate and ejector.* Section.

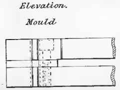

FIG. 246.—*Typograph; mould.* Elevation. Scale: half size.

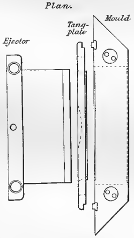

FIG. 247.—*Typograph; mould, tang-plate and ejector.* Plan. Scale: half size.

FIG. 248.—*Typograph; type-slug as cast.* Section through a space. Scale: full size.

FIG. 249.—*Typograph; type-slug trimmed and tang sheared off.* Section. Scale: full size.

where it comes into contact with the space-disks which project slightly in front of the letter-matrices.

The cavity formed by the various portions of the mould for the body of the slug is plain and rectangular, there being no beads, grooves, nor projections in this portion; the back is, however, recessed to a small depth, but only over a part of the length and width, so that the tang joins the slug below the level of the surrounding portion, fig. 248. The tang is formed by a separate tang-plate, figs. 245 and 247, interposed between the mould and the pump-mouth.

The tang-plate moves upwards, after the slug is cast and the metal-pot has receded, shearing off the tang. The shearing is actually effected by the steel tang-plate against the type-metal of the recess in the slug and thus wear is avoided. The slug is then ejected towards the matrices by an ejector acting through a hole in the tang-plate. Ejection takes place in two

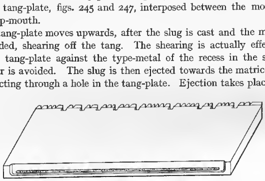

FIG. 250.—*Typograph; finished type-slug.* Full size.

stages; at the end of the first the fins on the shoulder of the slug, fig. 248, are removed by a pair of trimming-knives which travel in the direction of the length of the slug and towards the back of the machine. The second movement finally ejects the finished slug which is shown in section in

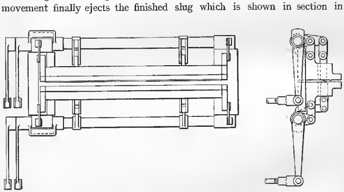

FIG. 251.—*Grantype; mould.* Scale: quarter size.

fig. 249 and in isometric projection in fig. 250. A second and smaller ejector removes the tang from the tang-plate causing it to fall into a chute. The finished slug is delivered into a galley.

The mould of the Grantype, shown in fig. 251, is somewhat similar to that of the Linotype or of the Victorline machine save that it is not carried upon a mould-wheel as in those cases, and that the water-cooling, unlike that of the Victorline and Typograph, in which the water passes merely through adjacent parts, is in its case carried through the actual metal of the mould itself, as is done in the Monotype. By changing the upper and lower mould jaws, fig. 251, the machine is capable of casting slugs, or lines of loose type, according to the jaws used. The length of the line is dependent on the mould-end jaws, fig. 252, one or both of which are adjustable. When the product is loose type, the entire line is cast at a single operation in a manner similar to that applied in machines of the Linotype class,

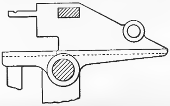

FIG. 252.—*Grantype; mould-end jaw.* Scale: half size.

whose distinctive feature is the simultaneous casting of all the characters forming the line. In this respect it fundamentally differs from the Monotype and its congeners, whose distinctive feature is the successive casting of each letter from matrices successively presented for each successive cast.

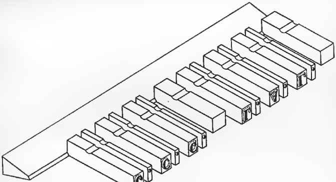

FIG. 253.—*Grantype; comb with tang attached.* Enlarged.

In the Grantype a continuous, but individually-separated slug or comb of type, attached to the tang, is cast, as shown in fig. 253; before leaving the mould the tang is sheared off, and in the process of ejection the type are closed up ready, fig. 254, for removal by gripping-jaws into the galley.

The mould of the Bellows compositor is water-jacketed and universal, and like the Typograph—or the Grantype when used as a slug-producing machine—produces slugs with smooth sides. In the advertising machine a mould is used which gives a cored or hollow slug from 18-point to 36-point. Figure 255, plate XIV, shows various slugs from the Bellows compositor.

The problem of mould construction is amongst the most serious of those which have to be faced by the designer of typecasting machinery.

In the earliest forms of mould, although the parts are of simple rectangular section, the number of holes drilled in them and the proximity of these holes to the edge of the steel causes liability to fracture and to change of form in hardening. With the more complex forms used in the elaborate

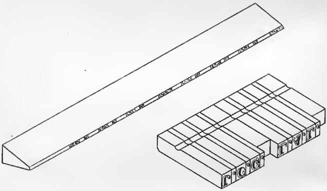

FIG. 254.—*Grantype; individual-type line closed up and ready for galley.* Enlarged.

moulds of casting and composing machines, these difficulties are greatly augmented, and some of the parts are of such complex shape that their production in hardened cast-steel presents excessive difficulty. In other industries the use of some of the special case-hardening steels has been found advantageous for the production of parts of intricate form, and it has been found that this material is capable of giving even greater hardness of surface without any reduction in toughness. It would appear, therefore, probable that the use of such case-hardening steels would be of advantage, at any rate in experimental work. As an example of the high cost of labour entailed in the making of experimental moulds, the authors may mention that it is within their knowledge that a mould of peculiarly difficult construction, made for a new casting machine, cost as much as £60 for net labour, owing to the large number of parts of which it was composed, to the great difficulty of preparing certain parts which failed by cracking through the water-ways, and to the replacement of parts made necessary by warping in the hardening process.

PLATE XIV.

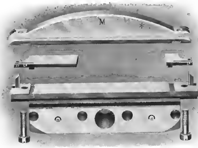

FIG. 237.—*Linotype mould; details.*

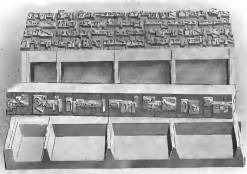

FIG. 243.—*Linotype; arabic recessed slugs.*

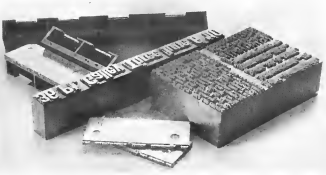

FIG. 255.—*Bellows or Electric compositor, slugs.*

[*To face page* 270.

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CHAPTER XV.

PUMPS.

"It be well said that is the best Pump that draweth best upward the Waters of Truth; By the Screw as Archimedes hath it, or by the Flap as hath become more common. But for us of the Craft an it draw Water from the House-Well, it hath done its duty for thereby Refreshed the Printer may pump forth store of Learning and streams of Letters into the hands of all men and their Brayne." Mirrour of Pryntyng.

Long primer skeleton antique No. 1 (Stephenson, Blake & Co.).

THE pump, as far as the authors know, was not used as a means for filling the mould with molten metal till the commencement of the nineteenth century.

A consideration of the very early efforts to introduce machinery for the process of typecasting shows that the first forward step in effecting good casts was based on obtaining an increase of pressure by "statical action," as is set out in the patent of Anthony Francis Berte, in 1806, when he took means "to compress a body of air against the surface of the type metal for the purpose aforesaid." In this he anticipated innumerable subsequent applications of the use of compressed air for displacing liquids. In the following year, 1807, he took out a further patent in which he makes use of "a plug or piston to expel the melted metal through the aperture described into the mould." To this inventor therefore, beyond question, belongs the credit of the application of the pump to typefounding.

In 1820 Marc Isambard Brunel, father of the still more celebrated Isambard Kingdom Brunel, one of the world's greatest engineers, also took out a patent for casting "under the pressure of compressed air"; for cooling by means of water; for the use of a vacuum in the mould, which process he states is not new; for cooling the cast by the expansion of compressed air; and generally, as was often the case with this genius, he showed himself far in advance of his time.

From this date onwards patents embodying the use of a pump in connexion with typecasting processes were taken out at frequent intervals.

As already stated, the earliest mention the authors have been able to find of a pump with a spring-propelled piston, is contained in the United

States Patent of M. D. Mann and S. Sturdevant of 7 January, 1831. This appears to forestall both the British patent of Sir Henry Bessemer, No. 7585 of 8 March, 1838, and the United States patent of D. Bruce, jun., No. 632, of 17 March, 1838.

It is difficult to ascertain exactly what valve arrangement was adopted in the early pumps, but it is clear that many of the difficulties still encountered in typefounding machines were very serious to the early designers. Thus we find that Bessemer in his casting machine was troubled with what he terms the metal becoming rubbed to a fine powder in the jet. The production of a vacuum in the mould, to ensure the casting of sound type, was claimed by him as a novelty, although, as the authors have shown, this invention was then already nearly eighteen years old.

Bessemer's patent and machine were sold to the Scotch foundry of the Wilsons, but he states that the invention was allowed to lapse in consequence of the hostility of the founders working with older methods.

In the matter of this invention credit appears to have been both claimed by and given to Bessemer for the origination of ideas which, as the authors have shown, were not novel; and little credit was either claimed by him or conceded to him for ideas and suggestions, which were in reality—like those of Brunel previously mentioned—far in advance of his time. Among these may be instanced duplex casting and the body-slide form of mould; a form presenting such difficulties of construction with the methods and means available at the time, that none but a man in the very front rank of mechanical skill, such as Bessemer himself was, could ever have seriously contemplated its manufacture. It is possible that this, as well as the hostility of the founders to which he alludes in his autobiography, may have contributed to the premature abandonment of the invention.

From the mediæval style of design which is found in the earlier pivotal typecasters, it would seem fairly clear that the pump must have been in use apart from a complete casting machine for some considerable time before a machine was constructed which so closely imitated the action of the hands in closing the mould, advancing it to the nozzle of the pump, receding with the cast, ejecting the cast, and repeating the cycle of operations.

It is probable that ball-valves were used at a very early date on account of the ease with which these could be fitted, and it is known to the authors that even in quite recent times some of the simpler forms of casting-machine pumps were working quite efficiently with ordinary clay marbles used as valves. Other machines, however, have used cone-valves fitted to the bottom of the plunger, and valveless pumps are found in which the admission of metal took place through a hole in the side of the cylinder uncovered by the plunger on its upward stroke and covered late in the downward stroke, the completion of which effected the pumping. Owing to the difficulties encountered in obtaining a sound cast in the mould, much superstition has been rampant and still exists amongst the workers in this industry. Any small change of form of the chamber at the base of the pump, or in the length of the port communicating to the nozzle, is expected to "cause the loss to force" of the metal, and the same is said even of altering the position of the pivot of the lever from one side of the machine to the other, which would merely alter the class of lever employed. The advent of the casting and composing machines is causing the death of many of these superstitions, and others are in a moribund condition, but the authors regret to say that they are dying hard. In fairness, however, to the earlier workers in this field, it must be admitted that the difficulties which they had to encounter and overcome are very similar to those encountered by the earlier designers of gas and oil engines in connexion with the form and details of the combustion chamber and valve passages; and men much more highly equipped technically than the old typefounders still have their own equivalent superstitions which have frequently proved a nightmare to the scientific engineer.

The difficulties generally met with are of three kinds: (1) freezing of the jet, (2) stoppage of the jet by accumulated oxide—which occurs in pumps of intermittent action—and (3) difficulty in getting rid of the air which fills the pump delivery-pipe and mould and causes blow-holes in the type. These difficulties are overcome by various expedients; the jet is separately heated by gas-burners, and is so arranged that metal does not remain adhering to the orifice and there become oxidized; the plunger throughout the working length is immersed below the oxidized surface in the metal-pot and the surplus metal which is pumped is returned to the pot without exposure to the external air; the metal is delivered in large quantity and continuously, so that but little heat need be supplied by extra burners under the jet; an electric resistance is kept at a comparatively high temperature round the delivery pipe and nipple; and finally, in some cases, special provision is made for clearing the air by fine grooves cut into the face of the nozzle, as shown in fig. 240, p. 265.

Justifier's pump.—For filling the mould and making the trial casts required for the performance of his work, the justifier uses a pump formerly worked by hand, but now generally operated by foot-treadle, the plunger being returned by a spring which also lifts the treadle clear of the floor. The operator is thus able to vary the pressure and quantity of metal injected by altering the speed at which the stroke is made.

The evolution which has taken place in the pump as applied to the pivotal typecasting machine has doubtless been influenced by the practical experience gained from this primitive form of typecasting by means of a pump.

The pump used on the simplest typecasters consists of a single plunger mechanically fitted and spring-operated. The pressure on the plunger at the commencement of the stroke is about 60 pounds per square inch, and it falls during the stroke.

Practically the pumps of the early typecasting machines, such as those of Mann and Sturdevant, Bessemer, Bruce, and other English and American inventors, present comparatively small differences; and the later machines of Titchener and his contemporaries in England, of Küstermann in Germany, and of Foucher in France, do not present features calling for any particular comment. Foucher, however, has shown in some of the metal-pots (illustrated in his catalogues) two brackets, one on each side of the machine, and a link connecting the plunger to a lever which can be pivoted on either side of the machine so that the pump-plunger is depressed either on the up-stroke of the handle or on its down-stroke according to the position of the pin which is inserted in the bracket and the lever, this probably in deference to local superstitions, which seem as strong among our neighbours across the channel as among our own compatriots. As a matter of fact, even in the latest machines there is very little that calls for particular comment; the ingenuity of inventors seems rather to be turning towards devising means and appliances for preventing freezing in the nipple. In the case of the old machines a device called a jobber was and still is used. This is a metal spindle passing into the nipple through a hole in the back of the casting which forms the delivery pipe. This plunger is made of larger diameter where it passes through the casting, to give it sufficient strength to enable it to be moved; it is, in some cases, flatted on two sides and operated by a fork lever embracing the central part. The action of the jobber is that it keeps the nipple closed during the whole of the period which lapses from the completion of one cast to the presentation of the mould in readiness for a succeeding cast, and consequently prevents oxidation taking place in the small port through which the whole of the metal must be ejected. The trouble which occurs from oxidation is largely due to the fact that the oxide adheres very tenaciously to steel or cast-iron surfaces, particularly the former, and undergoes a process of accretion very rapidly, with the result that, if once allowed to form, the orifice will speedily become so constricted that the casting of sound type becomes impossible. The Thompson typecasting machine contains an interesting modification of the jobber.

It is to be noted that in all pivotal machines, and in some others, the mould only makes temporary contact with the nozzle of the pump or with the nipple-plate interposed between the nipple and the mould; in some other machines the nozzle is permanently in contact with the mould or its equivalent, and in such case freezing occurs much more readily.

In rapid typecasting machines, by which are meant machines capable of casting 12-point type continuously at a rate of 120 type a minute and upwards, the time within which oxidation can take place is cut so short that this does not become an important source of trouble; but, owing to the necessity for the moulds of such machines to be water-cooled, freezing occurs more readily at the extreme end of the nipple which makes contact with the mould.

A difficulty of this kind has been overcome by the authors in a manner the converse of that employed for cooling the twyers of the blast-furnace; that is, instead of circulating water through the surrounding passage in the twyer to keep it cool, they have made the nozzle with an annular chamber round it, divided by ribs, and fitted with ports communicating with two channels in the casting, through which metal is pumped continuously by a supplementary pump kept running whether the machine is casting or not. This can be made as successful a method for keeping the metal at the nozzle end from freezing as is the water-circulation for keeping a twyer from melting.

The Wicks rotary typecasting machine pump has four plungers, of about 1-inch diameter and 2-inch stroke, each driven by an eccentric and rod from a belt-driven shaft. The plungers are a mechanical fit in holes in a steel block forming the cylinders; the inlet and delivery valves are flat-seated disks enclosed in cover-plates bolted to the pump-body. The delivery pipe is fitted with a vertical branch which forms a cylinder in which a mechanically-fitting plunger operates; this plunger is loaded by a lever and dead weight through the intervention of a long coiled tension-spring; at the top of the travel of the plunger in the cylindrical bore is a cross hole; the plunger thus serves the double purpose of accumulator and relief valve. The pump runs normally at 100 revolutions per minute, and the relief valve works at a pressure of 150 to 250 pounds per square inch. The diameter of the jet is about 0·1 inch. Through the jet the pump delivers a large surplus of metal, which is returned through a chute to the metal-pot of pressed steel in which the pump-body is immersed. The metal is kept at a temperature of 700° to 800° F. by gas-burners beneath the pot.

The inventor of the Wicks machine made numerous experiments with multi-plunger pumps, constructing pumps with various numbers of plungers; in one case the authors believe as many as thirty-six plungers were used. This is one of those cases in which a large sum of money would have been saved if the inventor had merely looked into the theory of pumps and their delivery instead of assuming that a more regular flow could be obtained by merely increasing the number of plungers. To judge from opinions several times expressed to the authors, it is not perhaps known, outside the circle of those who have specialized in pumps or their equivalent, that the ratio of minimum to maximum delivery is much higher with the 3-plunger pump than it is with the 4-plunger pump; it is, in fact, the same with three plungers and with six plungers. Had the inventor of the Wicks machine been aware of this he would have made his pump with either three, five, or seven plungers which give respectively for the ratio of minimum to maximum delivery 86·60 per cent, 95·01 per cent, and 97·48 per cent, instead of using four plungers, which give a corresponding ratio of only 70·71 per cent.

In order that the relative advantages to be obtained by the use of different numbers of plungers in multi-plunger pumps of the pattern alluded to above may be easily appreciated, the following table has been prepared.

TABLE 45.

Delivery of single-acting pumps with one plunger, or with more than one plunger, driven by cranks set at equal angles to each other and completing their cycle in one revolution.

Number of plungers.	Maximum.	Mean.	Minimum.	Ratio of maximum to mean.
1	100	30·9	0	3·24
2	100	61·7	0	1·62
3	100	91·8	86·60	1·09
4	100	90·0	70·71	1·11
5	100	96·7	95·01	1·03
6	100	95·2	86·60	1·05
7	100	98·3	97·48	1·02

The pump of the Monotype casting machine delivers the metal vertically upwards into the mould. The metal-pot is attached to a swing bracket, which is made to screw up and down so that the pot may be taken back away from its working position. Inside the pot is the pump-body, sometimes called the well-arm, one end of which carries a piston which forces the metal, let in through a port at the bottom of the pump-body, up a channel to the nozzle at the other end.

By the action of the pumping mechanism the pump-body rises so that the nozzle may meet the lower surface of the mould and form a metal-tight joint whilst casting is taking place; it then recedes so as not to overheat the mould or chill the nozzle.

In the Monotype metal-pot, as well as in those of many other modern machines, a thermometer is fitted, in order to enable the temperature of the metal to be controlled. The mean temperature depends upon the kind of metal used, and may be taken at about 660° F. for 12-point or pica, and 700° F. for 6-point or nonpareil. Thermometers for this purpose are of a kind well known to engineers; they are constructed of glass, filled with mercury, the boiling point of which is artificially raised by means of the compressed nitrogen with which the upper portion of the tube is filled. These thermometers of course require very careful handling and must not be subjected to jarring, as they are easily broken.

The Linotype pump.—This pump-plunger is shown in fig. 256 and the jet in fig. 257. The plunger is made an easier mechanical fit than in the pumps previously described, and depends largely upon the effect of the grooves. This method is familiar to many engineers owing to its adoption

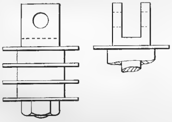


FIG. 256.—*Linotype; pump-plunger.* Scale: half size.

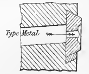


FIG. 257.—*Linotype; metal-pot mouth* Section. Scale: nearly full size.

about thirty years ago for the piston-rod in certain tandem steam-engines. The pump is spring-operated, the pressure being about 27 pounds per square

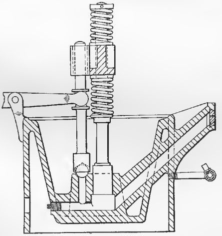


FIG. 258.—*Grantype; multi-plunger pump.* Vertical section. Scale: quarter size.

inch at the commencement of the stroke and about 16 pounds per square inch at the end. The metal used is softer and has a lower melting point than that used in the pumps of machines casting individual types.

The Victorline pump is similar to the pump used in the Linotype machine except that there is no waste of the preliminary portion of the pump stroke and that a longer dwell is given on the stroke.

The Grantype pump, shown in figs. 258 and 259, which is designed for supplying metal to a tang of considerable length having a large number of small openings from it, is arranged with a number of plungers working

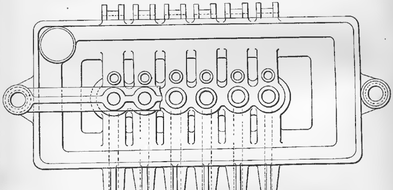


FIG. 259.—*Grantype; multi-plunger pump.* Plan. Scale: quarter size.

simultaneously with a view to obtaining equality of pressure throughout the length of the tang, a result which could not be obtained with a single central plunger. The nozzle-plate with its ports is shown in fig. 260.

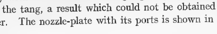


FIG. 260.—*Grantype; nozzle-plate.* Elevation and section. Scale: about quarter size.

The Bellows compositor pump does not call for any particular comment, but it is stated that it produces a very homogeneous slug and a clean cast.

The Graphotype pump, which is placed at a rather greater distance from the mould than usual, is provided with an arrangement for heating the connecting pipe by means of a low-tension electric current.

CHAPTER XVI.

THE CLASSIFICATION OF TYPECASTING MACHINERY, COMPOSING MACHINERY, JUSTIFYING APPLIANCES AND DISTRIBUTING APPLIANCES, AND OF MACHINES WHICH EMBODY TWO OR MORE OF THE OPERATIONS OR PROCESSES DESCRIBED.

"Classification, more than discovery, appears to be the work of to-day."
Joseph Cook. Biology.

18-point imperial script (Stephenson, Blake & Co.).

A SCIENTIFIC classification of typecasting and composing machinery might be attempted on the following lines in which the sequence of classes follows the cycle of the principal operations in the order in which they are usually performed. Thus we should obtain as a first class machines which carry out single operations, subdivided into :—

(*a*) Machines casting type only,
(*b*) Composing machines,
(*c*) Line-justifying machines,
(*d*) Distributing machines.

A second class of machines would be formed of those which combine these operations two at a time ; six combinations are possible :—

(*ab*) Casting and composing machines,
(*ac*) Casting and line-justifying machines,
(*ad*) Casting and distributing machines,
(*bc*) Composing and line-justifying machines,
(*bd*) Composing and distributing machines,
(*cd*) Line-justifying and distributing machines.

Of these combinations only a few would be of any use in practice ; for instance, a number of machines have been constructed combining the operations of casting and composing (*ab*). A machine has been made combining the operations of casting and distributing (*ad*), but a machine which combines the operations of casting and justifying (*ac*) is not very likely to appear on the field, though it has been proposed and patented as an adjunct to a typesetter for inserting in a line of type the desired spaces of accurate size. Machines have been made for performing the operations of composing and line-justifying (*bc*), and of composing and distributing (*bd*), line-justifying being performed otherwise; but it is not likely that any machine will be constructed to perform the two operations of line-justifying and distributing (*cd*).

In considering the triple combinations, the following are possible :—

(*abc*) Casting, composing and line-justifying machines,

(*bcd*) Composing, line-justifying and distributing machines,

(*abd*) Casting, composing and distributing machines,

(*acd*) Casting, line-justifying and distributing machines.

Of these, the first three are practicable, or exist, while no machine is ever likely to be built combining casting, line-justifying and distributing.

A quadruple combination forming a fourth class would consist of machines for performing the whole of the four operations, thus :—

(*abcd*) Casting, composing, line-justifying and distributing machines.

No such machines, however, are likely to be built. It is therefore evident that of the total fifteen combinations or groups which exist, only twelve are represented by machines extant or likely to be made.

What, therefore, would perhaps be the ideal classification for all forms of machines engaged in the production of relief surfaces for typographical printing is the one given above. Admitting this to be the fact, the foregoing scientific classification unfortunately cannot be rigidly adhered to in practice, for the subject becomes complicated and the subclasses are so numerous and so tend to shade off into one another, to borrow each other's attributes and often to combine such great differences and similarities in the same machine, as to make any truly scientific classification practically impossible.

A further complication, moreover, has also to be reckoned with owing to the fact that the modern typographical printing-surface is commonly reproduced one or more times for the printing-press by stereotyping, and that numerous attempts have been made to eliminate some of the processes and to obtain the stereotype-matrix direct, these efforts giving rise to an entirely new class of machine known in America as impression machines, and in England as stereotype-matrix machines.

A classification which has no claim to being scientific, but which is at least practical, is often adopted, and machines are divided into "hot" machines and "cold" machines. Even here, however, the classification can only be very rough. The term "matrix-circulating" machines, straining the meaning of the word circulating, might be used to designate a particular class; but this classification is unsatisfactory, and the only thing that remains is to accept the scientific classification as far as it goes, and to consider any special machines, not covered by that classification, on their individual merits.

For the general purposes of classification the authors have taken, as an entirely different class, machines which in conjunction with some form of typecasting mechanism are capable of producing the printing-surface more or less completely without the intervention of manual labour beyond the touching of the keys upon a keyboard. This classification has also the advantage of being roughly historic and chronological, for just as in the history of printing the Wicks rotary typecasting machine, in the authors' opinion, is so far the highest development of its class of machine and is the legitimate descendant of the primitive hand-mould, so is the highest development of the typecasting and composing machine of to-day, the legitimate descendant of the combined composing, line-justifying and distributing cold machine. In this treatise, therefore, following the various casting machines will come the simple composing machine; the simple line-justifying machine; the simple distributing machine; the casting and composing machine; the casting and line-justifying machine; the casting and distributing machine; the composing and line-justifying machine; the composing and distributing machine; the casting, composing, and line-justifying machine; the composing, line-justifying and distributing machine. In succeeding chapters the authors will deal in order with these respective combinations of operations, taking in each case as instances typical machines which effect, by various methods, the carrying out of the several processes of casting, composing, line-justifying, and distributing; either individually, or collectively, two or more at a time.

Most of the above machines are what are generally known as cold machines, that is to say, machines which receive their type cold and carry it in that condition through all its manipulations to its final position in the printing-surface. Even here the classification would break down, for there are machines which may be considered cold in some of their processes and hot in others. However, as a broad generalization the classification holds.

Composing, line-justifying, typecasting and (through the metal-pot) distributing machines.—In this category, with few exceptions, will be included the large class of machines known generally as hot. Their varieties are as numerous as those in the other class, but for the moment setting aside certain rarer classes, which are of no great commercial interest, they may be broadly divided into two classes, the monotype class and the linotype class, the generic difference between these two classes being that in the monotype class, the product, loose type, is cast by the successive presentation of matrices to a type-mould for the successive casting of the individual type or units which go to form the finished product of this class of machine—a line of individual type; whereas in the second or linotype class the product of the machine, usually a slug, is cast in a single operation of pouring the metal into the mould. The further class of hot machines includes impression machines, in which dies form impressions in flong or *papier mâché* from which slugs, logotypes, or type are subsequently cast, or in which steel dies impress soft-metal blanks in various ways to form type, strips of type in relief, or type-slugs. Some of these are in one sense cold machines, but as they are heavy machines driven by power, they may be conveniently classed here under the general heading of impression machines.

Miscellaneous.—Under this head one may put machines which seek to arrive at the production of a printing-surface by methods dissimilar from any already described, such, for instance, as machines in which no type is used, but which reproduce the characters directly by means of photography and etching or lithography.

CHAPTER XVII.

KEYBOARDS.

"All through my keys that gave their sounds to a wish of my soul,
All through my soul that praised as its wish flowed visibly forth."
Browning. Abt Vogler.

8-point venetian old-style (Shanks & Sons).

Before proceeding to the consideration of any form of composing machine, the question of keyboards demands individual attention. So far as the authors are aware, this subject has not been treated by itself *in extenso*, especially with regard to its development, and to the influences that have acted in determining the arrangement both of the printer's case itself, and of the keyboards of the various composing machines by means of which its former functions are now so frequently performed.

In the first place the arrangement of the printer's case must have been arrived at in a more or less haphazard manner, and the size of the different compartments gradually changed and varied to allow for the requirements of practice, dependent on the frequency of occurrence of the different characters and on the distance which the hand of the compositor must travel in picking up the characters successively in the performance of hand-composition.

ARRANGEMENT OF CASES.

The arrangement of the English case had attained very nearly its present form prior to the discarding of the long **s** (ſ), and its evolution may be studied from the following figures which give, (1) Moxon's cases, 1683, fig. 261; (2) Smith's cases, 1755, fig. 262; (3) the ordinary arrangement of the lower case, 1870, fig. 263.

No systematic attempt appears to have been made to improve the arrangement of the English case, but modifications have been gradually introduced and the case shown in fig. 263 has now been altered in many offices so that the compartments in the top row read: **fl**, **[]**, **()**, **:**, **;**, **'**; the large box for the lower-case **e** remains as before and is followed by: middle spaces, **1**, **2**, **3**, **4**, **5** and **6**; the compartments to the left of the **b** and **l** reading downwards now contain the **ff**, **fi**, **&**, **q**; the compartments to the right of **g** contain **7, 8, 9** and **0**, the odd figures coming under the **5**; and in the upper pair of compartments to the right of the **r** are placed the **k** and **j** respectively, the **k** occupying the compartment which previously contained the **q**. An illustration of this lay is given in Southward's "Modern Printing."

The size of the box in the case is not merely dependent on the number of characters required by a fount scheme, but also depends upon the set

Upper.

A	B	C	D	E	F	G	â	ê	î	ô	û	☌	△
H	I	K	L	M	N	O	ä	ë	ï	ö	ü	✱	☍
P	Q	R	S	T	V	W	á	é	í	ó	ú	□	
X	Y	Z	Æ	J	U		à	è	ì	ò	ù	☊	†
♄	♃	♂	☉	♀	☿	☽	♈	♉	♊	♋	♌	♍	*
1	2	3	4	5	6	7	♎	♏	♐	♑	♒	♓	
8	9	0			ſt	k	ſſi	ffi	ſſl	ffl	R	⊕	§

Lower.

<table>
<tr><td>j</td><td></td><td></td><td></td><td>æ</td><td>œ</td><td rowspan="3">e</td><td>s</td><td></td><td></td><td></td><td></td><td>ſl</td><td>fl</td></tr>
<tr><td>,</td><td rowspan="2">b</td><td colspan="2" rowspan="2">c</td><td colspan="2" rowspan="2">d</td><td rowspan="2">i</td><td rowspan="2">ſ</td><td rowspan="2">f</td><td rowspan="2">g</td><td rowspan="2">ſh</td><td>ſſ</td><td>ff</td></tr>
<tr><td>&</td><td>ſi</td><td>fi</td></tr>
<tr><td>ct</td><td rowspan="2">l</td><td colspan="2" rowspan="2">m</td><td colspan="2" rowspan="2">n</td><td rowspan="2">h</td><td rowspan="2">o</td><td rowspan="2">y</td><td rowspan="2">p</td><td rowspan="2">q</td><td rowspan="2">w</td><td></td><td>?</td></tr>
<tr><td>;</td><td>en</td><td>em</td></tr>
<tr><td>z</td><td rowspan="2">v</td><td colspan="2" rowspan="2">u</td><td colspan="2" rowspan="2">t</td><td rowspan="2">Spaces.</td><td rowspan="2">a</td><td colspan="2" rowspan="2">r</td><td>,</td><td>:</td><td colspan="2" rowspan="2">Quadr.</td></tr>
<tr><td>x</td><td>.</td><td>-</td></tr>
</table>

FIG. 261.—*Moxon's cases*, 1683.

width of the respective characters. This can be seen by comparing the size of the compartments containing the lower-case **l** and **d** respectively, the one compartment being one-half the size of the other, while the number of letters in each compartment is the same.

In these diagrams the authors have dealt chiefly with the lower case, because, owing to the importance of the characters, the influences have shown themselves clearly in this instance, whereas in the matter of the upper case, which is so much less used, the influences have not taken full effect. As a matter of historic interest, it may here be noted that Earl Stanhope,

Upper.

A	B	C	D	E	F	G	A	B	C	D	E	F	G
H	I	K	L	M	N	O	H	I	K	L	M	N	O
P	Q	R	S	T	V	W	P	Q	R	S	T	V	W
X	Y	Z	Æ	Œ	J	U	X	Y	Z	Æ	Œ	J	U
ä	ë	ï	ö	ü	H.S.	[ ]	â	ê	î	ô	û	¶	§
1	2	3	4	5	6	7	á	é	í	ó	ú	‖	‡
8	9	0	ſb	ſk	ſt	k	à	è	ì	ò	ù	†	*

Lower.

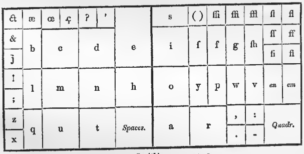


FIG. 262.—*Smith's cases, 1755.*

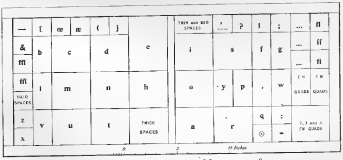
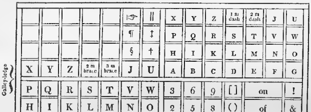


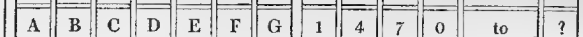
FIG. 263.—*Ordinary arrangement of lower case, 1870.*

who devised a large number of improvements intended to assist the printer,

UPPER CASE.



LOWER CASE.



PECULIARITIES AND ADVANTAGES OF THESE CASES.

First. The nine logotypes now in use are omitted. They are proposed to be printed with separate types, thus: ff, fi, fl, ffi, ffl, &c. instead of ff, fi, fl, ffi, ffl, &c. And the Italic thus: *ff, fi, fl,* &c. instead of *ff, fi, fl,* &c. In 20 pages of Enfield's Speaker, (namely, from page 71 to 90, both inclusive), those logotypes occur only 95 times, viz.

PRESENT LOGOTYPES.

ff	fi	fl	ffi	ffl	Æ	Œ	æ	œ	Total,
28	51	10	4	2	0	0	0	0	95.

Secondly. Eight new logotypes are introduced. Their regular and frequent occurrence expedite the process of composition in a very considerable degree; for, in those same 20 pages, the new logotypes would save to the compositor no less than 3072 lifts, viz.

STANHOPE LOGOTYPES.

th	in	an	re	se	to	of	on	Total,
771	441	413	385	291	279	264	229	3073.

Thirdly. The introduction of the new logotypes, and the great imperfection of the various existing arrangements of composing cases, have caused the above new and very superior arrangement to be adopted.

Fourthly. The front side of each box of the lower case is made sloping, instead of upright; which shape is convenient both to the view and to the hand of the compositor, and it enables him to lift the types with the same rapidity and ease when the boxes are nearly empty as when they are full. The types are much better preserved from wear, by means of this shape. It also allows the lower case to be made deeper than usual; so that, two of them contain as much as three lower cases on the old construction. At the bottom of each box of the upper case, the internal front arras is filled up.

The saving of time is of immense importance, especially in all cases where despatch is particularly required. The new cases are, by experience, found to save full *one day* out of *six* to the compositor.

Fifteen boxes on the left-hand side of the upper case are represented empty. They are intended for the sorts which are sometimes used for particular works; such as, accented letters, mathematical marks, &c.

As the asterisk, or star [*] is very liable to be filled with ink at press, it is intentionally excluded from among the reference-marks.

Stereotyped and Printed by EARL STANHOPE, Chevening House, Kent.

FIG. 264.—*Stanhope's cases.*

and, amongst other matters, devoted considerable attention to the introduction of logotypes, proposed an amended form of case in which provision was made for certain logotypes. This is shown in a page reproduced in reduced facsimile from his work, fig. 264.

In France the arrangement of the case appears to have been standardized at an early period in a form which left a considerable amount to be desired with regard to the distance travelled to and fro by the hand of the compositor in setting up and in distributing. The subject has been investigated at great length by Théotiste Lefevre, who publishes a table showing the distance moved by the hand both for composing and for distributing a quantity of matter equal to 18,000 ens with the case arranged in the old

A	B	C	D	E	F	G	A	B	C	D	E	F	G
H	I	K	L	M	N	O	H	I	K	L	M	N	O
P	Q	R	S	T	V	X	P	Q	R	S	T	V	X
â	ê	î	ô	û	Y	Z	J	U	É	È	Ė	Y	Z
É	È	Ê	Æ	Œ	W	Ç	ffl	ffi	Æ	Œ	W	Ç	!
à	è	ì	ŧ	ù	(	r	fl	a	†	§	]	/	?
»	o	Ū	J	j	e	m	ff	ë	ı	ü	ÿ	ñ	&

<table>
<tr><td>*</td><td>ç</td><td>é</td><td>-</td><td>’</td><td rowspan="3">e</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td></tr>
<tr><td rowspan="2">—</td><td rowspan="2">b</td><td rowspan="2">c</td><td rowspan="2" colspan="2">d</td><td rowspan="2" colspan="2">s</td><td rowspan="2">Esp moyen</td><td rowspan="2">f</td><td rowspan="2">g</td><td rowspan="2">h</td><td>9</td><td>0</td></tr>
<tr><td>æ</td><td>œ</td></tr>
<tr><td>z</td><td rowspan="2">l</td><td rowspan="2">m</td><td rowspan="2" colspan="2">n</td><td rowspan="2">i</td><td rowspan="2" colspan="2">o</td><td rowspan="2">p</td><td rowspan="2">q</td><td>;</td><td>w</td><td>k</td><td>Cadratin</td></tr>
<tr><td>y</td><td>Esp fines</td><td>fi</td><td>:</td><td>Cadratin</td></tr>
<tr><td>x</td><td>v</td><td>u</td><td colspan="2">t</td><td>Espaces</td><td colspan="2">a</td><td colspan="2">r</td><td>.</td><td>,</td><td colspan="2">Cadrats</td></tr>
</table>

Fig. 265.—*Lay of French cases.*

way and in the new way which he proposes. He takes the number of characters of each sort, multiplies by the distance and sums the totals, with the result that he is able to show a saving of 8 per cent in the distance travelled by the hand of the operator in composition. He also points out the interesting fact that in distributing type, the hand travels a considerably shorter distance than in composing it, the distances being respectively in the ratio of 66 to 100, according to the " Guide Pratique du Compositeur d'Imprimerie."

The lay of the French cases is shown in fig. 265; that of the German *Fraktur* case is shown in fig. 266; and that of the Russian case is shown in fig. 267.

Some mechanical devices have been produced with the object of saving handwork in composition, amongst which only one ever reached the stage of coming on the market. This machine, known as the *Lagerman Typotheter*, subsequently as the *Universal*, and later as the *Chadwick*, was the invention of Alexander Lagerman of Sweden. It was based on the assumption that the compositor could take up type faster with both

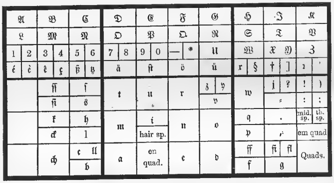


FIG. 266.—*Lay of German* Fraktur *case.*

hands than with one, and that a considerable portion of the time lost in composition was wasted in effecting the turning of the type to its proper position. The machine was constructed with a funnel into which the type

FIG. 267.—*Lay of Russian case.*

were dropped as fast as they could be picked up and released from the fingers of the compositor. The machine received the type from the funnel, selected it for position and turned it end for end, if necessary, so that the type was arranged face up and nick outwards, irrespective of its position

PLATE XV.

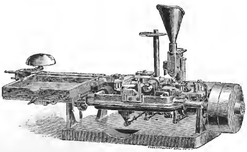


FIG. 268.—*Chadwick typesetter.*

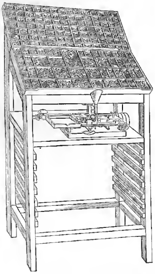


FIG. 269.—*Cases with Chadwick typesetter in position.*

To face page 288.]

when it entered the ho
machine. In this mac
full, and enabled him
condition and to proce

In the improvemen
plate XV, an indicator
line, and it was pro
hopper the requisite
the take was complete
position between the
in its place in front of

The machine in its
account of the very sm

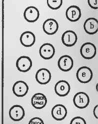


FIG. 270.—

other inventors in thi
and Alexander Dow, al
the composition of typ

C

The arrangement
the composition of ty
machines like the *Ha*
keys near together wh

The Kastenbein ke
keys together, fig. 27
apparently to use bot
hand-composition or
most typewriters.

Hooker (1874) ad
only arranged as, but

when it entered the hopper or was received by the filling mechanism of the machine. In this machine a bell warned the compositor when the line was full, and enabled him to shift it into a receiving galley in its unjustified condition and to proceed with the composition of the next line.

In the improvement of this machine known as the *Chadwick*, fig. 268, plate XV, an indicator showed the amount of space required to justify the line, and it was proposed that the compositor should empty into the hopper the requisite number of spaces to make up this deficit when the take was completed, and subsequently transpose them to their proper position between the words. Figure 269, plate XV, shows the machine in its place in front of the cases.

The machine in its earlier and later forms failed to make headway on account of the very small saving effected by it in actual practice. Amongst

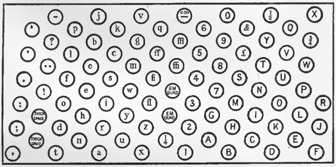


FIG. 270.—*Hattersley keyboard.* Scale: about ½ full size.

other inventors in this direction may be cited L. K. Johnson, A. A. Low, and Alexander Dow, all of whom have patented various devices for assisting the composition of type by hand.

COMPOSING-MACHINE KEYBOARDS.

The arrangement of the keyboard of machines designed for effecting the composition of type has been influenced by various causes; first, in machines like the *Hattersley* (1857), an attempt was made to group those keys near together which are most frequently used, fig. 270.

The Kastenbein keyboard (1869) also places the most frequently used keys together, fig. 271, but in two separate groups, it being intended apparently to use both hands more equally than could be the practice in hand-composition or than is usual in the arrangement now adopted in most typewriters.

Hooker (1874) adopted an arrangement in which the keys were not only arranged as, but were in size identical with the compartments of the ordinary compositor's case, fig. 263, with the exception that the compartment marked hair-spaces is used for the **k**. The keys formed electric contacts operating electro-magnets, one connected to each plate, and effected the ejection of the corresponding type from its channel.

Wicks (1883) in his composing machine arranged the keys in two parallel rows, fig. 272, with the object of obtaining a saving in the distance travelled by the hand of the compositor by giving special attention to the ease of production of chords forming logotypes. This inventor, however, like many others, appears to have been guided rather by his personal belief than by actual statistics.

Had the table of frequency of logotypes given in table 27, p. 148, been accessible at the time, it would have proved of considerable utility to the inventor in designing the Wicks composing machine. With the keyboard shown in fig. 272, chords can be struck for thirty-four of the logotypes given in the table accounting for nearly 33 per cent of ordinary reading matter. With the arrangement; **b t w p c h e a i o u r s n g d l y** sp. qd., for the front row, chords could be struck for fifty-one of the logotypes given in table 27, and for over 44 per cent of the ordinary reading matter.

The Pulsometer keyboard, fig. 273, is arranged with the space-key of greater width and central to the board; this key is of much larger size than the others, extending over the whole depth of the four rows of character-keys; at its front end it is fitted with a slide permitting it to act as desired on one or the other of two keys of normal size effecting the release of spaces from one or other of two corresponding magazine-channels. The arrangement adopted in this keyboard is one in which those characters which are most used are grouped together on each side of the central space-key, but no attempt is made to follow any well-known arrangement of keys.

The Monotype keyboard.—The arrangement of the original A, B, or C pattern keyboard of the Monotype, fig. 274, was influenced by a totally different set of conditions, namely, the set width of the various characters to be produced, and the grouping of these characters in classes according to the set widths. This arrangement did not permit of bringing those characters very close together which are most frequently used, and it produced a keyboard quite unlike that of any other class of machine.

All the fifteen characters of a row arranged vertically on the keyboard (or of a row arranged body-wise on the grid) have the same set width; this is a most important feature in designing faces to suit the machine. The unit employed is one-eighteenth of the quad, and the vertical rows of keys give the following set widths; one row each 5, 6, 7, and 8 units; three rows 9 units (en quad); two rows 10 units; one row each 11, 12, 13, 14, 15, and 18 units, fig. 367, p. 396. The space-key operates in a different manner and gives a setting of 4 units only; the keys act by elevating stops which limit the travel of a rack engaging with the counting wheel, one tooth of which equals one unit, and one revolution of which is equal to 9 ems, fig. 365, p. 394.

When the Monotype m
founts of type, it is possib

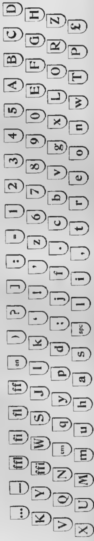


FIG. 271.—*Kastenbein composing machine; keyboard.* Scale: ⅓ full size.

When the Monotype machine is required to be used for two different founts of type, it is possible to change the lay-out of the grid and to give

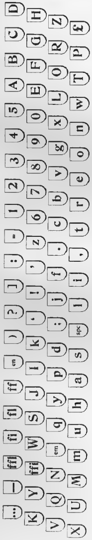


FIG. 271.—*Kastenbein composing machine; keyboard.* Scale: 1/6 full size.

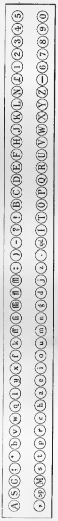


FIG. 272.—*Wicks composing machine; keyboard.* Scale: 1/6 full size.

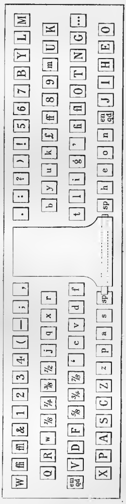
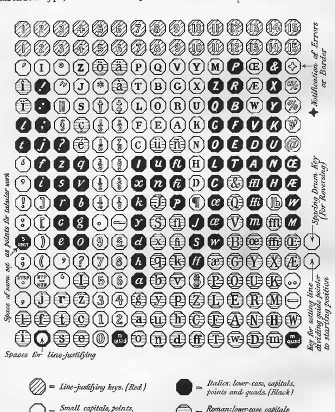


FIG. 273.—*Pulsometer composing machine; keyboard.* Scale: 1/3 full size.

different uses to some of the keys on the keyboard so that dictionary and tabular work may be set up on the same machine using sans serif or clarendon type, as the case may be, in conjunction with ordinary roman.



Two additional keys on extreme right of keyboard (Green).

FIG. 274.—*Monotype composing machine; pattern C keyboard.* Plan. Scale: about ½ full size.

In this form of Monotype keyboard it has been possible, by varying the lay-out and giving different uses to the keys, to replace the italics and accents with gothic or other display faces, but in doing this it has been necessary to follow the set widths of the characters changed and to give uses to the keys other than those which they originally possessed. This involved a change in the fingering and the necessity for putting some special mark on those keys which no longer represent the original character.

This feature, while simplifying the work from the printer's point of view, makes the manipulation of the keyboard extremely difficult for the

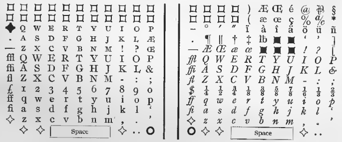


FIG. 275.—*Monotype D and DD keyboards; lay-out for books or news.*

operator. For this reason the Monotype Corporation have improved upon their original model.

The lay-outs of the new pattern D and pattern DD keyboards, for multiple founts, figs. 275 and 276, are so arranged that the ordinary standard typewriter arrangement of keys is adopted for the alphabet

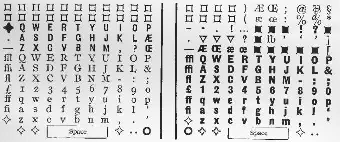


FIG. 276.—*Monotype D and DD keyboards; lay-out for jobbing.*

throughout, thereby greatly facilitating the work of the operator. In the D type of keyboard the differences of set width between the characters are allowed for by mechanism, arranged below the keyboard, which effects the distribution of widths to produce the proper feed of the unit-counting wheel, while in the earlier form of keyboard the lines of keys from back to front corresponded to the set width of the characters similarly arranged in the grid of the casting machine.

The DD keyboard differs from the D keyboard, not in arrangement of its keys, but only inasmuch as it will simultaneously compose at one operation by the compositor two different sizes of type in two different measures; there need be no agreement between body-sizes, measures or

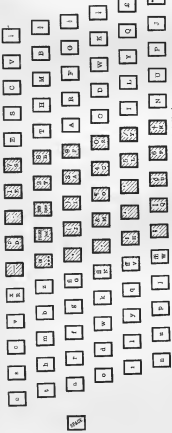


Fig. 277.—*Linotype keyboard; English.* Scale: ⅓ full size.

Where two characters appear on the same key, the upper is roman or italic, the lower a small capital. The 30 hatched keys are coloured blue.

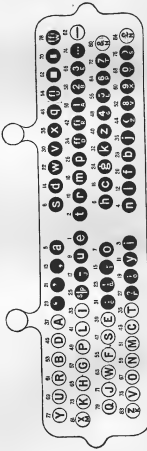


Fig. 278.—*Typograph keyboard; English.* Scale: about ⅓ full size.

spacing, the double product being quite independent. In the DD keyboard there are two paper-towers arranged for receiving the perforated rolls of paper. This form of keyboard is of use where the matter requires to be duplicated for editions of works to be published simultaneously in different styles, each tower being operated independently if required and also being capable of independent line-justification.

The Linotype keyboard, fig. 277, adopts what is probably the most rational arrangement of keyboard possible, as the characters are grouped

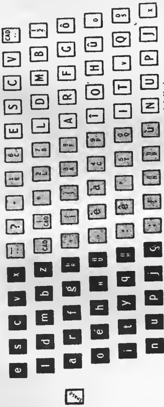


FIG. 279.—*Linotype keyboard; French.* Scale: about ⅓ full size.

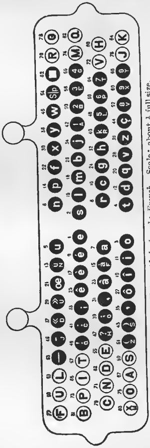


FIG. 280.—*Typograph keyboard; French.* Scale: about ⅓ full size.

according to the order of their frequency of occurrence, and at the same time are placed conveniently for making those combinations which are the most common.

The Typograph has an arrangement of keyboard, fig. 278, which is based on the frequency of occurrence of the characters, those sorts which occur most often being placed near the centre of the board; this is apparently intended to be operated with both hands. In machines like the Linotype and Typograph, different keyboards are used for different languages, the arrangement being dependent on the frequency of occurrence

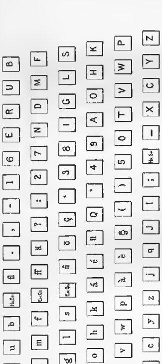


FIG. 281.—*Linotype keyboard; German.* Scale: about ⅓ full size.

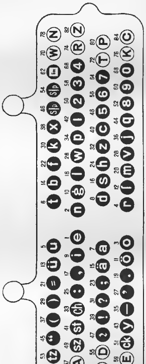


FIG. 282.—*Typograph keyboard; German.* Scale: about ⅓ full size.

and on the succession of characters in the language in question. For this reason the English, figs. 277 and 278, French, figs. 279 and 280, and German keyboards, figs. 281 and 282, of the Linotype and Typograph are shown in conjunction with each other.

The Monoline keyboard, fig. 283, affords an example of an existing keyboard being adapted to a machine in which the arrangement of the matrices is determined by their set width quite as rigidly as in the instance of the Monotype machine. Notwithstanding the fact that each kind of matrix must carry twelve characters, and that there are eight kinds of matrices, the arrangement of the matrices with their distributing mechanism has been effected without in any way altering the desired keyboard arrangement.

In the Monoline machine a different factor operated in deciding the form of keyboard. This machine was intended originally to be worked by girls, and with this object the typewriter keyboard was adopted so as

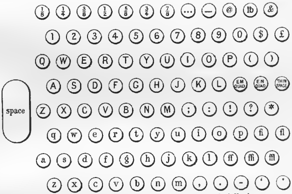


FIG. 283.—*Monoline keyboard.* Scale: about ⅓ full size.

to save all trouble of learning a special keyboard and to give the facility of obtaining without trouble operators accustomed to the fingering.

The keyboard of the *Victorline* machine is very similar to that of the Linotype, but has thirteen extra keys, making 103 in all; twelve of these are accents or special keys arranged in two columns on the right-hand side of the board; there is also a logotype **en** next the lower-case **a** on the left of the machine.

The lay-out of the keyboard of the *Bellows* machine is similar to that of the Linotype except that the two top rows are for small capitals or head letters. The letter-buttons are fastened on straight levers which rest under the release rods and these are in turn connected to a four-pointed star-wheel releasing-mechanism in such a manner that a depressed key-lever causes a quarter-revolution of the star-wheel, allowing one matrix to be dropped from the magazine. There is no mechanically-controlled mechanism for repeated-matrix release. The key touch is stated to be light and quick.

The keyboard of the *Stringertype* follows the standard pattern adopted by the Linotype and therefore calls for no comment. The same arrangement is also adopted in the *Grantype*.

The Unitype keyboard, fig. 284, has ninety keys—one for each channel in the cylinder—each key being connected by levers and wires with a small plunger at the bottom of the channel containing the character that it represents. The front end of the plunger rests immediately behind the foot of the bottom type in its channel, the point of the plunger being thinner than this type. When a key is depressed on the keyboard, its corresponding plunger is moved forward, carrying one type out ahead of it. A light touch of the finger depresses the keys, and their action is practically instantaneous.

The Unitype keyboard is arranged in such a manner that frequently-used combinations of characters can be played in chords such, for instance, as **and, con, the.**

This capability of the keyboard has been utilized in the case of many other machines, and although apparently an important matter, as there is hardly a word in the English language that does not present a combination of at least two letters that can be so treated, it does not in practice effect the saving anticipated. The authors have been informed by several

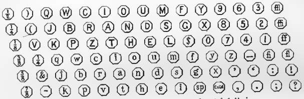
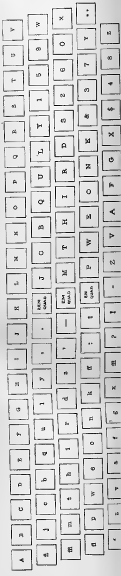


FIG. 284.—*Unitype keyboard.* Scale: about $\frac{1}{8}$ full size.

users of chord-producing keyboards that the compositors have found that the small saving of time effected by striking a large number of chords is neutralized by the time wasted over corrections of the extra errors due to transpositions, etc., that invariably arise in practice when chords are struck; for this reason the operators generally disregard this capacity on any keyboard.

The Paige compositor keyboard, fig. 285, is also shown in perspective view in fig. 360, plate XLVI. It is claimed that the arrangement of this keyboard was arrived at by a very careful analysis of the frequency of recurrence of combinations of letters, or logotypes, so that as many sorts as possible could be placed in the line by playing chords on the keys. This statement appears to be fully justified, for on comparing this keyboard with table 27, p. 148, the authors find that it permits of playing fifty-seven chords, which together account for over 49 per cent of the total matter—a result which is even better than that obtainable from their own suggested improvement on the key arrangement of the Wicks composing machine.

The line-key of the Paige compositor is of equal length to the space-key and works horizontally below it; this is of L-section to prevent the finger of the operator slipping off and it is operated simultaneously with



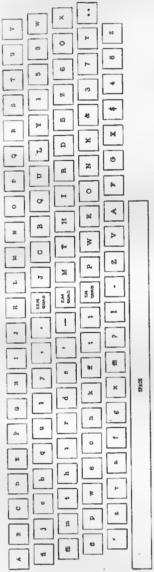


FIG. 285.—*Paige compositor keyboard.* Scale: about ⅓ full size.

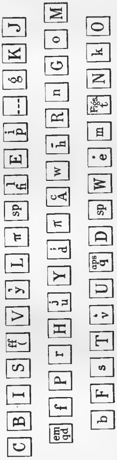


FIG. 286.—*Pulsometer distributing machine; keyboard.* Scale: half size.

the touching of the last word or syllable. An enlarged view of the Paige keyboard is given in fig. 360, plate XLVI.

The two-em quad-key really is an em quad, but operates the key below it so that two successive em quads are composed in the line.

At the back of the first six keys is a word and line indicator; this revolves one step for each depression of the word-key; the indicator point travels horizontally to the right and shows the space available for the last word or syllable.

The arrangement of keyboards, having for object the playing of chords representing the most common combinations of consecutive characters, was a feature of considerable importance in all machines dealing with loose type, but in matrix-composing and record-strip machines those arrangements have found greater favour which are dependent on bringing together the characters most frequently in use. In the case of the matrix-composing machine, arrangements of keys according to frequency of occurrence are usually adopted. In record-strip composing machines, the work of composition need not be performed in the casting-room, but can be carried out under less exacting conditions. The standard typewriter arrangement of keyboard may be advantageously adopted in these circumstances. It is, however, worth noting that the arrangement of keys on the typewriter is not purely dependent on the frequency of occurrence of the characters singly or in sequence; but it is necessary, in arranging the keys of a typewriter, to take account of the actual width of the character on the type-head, so that the broad characters are not placed next to each other. The period of time which elapses between the passing of one type-head by another in effecting successive impressions is extremely short, and upon this period depends the limit of speed at which a typewriter can be worked. This problem of type-bar interference becomes of very serious importance in the case of automatic typewriters for recording messages sent telegraphically. According to Donald Murray, the inventor of the Murray automatic printing telegraph, the moment of inertia varies as the cube of the length of the type-bar and it is necessary to reduce the length of the type-bars to about one-half the ordinary typewriter length, that is to 2 inches long, in the automatic printing telegraph.

Distributing Keyboards.

For the distribution of type, otherwise than automatically, some machines use a keyboard for restoring to the channels of a magazine each character in rotation from the matter to be distributed as it is read back and the corresponding key depressed by the operator. An example of this is afforded by the Pulsometer distributing machine, the keyboard of which is shown in fig. 286. This and earlier proposals are discussed in chapter XXI.

CHAPTER XVIII.

CASTING MACHINES.

"That printers of the future will be their own typefounders is evidenced by the efforts being made by inventors to furnish them with machines for casting type as required. Logically the printing-office is where the typemaking should take place, and emancipation from present conditions is looked forward to by all printers."
John S. Thompson. History of Composing Machines.

9-point bourgeois modernized old-style No. 2 (Monotype).

"Out jumps a type as lively as a tadpole."
Thomas MacKellar. A Manual of Typography.

10-point haddon (Haddon.)

In Europe, Anthony Francis Berte appears to have been the first to use the pump, in the year 1807, as an integral part of a typecasting machine, the type having been previously cast by hand at extremely slow speeds. Fournier gives 2000 to 3000 types per day as the output of a French hand-caster, but Moxon gives the higher number of 4000 as the day's work of an English caster. Marc Isambard Brunel's invention of 1820 is remarkable because, as has been stated, he used a vacuum to ensure the absence in the type of blow-holes, which had been one of the great difficulties up to his time, and is one that is still met with even in the present day by numerous workers in this branch of the subject. That his use of a vacuum was subsequently adopted by other inventors, together with his statement that even at that date it was a known device, has already been mentioned.

Before the advent of typecasting machines the cost of hand-cast type was naturally high. The prices of English type per pound in the years 1763 to 1825 are given in the following table :—

	1763 to 1792	1796	1800	1805	1816	1825
	s. d.	*s. d.*	*s. d.*	*s. d.*	*s. d.*	*s. d.*
Pica	1 0	1 $1\frac{1}{2}$	1 3	1 6	2 6	1 11
Small pica	1 2	1 $3\frac{1}{2}$	1 6	1 8	2 8	2 2
Long primer	1 6	1 8	1 10	1 10	3 0	2 4
Bourgeois	2 0	2 $2\frac{1}{2}$	2 6	2 6	3 8	3 0
Brevier	2 6	2 9	3 0	3 0	4 0	3 2
Minion	3 6	3 10	3 10	4 0	5 0	4 0
Nonpareil	5 0	5 6	5 6	6 0	7 0	5 6
Pearl	6 0	6 7	6 7	7 0	8 0	6 6

Foreign type at the commencement of the last century was generally of Dutch or French origin. According to Hansard the cost of French type cast by Didot in 1822 was as follows :—

" It does not appear that the French type has any advantage to offer on account of price that would be an inducement to its importation into England. The size equal to our Nonpareil is 12 fr. or 10*s.* per lb., that nearest our Brevier 6 fr. or 5*s.* ; Bourgeois, 3 fr. 80 c. or 3*s.* 2*d.* ; Long Primer, 3 fr. 30 c. and 2 fr. 70 c., equal to 2*s.* 9*d.* and 2*s.* 3*d.* ; Small Pica, 2 fr. 30 c. or 1*s.* 11*d.* ; Pica, 2 fr. or 1*s.* 8*d.* ; English, 1 fr. 95 c. and 1 fr. 90 c., equal to 1*s.* 7½*d.* and 1*s.* 7*d.* ; Great Primer, 1 fr. 75 c. or 1*s.* 5½*d.*"

The first typecasting machine of which an illustration is available is that invented and patented in England by Dr. William Church, in 1822. It was intended to be worked in conjunction with his composing machine, also patented in England in the same year. This interesting typecaster is shown in fig. 287, plate XVI.

According to De Vinne, " In 1811, Archibald Binny of Philadelphia devised the first improvement in hand-casting. He attached a spring lever to the mould, giving it a quick return movement, which enabled the type-caster to double the old production. In 1828, William Johnson of Long Island invented a type-casting machine which received the active support of Elihu White of New York ; but the type made by it were too porous, and the mechanism, after fair trial, was abandoned. About 1834, David Bruce, Jr., of New York invented a hand force-pump attachment to the mould, for the purpose of obtaining a more perfect face to ornamental type than was possible with the regular mould. This attachment was known as the squirt machine. Large ornamental types owe their popularity to this simple contrivance. In 1838, the same founder invented a type-casting machine, which was successfully used for many years in New York, Boston and Philadelphia. In 1843 he added other improvements of recognized value. Most of the type-casting machines in Europe and America are modifications and adaptations of Mr. Bruce's invention."

The foregoing statement, by so great an authority as De Vinne, can only have been made through lack of opportunity for investigating early English progress in the art, as disclosed by the records of the British Patent Office, and their incontrovertible logic of fact.

The Bruce machine, improved, is the American representative of the machine commonly known in England as the pivotal typecaster ; it holds its own to the present day for those particular classes of work for which such machines are specially adapted.

The hand or power-driven pivotal casting machine generally in use in British, Colonial, and some American foundries is illustrated in fig. 288, plate XVI, and is shown in side elevation in fig. 289.

Simultaneously with the developments in the construction of the pivotal machine in the United States and England, progress in the same direction was being made independently in France and Germany.

FIG. 287

FIG. 288.—Or

PLATE XVI.

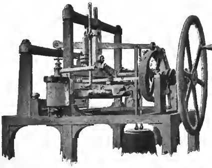


FIG. 287.—*Church typecasting machine* (1822).

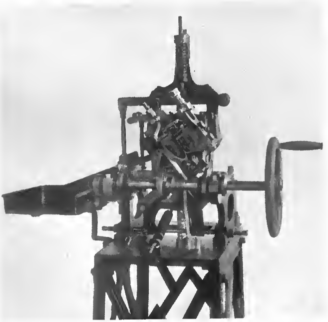


FIG. 288.—*Ordinary (English) pivotal typecasting machine.*

[*To face page 302.*

Pivotal machines, as a cla
the forms adopted for their c
The mould has been already il
and the pump is very similar

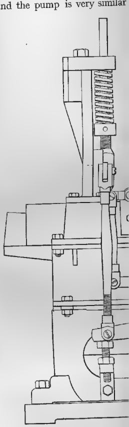


FIG. 289.—*Pivot*

addition of a jobber and a r
nozzle.

The action of the machin
in such manner as to move
pot, and in conjunction wit
opening the mould and closin

Pivotal machines, as a class, usually follow between very close limits the forms adopted for their construction, as shown in figs. 288 and 289. The mould has been already illustrated in figs. 217 to 219, pp. 243 and 245, and the pump is very similar to the justifier's pump, but has usually the

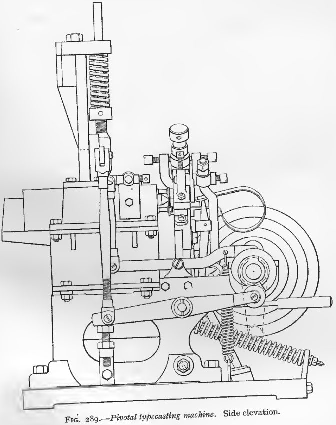


FIG. 289.—*Pivotal typecasting machine.* Side elevation.

addition of a jobber and a nipple-plate for preventing the stoppage of the nozzle.

The action of the machine is that a pivoted frame is capable of rocking in such manner as to move the mould to and from the nozzle of the metal-pot, and in conjunction with this movement are combined movements for opening the mould and closing it at the appropriate times, and also for tilting the matrix away from the face of the type so as to leave it clear for ejection at the moment of opening of the mould. The operations are performed by cams arranged on a cross-shaft generally in the front of the machine, the parts and levers performing the operation being spring-controlled as also is the pump-plunger of the metal-pot which is released by a cam carried on the driving shaft. Originally these machines were constructed with a hand-wheel for turning by hand, and the action of the hand-caster was to give the wheel a turn and pause, with the handle in one definite position corresponding to the closed mould, for a period of time which he varied according to the size of body being cast. The effect of this method of using the machine was to produce a form of time diagram for each of the cams different from that which would be obtained by running the machine continuously by power. The result has been great waste of time by the builders of these machines, who have experimented by rule of thumb to obtain the correct forms of cams under conditions of speed which were not constant. The influence of diameter of roller on the shape of the cam, and that of sine-curve form on the quietness and smoothness of its action, were apparently quite unknown to workers in this field.

The following is a description more detailed than the general *résumé* which has preceded it, of the ordinary and simple typecasting machine in common use in English foundries. This machine, as has been said, is substantially the same as the Bruce machine invented and used in America. The machine, or yet further and more recent improvements and modifications of it, made by one or other of the few makers of typecasting machinery that there are in England, is in general use, so far as the authors can ascertain, by all the printers who cast their own type, and by all the typefounders in the United Kingdom, with the exception of P. M. Shanks and Sons, who also use a machine of their own design and construction, which has a vertical body-slide, and John Haddon and Company, who use both the pivotal and the Foucher machine.

The two halves of the mould are mechanically operated so that they are brought together and, by the action of a cam carried on the driving shaft, held in contact with the nipple-plate which covers the nozzle of the metal-pot. The sequence of operations in the ordinary pivotal casting machine is as follows :—

After the ejection of a type the swing frame of the machine is moved towards the metal-pot by the action of the cam on the driving shaft which bears against a roller carried in an adjustable roller-box on the swing frame. The movement of the swing frame towards the metal-pot causes the mould to be closed positively by the action of the ball-ended rod, the lower end of which is secured to the table of the machine ; the upper end actuates the lifting arm to which it is pivoted. Also pivoted to the lifting arm is the bent arm, or binding arm, which is connected to the top mould-block by a pin at right angles to its upper portion. A groove is turned in this pin into which fits a slotted latch-plate ; when this plate is lifted till the slot is clear of the groove, the pin can be withdrawn to enable the mould to be opened by hand and to be examined, cooled or cleaned.

The pin carried by the binding arm comes into contact with the top mould-block and presses it firmly into contact with the bottom mould-block, thereby ensuring uniformity of body in the type.

After the mould has come into contact with the nipple-plate, the jobber-cam acting on the jobber-lever causes the jobber to retire through the nipple, leaving the opening in the nozzle clear and in communication with the gate of the mould; the pump-cam then reaches the point at which the roller on the pump-lever can move under the action of the pump-spring, and the pump-plunger is allowed to descend, pumping the metal into the mould. When the pump-plunger has descended, the jobber returns into the nipple, and when the mould leaves the nipple-plate it assists the dot in leaving the plate; the roller on the pump-lever then comes into contact with the spiral portion of the pump-cam and commences its up-stroke, filling the pump ready for the next shot.

As the swing frame with the mould attached to it leaves the nipple-plate under the action of the withdrawing-spring, when the maximum radius of the cam on the main shaft has passed the roller, the mould during the first quarter-inch of its movement from the metal-pot is still held closed; but as the movement proceeds, the binding arm with the pin attached to it commences to move upwards and the pin in its upward movement comes into contact with an adjusting screw, fitted with a lock-nut, passing through the top mould-block and entering an elongated hole in it, through which the pin passes; the adjustment of the screw enables the period of time for which the mould remains closed after withdrawal to be determined by limiting the travel of the pin before the opening commences. Thus, after the cast is made and the mould has been withdrawn from the metal-pot, the top mould-block is not constrained until the mould commences to open.

The actual opening of the mould is effected by the withdrawing-spring which draws back the swinging frame. The binding of the matrix in its presentation against the mould is effected by the lining-bar, the end of which carries an adjusting screw; this bears against a stop on the side-frame of the machine. The brass plate lining-spring, the point of which enters a hollow in the back of the matrix behind the strike, holds it in position for line and prevents it from falling out of the machine. When the matrix is presented and the mould has closed, it is held positively against the mould by the action of the lining-bar. When the mould is withdrawn from the nipple-plate and before it begins to open, the movement of the swinging frame, which lifts the lifting arm, acts on an adjustable roller-box carried on the lower end of the delivery-lever and causes its upper end to move towards the nozzle; this causes the adjustable arm of the delivery to be pushed forward against the tail of the matrix and ensures the tilting of the matrix on the lower edge of the back plate of the mould; this rocking movement of the matrix about a point midway between the face and the lower end of the matrix, frees the type. After the type has been cast and while it is still attached to its tang, it is sometimes retained by the top half of the mould and sometimes by the bottom half. To ensure its being freed from the mould in the former case, an adjustable knife fixed to the bottom mould-block is so set that if the type sticks in the upper half as the mould opens, the knife comes into contact with the dot and causes the type to fall away freely. If, on the other hand, the type sticks in the bottom half of the mould, which in this form of machine is inclined, an adjustable knife fixed to a stud on the back of the lifting arm catches the dot and lifts the type up by its tang freeing it from the mould, from which it then falls. Both knives are now usually fitted on machines of this class.

The type, with their attached tangs, fall down a chute into a tray, the operations of breaking off, setting up, and dressing having to be subsequently performed by hand.

The Davis pivotal machine for casting finished type.—An improved form of pivotal machine for throwing out finished type has been devised by one of the authors in conjunction with H. Davis. In the 1912 model, fig. 290, plate XVII, a slotted nick-wire is fitted to the bottom half of the mould and projects across the gate through which the type-metal enters. Drags are fitted to the top half of the mould to ensure the type being retained and being broken from its tang as the top half of the mould lifts; the act of breaking off causes the type to fall away from the top of the mould completely finished with the break below the level of the feet, as in the case of the Stringer break shown in fig. 9, p. 13. A knife, connected with the lifting arm and operated by a pin fixed to the lifting arm and working in a slotted cam-path in the knife-lever, effects the ejection of the tang from the nick-wire which has retained it, thus completely clearing the mould in readiness for the next cast.

The finished type fall down a chute into a tray or box and require none of the operations of breaking off, setting up, and dressing.

In this machine, as in the one next described, a straight-line movement of presentation and withdrawal of the matrix is used, the mode of operation being practically the same as in the original pivotal machines, with the exception that a helical spring on the guide-rod of the presentation box, or matrix-holder, is substituted for the brass plate spring, and that the delivery-lever is no longer required as the helical spring performs the work of withdrawing the matrix.

Pivotal machine for casting and setting up finished type in line.—In a further modification of the pivotal machine, fig. 291, plate XVII, also due to one of the authors and to H. Davis, the mould has been placed horizontally instead of in an inclined position. The matrix-presentation has been made rectilinear as in the machine last described. The sequence of operations and description of the points in which this machine differs from the original pivotal machine are as follows:—

After the presentation of the mould and the completion of the cast,

FIG. 290.-

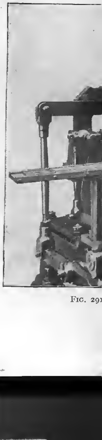


FIG. 291

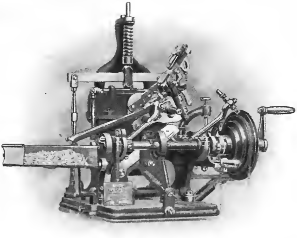


FIG. 290.—*Davis pivotal typecaster; throwing out finished type.*

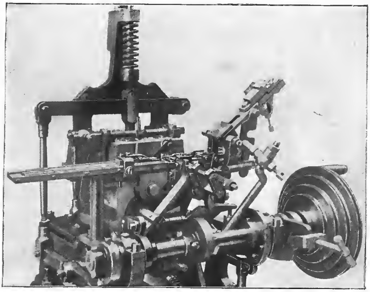


FIG. 291.—*Davis pivotal typecaster; setting up type in line.*

[*To face page* 306.

PLATE XVIII.

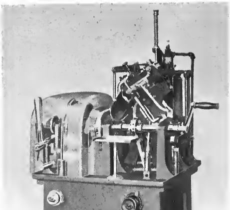


Fig. 292.—*Nuernberger-Rettig typecaster.*

To face page 307.]

the swing frame with the m
the action of the withdrawing
mences as in the previously
matrix is drawn back to a s
drawing-spring acting on the
mounted on a slide-block are
type is to leave the mould;
to the metal-pot is formed
or that portion of the tang w
plate; the supplemental pus
the wall or relief projection o
drawal of the matrix. The
effected by means of a cam ca
pin-jointed to the fixed pillar
plunger carried in a spring b
bearing against the end surfac
its forked upper end to act on
pushers are attached. The
causes the type to be ejected
the last type, previously ca
machine, type following type
the movement of ejection th
a presser, and on the return
actuates a plunger carried on
the type; an alternative met
in which the power required
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box or holder suitable for ca
in place of those of ordinary
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cast complete logotypes.

Nuernberger-Rettig.—Anot
origin, which in the last ye
has been considerably adv

the swing frame with the mould is withdrawn from the nipple-plate by the action of the withdrawing-spring, and the opening of the mould commences as in the previously described case; simultaneously with this the matrix is drawn back to a sufficient distance by the action of the withdrawing-spring acting on the matrix-box or holder. Two thin metal blades mounted on a slide-block are made to travel in the direction in which the type is to leave the mould; the one blade or pusher on the side adjacent to the metal-pot is formed with a forked end which embraces the dot, or that portion of the tang which was formed in the cavity in the nipple-plate; the supplemental pusher bears simultaneously or nearly so against the wall or relief projection of the face of the type left clear by the withdrawal of the matrix. The process of ejection by these two pushers is effected by means of a cam carried on the main shaft which operates a lever pin-jointed to the fixed pillar of the machine. This lever raises a spring plunger carried in a spring box, and the upper end of the spring plunger bearing against the end surface of the bent arm of the ejection-lever causes its forked upper end to act on the pin moving the slide-block to which the pushers are attached. The movement of the pushers when completed causes the type to be ejected on to the receiving-stick along which it pushes the last type, previously cast, forward towards the outer side of the machine, type following type in regular order. After the completion of the movement of ejection the finished type stands in the type-race under a presser, and on the return of the swing frame an arm on the jobber-shaft actuates a plunger carried on the swing frame, breaking off the tang from the type; an alternative method of breaking the type can also be arranged in which the power required is provided by the movement of the swing frame towards the type-race; a breaking-off lever is carried on a pin on the side of the type-race next to the metal-pot, and a fixed cam-path, over which the tail of the lever travels, causes the depression of the lever and breakage of the tang to be effected before the completion of the movement of the swing frame towards the metal-pot.

In this form of machine the nipple-plate is usually made of two thicknesses of metal, the one containing the cup-shaped depression for the end of the nozzle, and the circular hole for the jobber, while the other part is formed with a tapered elongated hole for producing a form of dot which, when embraced by the forked end of the pusher, will prevent the turning over of the type during ejection.

In this machine and in that last described it is possible to use a matrix-box or holder suitable for carrying either Linotype or Monotype matrices in place of those of ordinary form; moreover, it is possible to use a box for containing two or more Linotype matrices, fig. 94, p. 108, and thus to cast complete logotypes.

Nuernberger-Rettig.—Another pivotal typecasting machine, of American origin, which in the last year or two has appeared on the market and has been considerably advertised, is the Nuernberger-Rettig, fig. 292, plate XVIII. Apart from neatness of design and solidity of construction, this pivotal casting machine does not call for any particular remark. The main difference between it and its congeners lies in its mould, which has a somewhat peculiar method of removing the tang from the type when cast. This, however, has been treated of elsewhere (pp. 12 and 13) in this work, and here requires no further comment.

Speed of pivotal machines.—The maximum speeds claimed for pivotal casting machines are about 3000 type per hour for pica, increasing up to 6000 type per hour for 6-point and smaller bodies. Owing to the fact that the moulds of pivotal machines are not generally water-cooled and only occasionally have an air-blast fitted for cooling, it is frequently necessary to stop to cool the mould, and for this reason the figures given do not correspond to the mean rate of output which can be maintained for a longer period.

In the case of large work, from 24-point to 72-point, the pivotal machine requires to be run at a considerably-reduced speed, for which purpose it is usually fitted with a reducing-gear, and in some cases with a gear which cuts out the driving shaft for one or more revolutions, allowing it to turn freely and then throwing it into gear again. This is done in order to imitate the action of the hand-caster who allowed a dwell, in turning the handle, at the moment when the mould had been filled, of sufficient length to ensure the solidifying of the type before the mould was allowed to open. In some of the large-work machines, fig. 293, plate XIX, used for casting quotations, special arrangements of mould are made for coring these hollow. The core must of necessity be withdrawn before the quad is ejected from the mould. Somewhat similar arrangements are also necessary for casting large type of bridge-section, a form which is sometimes adopted to effect a reduction in weight.

In all ordinary pivotal machines a different mould is required for each body, but the mould is adjustable for those variations in set which occur in a fount of type; a different mould of each body is also required for spaces and quads, on account of the difference in height-to-paper, and, where a nick is fitted, yet another mould is required for the 2, 3, or 4-em quads. As the nicks differ for different faces of the same body, a suitable mould is required for each different arrangement of nick. The nicks on the body are produced in casting, but the removal of the tang and the cutting of the heel-nick, as has been said, must be performed subsequently, except in those machines like the Nuernberger-Rettig or the Davis, in which special provision is made for breaking off the tang without leaving any projection beyond the feet of the type.

Rapid typecasters.—Among other classes of machines to be considered are rapid typecasters, casting finished type at a high rate of speed from a single mould; the only one known to the authors is one designed and produced by them and in connexion with which certain novel patents have been taken out. This machine is perhaps the most rapid producer in the world

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PLATE XIX.

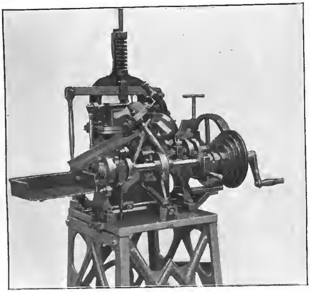


FIG. 293.—*Pivotal typecaster for large-work.*

[*To face page* 308.

PLATE XX.

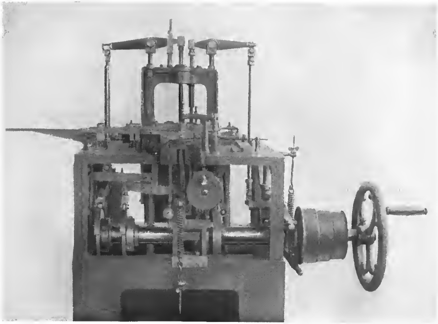


FIG. 294.—*Rapid typecasting machine.*

To face plate XXI.]

FIG. 295.–

PLATE XXI.

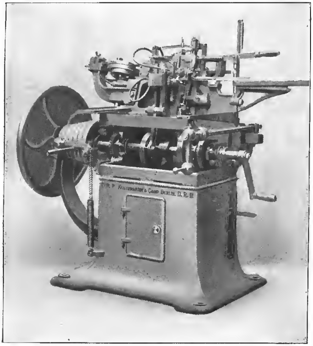


FIG. 295.—*Küstermann typecasting machine.*

[*To face plate XX.*

PLATE XXII.

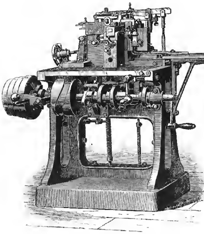


FIG. 296.—*Barth typecasting machine.*

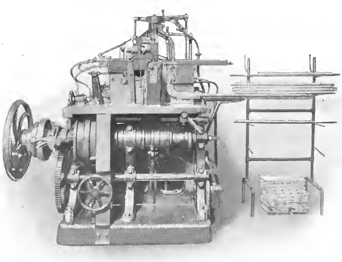


FIG. 297.—*Automatic typecasting machine; American Type Founders Co.*

To face page 309.]

of ordinary printers' type from a single mould, which is water-cooled and constructed somewhat on the lines of the Monotype mould. It delivers its type in a continuous line, and is capable of producing over 10,000 10-point type per hour, a slightly slower speed being maintained in the case of 12-point, and the rapidity of production of the smaller sizes is of course proportionately increased. These machines deliver their type from the mould completely finished without using any form of knife, file, dressing-plane, or milling-cutter.

Several of these machines have been constructed; the idea which led to their building not being the production of type for sale, but the supplying of type to the magazines of composing machines used in a newspaper office. A novelty in these machines is the holding in actual contact of a hot nozzle against a cold mould, freezing being prevented in the orifice of the nozzle by the circulation of molten metal round the nozzle delivery-pipe in the manner already described elsewhere in this work. This machine is shown in fig. 294, plate XX.

Foucher, of Paris, has also produced a rapid caster, for which very high rates of speed are claimed. The type, however, from this machine is not, as in the machine just described, delivered finished from the mould, which is duplex, but is finished by means of cutting knives in a manner somewhat similar to that adopted in his earlier machines. These machines respectively represent the highest speed at which type have been cast commercially, in the first instance from a single mould and a single matrix, and in the second from a duplex mould and two matrices.

Next must be considered a different class of machines, such as the ordinary machine of Foucher of France, of Küstermann of Germany, fig. 295, plate XXI, of Böttger of Germany, and of Barth of America, fig. 296, plate XXII, which may be taken as representative; and along with these certain still later machines, such as the automatic typecasting machine of the American Type Founders Company, fig. 297, plate XXII, the Compositype sorts caster, fig. 298, plate XXIII, and the Thompson type-caster, fig. 299, plate XXIII.

The Foucher universal typecaster casts, breaks off the tang, rubs the type, finishes the foot, and sets up in line either type, or spaces, or quads.

The mould is made with one side adjustable and the body-slide is changed for each body. Any form of matrix can be used, adjustments being provided for setting the matrix for the line, position, and set width of the character to be produced.

The output of the small-size machines is stated to vary from 4500 to 2500 per hour; the rate, of course, decreases as the section of the type increases. The machine is made in four sizes, the smallest making from 3 to 14-point Didot and the largest from 48 to 108-point Didot.

The Küstermann rapid typecaster, fig. 295, plate XXI, is constructed on lines somewhat similar to the Foucher machine. A screw-adjustment is provided for setting the matrix to line, and the position of the matrix

Founders Co.

as well as the set width of the character are also determined by adjustments. The machine is driven by a horizontal shaft which actuates a portion of the gear indirectly by means of a vertical shaft driven through bevel-wheels. The output of the machine is stated to vary in 10-point body from 4500 em quads to 9600 of the thinnest sorts per hour.

The Böttger typecasting machine.—The earliest German rapid typecaster produced was that of Gottfried Böttger of Leipzig. In this machine a curved slide is substituted for the pivoted rocking frame of the ordinary machine, and a vertical shaft operated by helical gear from the main horizontal shaft operates the mould.

The Barth machine, fig. 296, plate XXII.—The patent of Henry Barth was granted in the United States on "January 24, 1888, for a complete type-casting machine. He claims that this machine produces one-half more than the older machines; that it does its work with more accuracy, and that it permits the use of a harder quality of metal. Its construction and its processes differ radically from those of the Bruce machine. One half of the mould and the matrix are fixed upright and made immovable; the other half of the mould rapidly slides to and fro on broad bearings, releasing the type that has been founded and closing again before the hot metal is injected for a new type. It breaks off the jet, ploughs a groove between the feet, rubs down the feather-edges at the angles, and delivers the types on the channel in lines ready for inspection." (De Vinne.)

The American Type Founders automatic machine.—Figure 297, plate XXII, shows the automatic typecasting machine at present in use by the American Type Founders Company. These machines, which are both air and water cooled, are stated to be able to cast up to a rate of 12,000 type per hour. The type are, however, cast unfinished and ejected along a channel where, by means of supplementary mechanism, the burrs are trimmed off, the tangs removed, the heel-nicks and distinguishing nicks cut and the type delivered on to a stick ready for inspection. In many ways this machine closely resembles those of Foucher (French) and Küstermann (German).

The Compositype sorts caster, fig. 298, plate XXIII, had its origin and was manufactured in Baltimore, Md., U.S.A.; it casts any size of type from 6-point to 36-point, and also quads and spaces, at a speed of from 26 to 13 type per minute, according to the size.

The mould is so constructed that only one mould section is required for each body-size of type, including high or low spaces and quads, and is readily adjusted for any change of set required, without recourse to skill or to micrometric measurements. The usual equipment for a machine is five mould sections with space and quad matrices, and spaces can be cast of 1-point set. It is claimed that the change from one body-size to another can be effected in from two to three minutes. The casting, ejecting, and trimming movements are automatic, so that the machine delivers a finished type at each revolution. The matrices are electrotyped and closely resemble those of the Thompson machine, fig. 176.

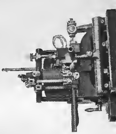


PLATE XXIII.

PLATE XXIII.

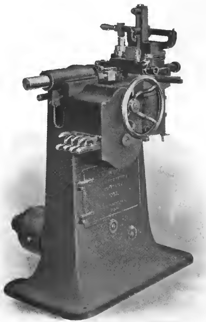


Fig. 298.—*Compositype sorts-caster.*

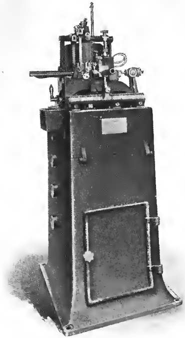


Fig. 299.—*Thompson typecaster.*

[*To face page* 310.]

PLATE XXIV.

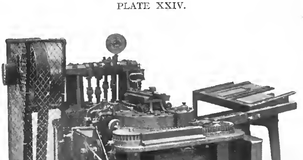


FIG. 300.—*Wicks rotary typecasting machine.*

To face page 311.]

The machine is of compact design, occupies about 9 square feet of floor-space and weighs about 800 pounds; the pump works at about 200 pounds per square inch, and about 0·25 horse-power is required to drive the machine.

The Thompson typecaster, fig. 299, plate XXIII. Another machine of which a good deal has been heard of late is the Thompson type-caster produced by the Thompson Type Machine Company of Chicago. This machine, the invention of John S. Thompson, the author of the well-known "History of Composing Machines," belongs to the class of machines which have a body-slide and a composite mould with detachable and inter-changeable components; these give it a range of from 5-point to 48-point. The mould is cooled by the circulation of water through its jacket.

The casting of the type presents no marked peculiarity; the removal of the roughness left by the tang when broken off, as well as the production of any supplementary nicks required, are effected by suitably-placed cutters; as in other machines which finish the type in this way, these nicks are shallow as compared with the cast nicks.

The Thompson machine is usually fitted with an electric motor, and is capable of being run at varying speeds which are stated to give from 11 to 163 type per minute, the higher speeds of course being employed for the smaller bodies. In this machine Linotype matrices are generally used for bodies up to 24-point, and the matrix-holder is fitted with a micro-meter screw for adjusting the alinement. For large bodies a copper matrix formed in a brass casing, fig. 176, p. 221, is used. The machine, which is of extremely compact and neat design, delivers the type finished into a race.

The Wicks rotary typecasting machine, fig. 300, plate XXIV, represents the highest development, at the present time, of machines for producing finished type. The machine has 100 moulds mounted in a wheel which is revolved continuously by worm-gear, the number of moulds of each particular set being determined by the demand for type of that set size. The last columns of tables 7 and 8, pp. 72 and 73, show the normal demand based on the bill of fount, and the number of moulds of each set must be determined from this so as to give the minimum of waste due to over-production of certain sorts.

Although type is produced by the Wicks rotary typecasting machine at a much lower cost than by the single-mould machine, it is obvious that the machine cannot cope with a heavy demand for extra sorts if these are of a set width of which there may happen to be but few moulds in the mould wheel. Hence it is a commercial necessity that a foundry equipped with Wicks rotary casting machines should have, in addition, some single-mould machines; these may, however, be adapted to use the Wicks matrices by providing suitable moulds. It is, moreover, necessary that some of the matrices should be changed at suitable intervals, so that the proper proportional number of each character may be cast. From these considerations it follows that if more than one face is to be cast in the wheel, these faces must be so designed that they agree closely in total demand for each set width. Type of different faces may be distinguished

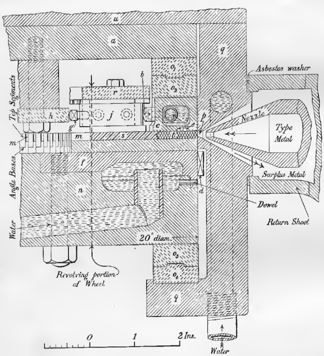


FIG. 301.—*Wicks rotary typecaster; section through mould at casting point.*

Key for figs. 301 and 302.

- *a.* Cam-head (stationary).
- *b.* Plate spring.
- *c.* Top cover (stationary).
- *d.* Chain-driving teeth.
- *e.* Nick-wires.
- *f.* Foundation ring.
- *g.* Height-to-paper screw.
- *h.* Height-to-paper cam.
- *j.* Matrix-jacket.
- *k.* Chain-link.
- *l.* Chain-leaves.
- *m.* Mould.
- *n.* Mould-wheel.
- o_1 o_2 o_3 o_4. Folding-wedges (stationary).
- *p.* Port.

by supplementing the cast nicks with a cut nick, milled by a cutter like that used for producing the heel-nick.

The sequence of operations in the Wicks machine is as follows: after the type has left the mould *m*, figs. 301 and 302, the matrix *s* is gradually withdrawn by a cam carried on the head *a* of the machine and bearing against

the hard steel surface of the ma
stem by the mould, and at the u
ring *r*. After passing the wi

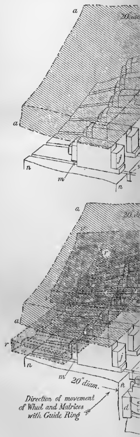


FIG. 302.—*Wicks*

- *q.* Shield (stationary).
- *r.* Matrix guide-ring.
- *s.* Matrix-stem.
- *t.* Type.
- *u.* Sliding head.

the hard steel surface of the matrix-jacket *j*. The matrix is guided on the stem by the mould, and at the upper part by a groove in the matrix guide-ring *r*. After passing the withdrawing-cam *w*, fig. 302, the matrix is

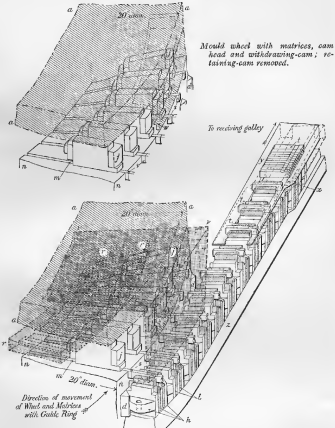


FIG. 302.—*Wicks rotary typecaster; delivery of type.*

Key—*continued.*

q. Shield (stationary).
r. Matrix guide-ring.
s. Matrix-stem.
t. Type.
u. Sliding head.
v. Retaining-cam (stationary).
w. Withdrawing-cam (stationary).
x. Side-cams (stationary).
y. Receiving-galley (stationary).
z Chain-race (stationary).

slightly advanced towards the periphery of the wheel by the height-to-paper cam *h*, fig. 301, which acts on the screw *g* in the matrix-jacket; a light plate spring *b* carried on the top cover *c* presses against the outer surface of the matrix-jacket *j*, ensuring contact with the screw, and so secures uniformity in height-to-paper. Before reaching this point the end of the matrix-stem *s* has been covered by the top cover, and the end of the mould has also been covered by the shield *q*, which is mounted under an adjustable sliding-head *u*. On nearing the centre of the shield the port *p*, into which the stream of metal delivered by the pump is forced, becomes uncovered and the metal enters the mould. The type sets in a very short interval of time after the mould has closed the port in the shield, since the mould-wheel *fn* and the top cover *c* are both cooled by water-circulation.

So far as the authors can ascertain, the type sets in less than 0·03 second, in a water-cooled mould, for bodies not larger than 10-point. This figure was arrived at by experiments on the length of nick-wire necessary, in the top cover of the Wicks mould, to enable the type to set before it cleared the end of the wire. It was, of course, necessary that the wire should extend the width of the widest sort, say 0·25 inch to the left of the centre of the nozzle, and it was found in practice that if the wire extended for 0·3 inch beyond the centre the type did not show signs of flow of metal into the nick. The linear speed of the mould-wheel at the nick was about 10 inches per second, hence the time of setting could be arrived at. In practice the nick-wires were made a standard length of about 1·25 inches to cover all classes of work.

As the revolution proceeds, the type is carried round in the mould, and when it is clear of the shield the ejecting-cam (not shown in the drawings) begins to operate on the matrix-jacket, causing the matrix and the type *t* with it to move outwards. When ejected about 0·05 inch, and therefore well supported in the mould, the heel-nick is cut in the foot of the type by a rapidly revolving milling-cutter; when further ejected, to about 0·20 inch, an extra body-nick for distinguishing founts may be milled in if required. The ejection continues with the revolution of the wheel, and the end of the type when ejected about 0·35 inch enters the space between the leaves *l* of the chain-link *k* corresponding to its mould, fig. 302. The chain consists of 100 links, and is driven by the teeth *d* cut on the periphery of the mould-wheel. The ejection continues till the type is just clear of the mould, when the retaining-cam *v*, carried by the head of the machine *a*, engages with one of the body-nicks in the type and prevents the type from being drawn back with the matrix by the action of the withdrawing-cam *w*. The cycle of operations with the matrix is now repeated.

The type which has left the mould is carried by the leaves *l* of the chain-link *k* to the receiving-galley *y*; this is slotted so that the type t_1 t_2 is supported at the ends on the galley-plate, while it is propelled along the galley, and prevented from tilting by the leaves *l* of the chain; near the end of the slot in the galley-plate the leaves of the chain, which have up to the present been carried on the chain-race z, drop so that the upper ends clear under the galley-plate; the side cam-pieces x, which bear on the rounded shoulders of the leaves, control the dropping, fig. 302. The type is now free in the galley along which it is impelled by the next succeeding type. The stream of type is received on a stick of L-section, and removed by a boy who places the type either 300 or 400 at a time into a type-galley in which

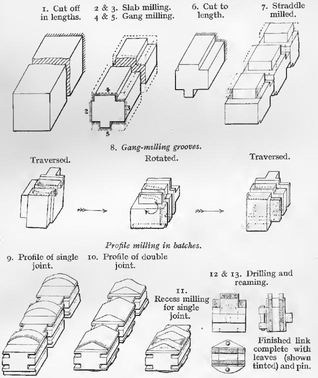


FIG. 303.—*Wicks rotary typecaster; operations in machining chain-links.* Scale: half size.

they occupy the same relative positions. The recurrence of the largest set size or of a sequence of characters of large set serves as a guide to the boy in sliding the type along on to the stick, and at the same time gives stability to the last line in the galley.

The type as received in the galley form a block, the appearance of which is shown in fig. 118, p. 116, which illustrates the lock-up test. The number of lines in which the blocks are made up is so chosen as to give a nearly constant width of block body-wise of about 4½ inches. The blocks are then divided by cutting them at right angles to the direction of the lines of which they are made up. This work is performed by girls who insert thin strips of metal or celluloid between the rows of different characters, and add the lines of the same character together in small galleys to form pages of an approximately constant width. These pages are examined for defective type which are replaced by sound type; the pages are then tied round with string and packed in thick whitish paper. The handling of several lines of separate type between two flat pieces of metal requires a peculiar knack which the girls acquire easily.

The casting machine is operated by one skilled typefounder who attends to the lubrication, to the maintenance of the metal in the pot at the correct temperature and level, to the exact adjustment of the top cover so that the body-size is maintained, and to the finish of the type left by the milling-cutter. One boy takes off the type, and four to five girls distribute the output of each machine.

The output of the Wicks machine is from 70,000 to 60,000 finished type per hour for bodies from ruby to long primer, and falls with larger bodies to about 35,000 per hour for pica.

The pump runs at 100 revolutions per minute and requires about 0·7 horse-power. The machine runs normally on bodies up to long primer at 10 revolutions per minute and takes about 1·1 horse-power. The total power required to run both the machine and the pump is 1·8 horse-power.

The original idea of the inventor was that type could be produced so cheaply by this machine that it could be replaced by new type for less than the cost of distributing. The cost of distributing by hand is generally 25 per cent of the cost of composing by hand, or about 2½*d.* per 1000 type. The type when so distributed is not, moreover, in lines in the form required by composing machines, and a small further expenditure would be necessary to set up the type in the composing-machine tubes. The authors are of opinion that, if the Wicks machine had been brought to its present state of perfection about 1886 and a foundry equipped with a large number of machines, the system adopted by "The Times" of using fresh type every day and distributing by remelting would have found favour with a great number of the most important daily papers.

Type-slicing machine.—For charging composing-machine tubes with type an auxiliary appliance was designed by F. Wicks; it is shown in fig. 304. This being a necessary adjunct for completing the series of operations contemplated by the inventor in the performance of a complete cycle of casting, composing, and distributing by the melting-pot, is inserted at this point, although, strictly speaking, the machine forms a class quite by itself.

The lines of type are transferred from the galley in which they are received to a slotted galley *g*, in which the faces are turned towards the galley. The slot is temporarily covered with a slip of metal which rests on the lower edge of the galley when placed on the slicer, and is ejected at the first stroke of the blade. The blade *b* is drawn back by means of the handle, a tube *u* is placed on the hinged carrier *c* in front of the machine, and is charged by the next stroke of the handle. The end type in the tube are pressed towards each other by the fingers of the operator, and at the same time the hinged carrier is brought forward (as at c_1), till the type are

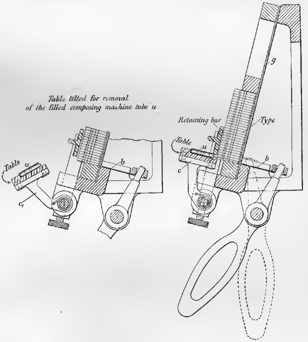


FIG. 304.—*Wicks type-slicer.* Scale: $\frac{1}{3}$ full size.

inclined upwards, when the tube can be lifted off and transferred to the magazine of the composing machine. About 200 of these machines were in use till recently at the printing-office of "The Times."

Distribution by hand could be realized at a speed of 5000 type per hour. Boy labour could arrange distributed type in line at some 10,000 per hour, and type was cast in "The Times" office, prior to 1900, at an average of 4000 per hour in the hope that new type could be supplied to the composing machine. J. C. MacDonald, then manager of "The Times," who conducted the earlier experiments in the endeavour to cast a new fount of type for each day's paper, concluded his efforts by the reflection that the more he pursued the inquiry the more he was struck with "the glorious simplicity of the compositor and a pair of cases." In the Paris Exhibition of 1878 was exhibited the Delcambre machine, an improvement upon that of Church, whose machine was really the foundation of all the loose-type composing machines subsequently devised; this was used in composing the first number of the "Family Herald" in 1842. According to F. Wicks, a visit to that exhibition and a conversation he had with A. Delcambre, in company with J. C. MacDonald, started the series of ideas that resulted in the Wicks composing machine, which set many combinations and several short words with a single touch. The same conversation led later to the invention of the rotary typecasting machine, which put into line 60,000 finished type per hour. The realization of the rotary scheme solved the question of supplying loose type to a composing machine, seeing that it produced the finished type from molten metal at a speed twelve times faster than the hand or mechanical distribution of the manufactured type.

The mechanical difficulties involved in the production of type in a machine like the Wicks rotary are largely due to the fact that it is constructed in a shop temperature of, say, 60° F., and has to deal with molten metal at a temperature of about 700° F., having a freezing-point at about 500° F. As the product has to be delivered with a limit of error of 0·0002 inch it is necessary not only that the mechanical construction should be precise and accurate, but that it should withstand the expansion and contraction involved in the reception and chilling of these thousands of castings. Moreover, allowance has also to be made for the contraction of the type-metal due to cooling.

In typefounding, for three or four hundred years, ever since Gutenberg made use of separate types, the practice had been to cast dummies until the heat of the mould had reached about 400° F., and then satisfactory casts began. After a few hundred type had been cast the mould became too hot, and the operator had to refrain from casting for a time until the mould had cooled down. In later machines automatic cooling by an air-blast or by water-circulation was adopted; but neither of these methods was adequate to the cooling down of castings produced at the rate of a thousand per minute, and a uniformly cold mould became a necessity.

It is somewhat a matter of regret that a machine, which in the course of its evolution had resulted in the solution of so many interesting mechanical problems, should have become practically obsolete by natural development on the lines of the principles it had demonstrated. It is not probable that many more rotary casting machines will be built, firstly owing to the great cost of building the machines except in batches of ten or twenty at a time, and secondly owing to their inability to cast different faces from the same wheel in the proportions commercially required, because variations in the set width of the same character in different faces necessitate the supplementing of the Wicks machine by a simple sorts-caster. This defect the inventor would never admit to the authors, nor allow it to be remedied, and, in their opinion, it was the primary cause of the commercial failure of the machine. As soon as the problem had to be solved of supplying type to foreign fount schemes, accompanied by heavy orders for sorts of rare occurrence in the English language, the philological as well as the technical problem already recognized by his engineers and advisers became a final obstacle to continuous financial development. The business of the Wicks Rotary Typecasting Company passed into other hands after the authors had ceased their connexion with it; it is, however, within their knowledge that their suggestion of auxiliary sorts-casters was adopted subsequently by its new proprietors, the Blackfriars Type Foundry.

The Bhisotype.—This machine, a multiple-mould typecaster, the invention of Prof. S. A. Bhisey, is stated to be arranged to cast from thirty to sixty different characters per revolution of its cam-shaft, which runs at 40 revolutions per minute. The speed claimed for it is, therefore, even greater than that of the Wicks machine, being 2400 type per minute in the larger machine. The type are stated to be turned out with the full depth of strike and with nicks and groove finished.

As it is intended to work this machine in conjunction with a composing machine, the characters cast on the casting machine being conveyed by chains to a group of from eight to ten composing machines, it is treated of elsewhere in this work, in chapter XXIV, under the heading of Casting and Distributing Machines. The Bhisotype machines are not at present in general use.

A new form of rotary typecaster, in which the axis is horizontal, has been invented and patented recently by Prof. Bhisey; this machine is fitted with groups of moulds so placed that the body of the type is arranged parallel to the axis of the mould-wheel; each group of moulds may comprise, say, four cavities and the wheel may carry twenty-five groups, so that the number of mould cavities available can be as large as in the Wicks machine; there is, however, the important difference that in this new form of the Bhisey machine the type are cast with a tang which is subsequently sheared off. It is proposed to use Linotype matrices with the mould groups.

The Bhisotype single typecaster is a sorts-caster designed for casting single types, with the object in view of simplicity and capability of being operated by any person of ordinary intelligence.

The construction of the mould is different from that of the other single typecasting machines described. One side and the top retain their relative positions once the body-size has been determined by a third, L-shaped, piece which with the other two parts forms a ⊓ cavity against the under side of which a cover-plate is held during the casting operation and withdrawn downwards carrying the type with it when the cast has been made. This cover-plate is provided with a hook-shaped member which engages with the tang; the cover-plate also carries a bead for forming the nick in the type. By means of the hook, assisted if necessary by a supplementary slot in the end of the nick-wire, the type is held during the down-stroke of the cover-plate till it comes into alinement with the stationary platform on to which the type is pushed by a horizontally-sliding pusher-plate. The action of the pusher moves the type clear of the hook and also breaks off the small retaining-piece held by the supplementary slot in the nick-wire. A vertically-moving slide breaks off the tang when the type is ejected clear of the hook. After the type has left the surface of the cover-plate the pusher retires and the cover-plate rises to its normal position ready for a new cast to be made. As the type travels to the receiving-galley the edge is trimmed and any additional nicks that may be required are cut into it. The mould parts are water-cooled, and a feature of the design is that in casting there is no sliding movement of the parts of the mould on each other. The same mould with change only of the L-shaped body-piece serves for casting any body-size from 5 to 48-point; low spaces and quads are also cast in the same machine, which has been run experimentally.

The matrix-holder can be adjusted to suit Linotype or ordinary electrotype matrices, and is fitted with detachable packing-blocks to enable the change to be effected rapidly. The complete operation of changing from one size to another is stated to be effected in less than two minutes.

The total movement of the mould cover-plate is only about an inch, consequently a high speed is expected from the machine. Other special features are: the nozzle which is not fitted with a jobber, and the pump which is fitted with a gear for enabling the stroke to be varied while the machine is running. The matrix-holder and the mould can be withdrawn readily from the machine. Under normal conditions the machine is run by a variable-speed electric motor contained in the pedestal of the machine; the floor-space required is about 2 feet by 2 feet. The power required is 0·25 horse-power.

PLATE XXV.

FIG. 305.—*Church composing machine.*

To face page 321]

CHAPTER XIX.

COMPOSING MACHINES.

"Typesetting by machinery has done more to advance the cause of universal education than any other one factor since the art of printing was invented."

John S. Thompson. History of Composing Machines.

Brevier old-style antique No. 7 (Miller & Richard).

The distinctive characteristic of the Analytical Engine, and that which has rendered it possible to endow mechanism with such extensive faculties as bid fair to make this engine the executive right-hand of abstract algebra, is the introduction into it of the principle which Jacquard devised for regulating, by means of punched cards, the most complicated patterns in the fabrication of brocaded stuffs. It is in this that the distinction between the two engines lies. Nothing of the sort exists in the Difference Engine. We may say most aptly, that the Analytical Engine *weaves algebraical patterns* just as the Jacquard loom weaves flowers and leaves. Here, it seems to us, resides much more of originality than the Difference Engine can be fairly entitled to claim.

Notes by Ada Augusta, Countess of Lovelace: Translator of the Memoir by General Ménabréa on the Analytical Engine invented by Charles Babbage.

5-point old-style (Clowes).

OWING to the number and complexity of the various machines of the class now coming under discussion, only primary or salient and typical examples are given; reference to others will be found in the lists of British and American patents at the end of the volume.

The earliest and simplest form of composing machine, so far as the authors are aware, was that of Church, whose patent is dated 1822. Dr. William Church, the patentee, though taking out his patent in England, was a native of Boston, Massachusetts, and to him we must accord the place of honour in originating the first of these labour-saving appliances. The accompanying illustration, fig. 305, plate XXV, is reproduced from J. S. Thompson's well-known book.

Though somewhat crude in construction, it is surprising how many features its conception embodies which have since become common and are retained in a large number of well-known machines subsequently designed. The type, carried in channels in a wooden frame placed nearly vertical, were released on operating the keys of a keyboard. On the depression of a key the type was ejected on to a horizontal race, and by means of rocking arms was swept to the centre of the machine, where it was received as a continuous line in a collecting channel; it could be divided subsequently and line-justified by hand as was done later on in several other instances.

The machine was not driven by power derived from any outside source, but the rocking arms or sweepers were operated by clockwork mechanism released by the depression of the keys.

The next invention of this class made its appearance eighteen years later: this was the composing machine patented by E. R. Gaubert in 1840.

In the same year Young and Delcambre brought out their machine, which bears the next consecutive patent number.

The Young and Delcambre composing machine, fig. 308, does not present any very striking novelty over that of Church, but instead of the type being delivered into a race in front of the machine, it was delivered on to an inclined guide-plate at the back. The story of its practical genesis from the "Autobiography of Sir Henry Bessemer" may be here quoted with interest.

"One day I was called upon by a gentleman, a Mr. James Young, who presented a card of introduction from a barrister to whom I was well known. His object was to obtain the assistance of a mechanician to devise, or construct, a machine for setting up printing type. I had a long and pleasant conversation with this most agreeable client; indeed, our frequent meetings and friendly discussions resulted in a close friendship, terminating only with his death, which occurred several years later. My friend Young, who was a silk merchant at Lille, had persuaded himself that by playing on keys, arranged somewhat after the style of a pianoforte, all the letters required in a printed page could be mechanically arranged in lines and columns more quickly than by hand; but as he was personally wholly unacquainted with mechanism, he desired some one to elaborate all the details of such a machine, and asked me if I would professionally study the subject for him, and prepare models to illustrate each proposition. The matter seemed a very difficult one at first sight, and I said that it would be impossible for me to devote more than a portion of each day to its consideration. It was then arranged that I should give as much thought to the subject as I could, consistent with due attention to my general business, and to these terms was attached a guinea per day as a consulting fee.

"The general idea on which the machine was based was the arranging of the respective letters in long narrow boxes, from which a touch of the key referring to any particular letter would detach the type required; this, when set at liberty, was to slide down an inclined plane to a terminal point, where other mechanism was to divide the letters so received, into lines if required, and thus build up a page of matter, such as a column in a newspaper, etc.

"It will be at once understood that this was not a very simple matter, in consequence of the many signs required. We have first the twenty-six small letters of the alphabet, and the double letters, such as **fi, fl, ff, ffi, ffl**; then we have the points, or punctuations, signs of reference, etc.; there are also the ten figures and the twenty-six capital letters and their respective double letters, as well as blank types, called 'spaces,' of different thicknesses, required to divide separate words from each other, etc. Now, as a primary necessity, these numerous letters, when wanted, must, of course, come from different places, and all must descend grooves in the inclined planes in precisely equal times. The time of the whole journey down the incline, say, 2 ft. long, must not occupy any one type more than one-hundredth of a second more or less than the one before or behind it, or its arrival will be too soon or too late, and the word will be wrongly spelt. Thus, suppose the word ACT is required, and the keys A, C, and T, are touched rapidly in succession. If the letter C should arrive first instead of A, the word would not be 'ACT,' but 'CAT,' and so for every word. A type that is less than 1 in. in length must never, on its journey, arrive its own length in advance or in the rear of the others that are simultaneously rushing down the inclined plane to the same terminus.

"The difficulty that this fact presented was almost beyond belief. Many models were made and much study devoted to it. Thus, suppose a type detached at the point *A* in the accompanying diagram [fig. 306] is required

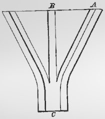


FIG. 306.—*Young and Delcambre composing machine; diagram illustrating Bessemer's problem.*

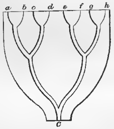


FIG. 307.—*Young and Delcambre composing machine; diagram of guide-plate.*

to slide down the inclined plane to *C*, and another one from the point *B* is immediately to follow, it will be seen that not only is the road to be travelled by *A* much longer than that by *B*, but *B* also has the advantage of coming straight down the inclined surface, encountering friction only on the one surface on which it rests; while *A* has not only got a longer journey to perform, but it lays its whole weight on the inclined surface, and rubs also against the inclined side of its groove, thus causing additional friction, so lessening the speed of its descent, and resulting in the arrival of *B* at its destination before, instead of after, *A*.

"The result of studying this part of the question forced on my mind the important fact that the grooves on the surface of the inclined plane would have to be all of precisely the same length, and every letter, in descending, would have to encounter exactly the same amount of sideway rubbing surface. This knotty point was at last settled in so simple and perfect a manner, that when I had accomplished it I felt half ashamed that it had so long eluded me. The form of grooved incline thus indicated ensured a perfect spelling of every word, and removed the greatest obstacle on the way to success.

"The diagram [fig. 307] represents a portion of the inclined plane, with its small shallow grooves so arranged that any one of the letters *a*, *b*, *c*, *d*, *e*, *f*, *g*, and *h* at the top of the inclined plane would, if allowed to slide down this series of curved grooves, pass along precisely similar paths, and travel precisely equal distances before arriving at the terminus *C*.

"It will be readily understood that a simple extension of this system would allow any number of letters arranged along the upper line to reach

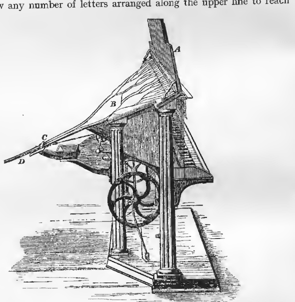


FIG. 308.—*Young and Delcambre composing machine.*

the terminus in the same time; hence each one would arrive in the order of its departure and every word would be spelt correctly.

"I will not tire the reader with the many other difficult points surmounted, only by constant patience, during fifteen months. The type-composing machine was then a success, and my friend Young was greatly pleased at the result. His patent was much used in Paris, and in England it was employed by the spirited proprietor of the *Family Herald*, who gave an engraving of the machine at the head of the paper, very similar to the illustration [fig. 308], which shows the type-composing machine in operation. The person shown on the right" [*in the original illustration*] "is seated before a double set of flat keys, similar to the keys of a pianoforte, each key having its proper letter marked thereon; the depression of a key detaches its corresponding type from one of the numerous partitions in the box or case *A*; this type will then slide down the series of grooves allotted to it on the inclined plane *B*, and arrive at a point *C*, where a rapidly vibrating finger or beater tips up every letter as it arrives into an upright position, and forces it along the channel *D*. These rows of letters are moved laterally, forming one line of the intended page. The boy on the left hand" [*in the original illustration*] "divides the words with a hyphen if necessary, or he so spaces them as to fill one complete line; this operation he can complete while another line is forming in the channel *D*. In this way he makes line after line until part of a page is set up, when he moves on the galley *E*, shown at his left hand. Thus a page or a long column of matter was produced with the greatest ease, and in a very short space of time.

"In the ordinary way of composing types, each letter is picked up by hand from one of the numerous small divisions of a shallow box, or 'case,' as it is called, and the letters are then arranged in their right positions in a small frame held in the left hand of the compositor. About 1700 or 1800 letters per hour can be formed into lines and columns by a dexterous compositor, while as many as 6000 types per hour could be set by the composing machine. A young lady in the office of the *Family Herald* undertook the following task at the suggestion of the proprietor of *The Times*, viz.: she was to set up not less than 5000 types per hour for ten consecutive hours, on six consecutive days; giving a total of 300,000 letters in the week. This she easily accomplished, and was then presented with a £5 note by Mr. Walter.

"This mode of composing types by playing on keys arranged precisely like the keys of a pianoforte would have formed an excellent occupation for women; but it did not find favour with the lords of creation, who strongly objected to such successful competition by female labour, and so the machine eventually died a natural death."

It is a curious commentary on the difficulty and absence of exchange of ideas and knowledge of the trend of development, other than within individual limited circles of interest, that in the early part of the nineteenth century Bessemer wrote as in the passage just quoted, when, nearly twenty years before the period he alludes to, the problem of composing by machine had been propounded and solved by Church, whose machines were in actual operation when Bessemer was engaged by Young to carry out his ideas. Very different is the case to-day when the scientific discovery of one individual becomes within a period of a few weeks, through the medium of the technical press, the scientific commonplace of his contemporaries.

From 1840 onwards machines of this class appeared at intervals of from two to three years, and occasionally oftener, but they presented nothing of permanent character until the year 1853.

The Hattersley composing machine.—In the year quoted Hattersley applied himself to the subject with the result that in 1857 the Hattersley patent was obtained, and in 1859 the Hattersley machine, fig. 309, plate XXVI, was evolved. This machine marks a distinct advance, because the type was composed into a short line immediately accessible to the compositor who could readily space out the matter to the requisite length before removing it from the machine into the composing-stick.

As an adjunct Hattersley at one time had a separate justifier which was virtually a galley to which the unjustified matter, in lines temporarily separated by leads, was transferred line by line; the leads were automatically ejected as each line was pushed forward in succession to the mouth of the

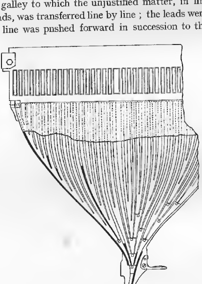


FIG. 310.—*Hattersley composing machine; guide-plate.*

galley into which the line was depressed and then spaced out by hand to the measure. This method was soon abandoned, the justification being more easily effected at the machine itself.

The guide-plate of the Hattersley machine, fig. 310, instead of being inclined, as in the case of the Young and Delcambre machine, is arranged vertically; it is made of brass, but those guiding ribs which are subjected to the heaviest work in deflecting the type to its common destination are made of steel to enable them better to withstand the wear.

The magazines, or tables, as they were formerly termed by the inventor, in the Hattersley machine, unlike those of the Church and its congeners, are arranged horizontally, the type being ejected downwards from the front of the line contained in any groove in the magazines; the type is arranged body-wise in the grooves of the magazines in which it is kept pressed forward by a presser operated by a cord passing over a pulley, and acted on by a spring. The keyboard is arranged with the keys in multiple rows and a more compact form is adopted than in the machines of Church, or of Young and Delcambre. The Hattersley machine is remarkable because it was constructed by a man without large financial backing, and is one of the few cases in which the inventor carried on a profitable business for a large number of years in a machine of this class. Hattersley was himself a first-rate mechanic and a friend of Roberts, of Sharp, Roberts & Co., one of the finest mechanics Manchester ever produced. Hattersley machines are still working in England successfully, the "South Wales Daily News," for instance, being composed by means of these machines. The manager of the printing-department of this paper, who has a number of these machines in operation, has afforded the authors opportunity for seeing them in the performance of their daily work. Of their efficiency and cheapness there can be no question.

Although no provision was made in the Hattersley machine for justification, the requirements of the operator were provided for in the design, and the line when set is so conveniently placed and accessible that the work of justification is performed by the compositor in very few seconds; in ordinary work an average compositor can set and justify some 6000 ens per hour.

The fact that the Hattersley machine has been in continuous use for so many years has led to the devising of a number of small accessories used in conjunction with it, which facilitate greatly such operations as the charging of the magazines and the replacement of a partially-emptied magazine by a fresh one fully charged. To such a fine point has this work been brought in the office above mentioned that the authors have seen the change of magazine effected in less than one minute.

These machines are worked in conjunction with the Hattersley distributor, which will be described later under its proper heading. The old type is distributed and the supply is maintained by means of type cast on the premises in whole founts or sorts as may be required. Whether this combined installation would prove as adequate elsewhere the authors are not prepared to say, but certainly under the efficient and capable organization of the manager of the printing-department of the "South Wales Daily News" it leaves little to be desired.

According to an article dated 11 June, 1890, in the "Newcastle Daily Journal," a paper which at that period was using the Hattersley compositor, "a good man manipulating the Hattersley machine averages 150 lines or 7500 letters in an hour."

The original invention by Bouchon of the use of a previously-prepared perforated paper strip as a means of subsequent mechanical control, and applied by him to the loom in 1725, has often been overlooked. The later improvements made by Falcon, who, in 1728, substituted a chain of cards for the strip, by Vaucanson in 1745, and finally by Jacquard, who perfected the card-control of the power-loom, have led to the popular association of the name of Jacquard with all perforated controllers, whether of card or paper.

The use of a continuous paper strip, similar to that of Bouchon, for the automatic setting of type—though generally ascribed to William Martin, who claims a method of actuating type-composing instruments in his British patent 12,421 of 1849, and specifically mentions the machine of Clay and Rosenborg—appears to have been first suggested by D. Mackenzie in his British patent 12,229 of 1848. In this he claims the use of

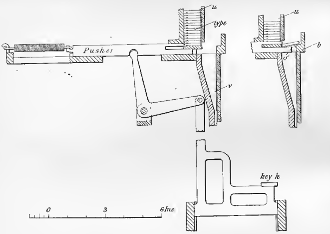


FIG. 312.—*Kastenbein composing machine; type-freeing mechanism.*

a perforated band of paper for controlling musical instruments, and in his first description, or title of patent, he includes "type-composing machinery." The invention does not, however, appear to have reached a practical form until it was utilized by Alexander Mackie in 1867 in the control of his automatic typesetting machine known in Manchester as the "pickpocket." The "Manchester Guardian" is stated to have been composed by the Mackie compositor, and the authors recently have had under their notice many large volumes of print produced with the aid of these machines.

The Kastenbein composing machine, fig. 311, plate XXVII, invented prior to 1870, was brought into practical working form at "The Times" Printing Office, and, with some modifications there introduced, was used for composing almost the whole of "The Times" and many other publications printed in

PLATE XXVI.

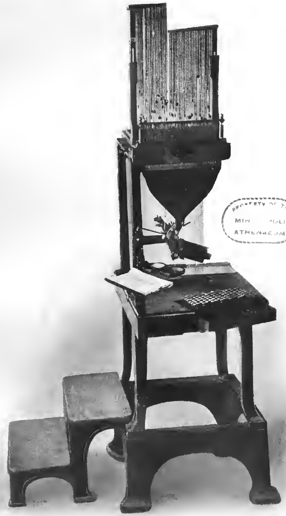


FIG. 309.—*Hattersley composing machine.*

[*To face page* 328.

PLATE XXVII.

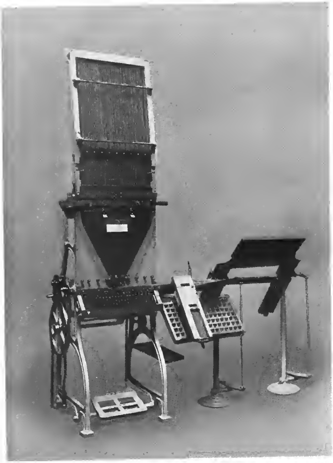


FIG. 311.—*Kastenbein composing machine.*

To face plate XXVIII.]

PLATE XXVIII.

FIG. 313.—*Fraser composing machine.*

[*To face plate XXVII.*]

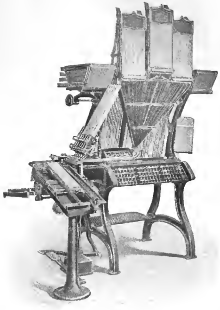


FIG. 314.—*Empire composing machine.*

PLATE XXIX.

FIG. 315.—*Wicks composing machine; with Stringer line-justifier attached.*

To face page 329.]

"The Times" Office. The tubes *u*, fig. 312, are U-shaped, and the type are arranged set-wise, all the nicks being downwards and the faces towards the operator when the tube is placed in the vertical position it occupies in the machine. The depression of a key *k* pushes the lowest corresponding type forward by the foot towards the front of the machine; when more than half ejected, the front end comes over a bar *b* running along the front of the machine; when the type is fully ejected it overbalances backwards from this bar (as shown dotted) on the release of the pusher, and falls feet downwards down a guiding groove in the guide-plate *v* of the machine. A lightly-balanced lower lever arm against which the type bears in falling into the race corrects any tendency to turn. The type as they arrive at the level of the race are pushed forward by a continuously-driven reciprocating plunger having a stroke a little greater than the body-size of the type. The type are thus delivered on a type-race from which they are drawn by hand by a second operator who performs the line-justifying. The keyboard of the Kastenbein machine is very compact, and comprises eighty-four keys arranged in four rows, as shown in fig. 271, p. 291.

The power required is less than 0·1 horse-power.

The Fraser machine, fig. 313, plate XXVIII, was brought out about 1872 at Edinburgh. The bulk of the ninth edition of the "Encyclopædia Britannica" is claimed to have been composed upon this machine. In construction the position of the magazine resembles that of the Church machine, but the guide-plate which is similar to that of the Hattersley, is placed in the front of the machine and below the nearly vertical magazine.

The Empire composing machine, fig. 314, plate XXVIII, was, according to Thompson, originally known in 1872 as the Burr and was one of the first American typesetting machines to come into common use. In 1880 the name Empire was adopted for the machine which remained in use for many years both in this country and in the United States. The type are contained in eighty-four tubes arranged in three separate magazines capable of a rocking movement for the purpose of refilling. The line-justification, as in the Kastenbein and other machines of this class, is effected by a second operator. A subsidiary magazine placed above the end of the type-race furnishes the necessary spaces. As in the Kastenbein, the Wicks and other similar machines, a clear space is maintained in the raceway for the letters falling from the channels by means of a small motor-driven cam.

The Hooker composing machine, patented in 1872 and 1874, had its types placed in a series of slanting troughs. At the foot of each trough was an endless revolving carrier-tape, which received the type when discharged from the trough, and passed it on to another tape, running in a transverse direction. This transverse tape received the several types in succession, and carried them forward in their proper order to a point where a collector arranged them in a continuous line ready for justifying.

Hooker dispensed with the keyboard, and instead of it he provided a range of small electro-magnets in connexion with metal contact-plates. These plates, in size, shape, and arrangement, were a copy of the ordinary lower case, fig. 263, p. 285. Before these contact-plates, as before a desk, the

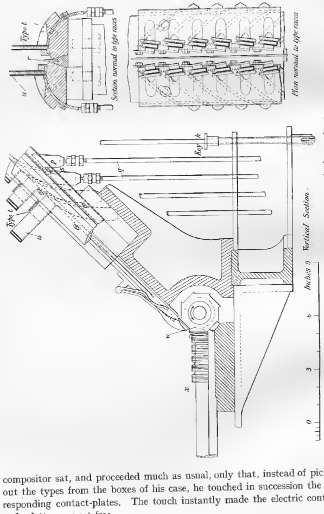


FIG. 316.—*Wicks composing machine; type-freeing mechanism.*

compositor sat, and proceeded much as usual, only that, instead of picking out the types from the boxes of his case, he touched in succession the corresponding contact-plates. The touch instantly made the electric contact, and a letter was set free.

Hooker composing machines were introduced into the works of William Clowes and Sons, Ltd., in 1875, although not to any great extent, there being four machines in use at one time. These machines ran at their Beccles works for a number of years and only ceased to be used in 1905.

The approximate floor-space occupied by each machine was about 36 square feet, including the stand with rack.

The same inventor subsequently devised a distributing machine, and later still a line-justifying machine for equalizing the spacing of the lines, but none of these machines came into general use.

The Wicks composing machine. — In the Wicks composer, fig. 315, plate XXIX, the keyboard is of great length, with only two rows of keys, the arrangement resembling more closely that of the piano than that of the typewriter. The keys *k* operate vertical rods *q*, fig. 316, which are jointed to plunger sectors of helical strip *p* working in the spaces of a coarse square-thread screw *s*. Two quarters of round bar with screws milled out are arranged, the one right-hand and the other left-hand, facing each other, and are machined so as to form a pair of races (between which is an intervening strip *r*) inclined at 45° to the horizontal for the type to slide down. The type *t* are contained in **U**-shaped tubes *u* of tin plate or brass inclined at 45° to the horizontal (and at 90° to the race). The type are arranged in the tube body-wise, the nicks lying against one side of the **U**. The depression of a key causes the plunger, the end of which is reduced to the set width of the type, to remove the lowest character from the corresponding tube and push it into the race down which it slides on its side by gravity to the nose of the machine where a star-wheel *w* catches it, brings it into an erect position and pushes it into place against the line accumulating in the type-race *x*. The star-wheel is driven continuously by a pedal or a small electric motor. Sections of the line are drawn away by a second operator, who line-justifies each line and transfers it to a galley in exactly the same manner as in the other machines of this class.

The Wicks machine is interesting chiefly for the reason that the keyboard was designed so as to enable a number of the most frequently occurring combinations of characters to be obtained by the simultaneous depression of two or more keys, for example **the**, **ing**, and **and**. While this effects some saving of time, the long distance which the more remote characters must travel under the action of gravity makes the machine slow in such cases, though this is said to be compensated for by the advantage gained on the chords; in addition the distance through which the operator must move his hand is much greater than in those machines which have a compact multiple-row keyboard.

A battery of Wicks composing machines, supplied daily with new type from the Wicks Foundry in Blackfriars Road, was used for several years in the offices of the "Morning Post," where the machines performed good work from the time of their installation in 1905 till the combination was replaced by Linotype machines in 1910.

The Wicks composer was a two-man machine, and was operated by a team who worked "in pocket" and alternated as operator and spacer-out respectively. Small capitals and italics not being on the keyboard were set when required from a separate case by the spacer-out. The speed obtained by the two operators together on long runs averaged 9000 ens per hour, while there were individual teams who produced 11,000 ens and upwards per hour on ordinary work; moreover on memorized copy a much greater output could be obtained.

The machine weighed about 6 hundredweight, occupied a space of about 10 square feet, and required less than 0·1 horse-power to run it.

The Pulsometer composing machine, fig. 317, plate XXX.—The type *t* are contained in horizontal tubes *u*, fig. 318, and the contents of each tube

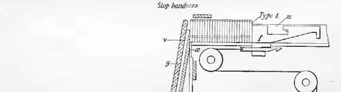


Fig. 318.—*Pulsometer composing machine; type-freeing mechanism.*

or channel are kept pressed towards the front of the machine by a weighted follower *f*; the type are supported by a front plate *v*, which extends about 0·50 inch in height above the bottom of the tubes and is bevelled at the top to a knife-edge. This arrangement, though the fact was not known to the inventor and designers of the Pulsometer machine, had been designed in 1890 by H. T. Johnson, formerly one of Hattersley's apprentices, as an improvement on the Hattersley machine, to avoid the alleged possibility of damaging the face of the type by the action of the pusher in ejecting the type downwards. The depression of a key *k* causes the front type in the corresponding tube to be raised till it clears the knife-edge, when the action of the follower ensures that this type is projected over the edge of the guide-plate. It now falls freely down a vertical groove in the guide-plate v of the machine, which is shaped as an inverted triangle. At the lower end of the vertical groove it is guided by the inclined raceways, into which it falls, to a central channel, and thence to the entrance to the composing-race, into which it is pushed by a continuously-revolving eccentric. The guide-plate is covered with a sheet of plate-glass g to keep the type from turning, and to enable the operator to see that the grooves do not become blocked. A continuously-driven horizontal shaft s imparts a vertical reciprocating motion to two steel swing plates p placed longitudinally with the machine. Across the direction of these are flat steel levers l, one for each character, pivoted at the front end and each carrying a triangular pawl q, which is normally raised. When a key k is depressed the corresponding pawl drops into the range of action of one of the swing plates which carries it and the lever upwards; the keys acting in conjunction with the lower swing plate are not shown in fig. 318; the vertical pusher is driven upwards by the lever, and its upper end x passing through the lower side of the U-shaped tube, lifts up the corresponding first type till it clears the edge of the guide-plate and is free to fall down its particular groove. There are four rows of keys arranged as shown in fig. 273, p. 291.

The power required is stated to be about 0·1 horse-power.

Numbering-machines.—Numbering-machines, taken as a class, may be considered as a miniature, but highly ingenious, form of composing machine, because, though dealing with those ideographs which we term figures, they compose these in order to form numerical equivalents of what in the larger composing machines would be represented by the composed letters forming the words which in combination convey the same idea.

Numbering-machines were first devised with large wheels giving space for arranging the carrying gear and either pivoted and lever-operated by hand or treadle, or worked by a vertical slide so as to print consecutive numbers on sheets successively presented to the machine. Automatic arrangements were added later for inking the typewheels on the stroke of the machine, and for performing the operations of counting and carrying.

The earliest British patent for these machines dates back to 1845, but it was found that for many purposes, such as numbering bank-notes, bonds and similar documents, it was desirable to have machines made sufficiently small in size and height to be locked up in the forme with type, and in 1857 we find machines of this kind described. The actuation of some of these machines was effected by a plunger which was depressed by the platen, but as this plunger rose above the level of the printing-surface when the platen was raised, it follows that specially-devised means to prevent obtaining an impression of the plunger had to be provided. Some inventors and makers have preferred making the whole of the numbering-machine in a case to slide inside an outer case which is locked up with the type, the numbering-machine itself acting as the plunger. As the operation of carrying is immediately dependent on the operation of the plunger or of the box containing the numbering-machine, it was found that the carrying which took effect immediately the platen rose, produced blurring of the printed characters, and means for obviating this blurring form the subject of recent inventions.

The printing of bonds, in particular, has had a great influence on the development of these machines, as the coupons attached to them require the simultaneous operation of a plurality of numbering-heads or numbering-machines for the identification of the whole of these detachable portions of the document.

The adoption of the arabic system of numbering, which harmonizes with a writing or printing reading from right to left, but in which the figures are written in the order opposite to that in which they would naturally be composed or counted for print running from left to right, has resulted in the production of many ingenious inventions, also dating from 1857 in Europe, for the suppression of the zeros by which low numbers would be preceded at the commencement of the operation of numbering. The abolition of the zero preceding the significant figure has been effected by what is termed the drop-cipher or drop-cipher wheel; in some cases the wheel itself drops to an eccentric position so that the zero falls below the level of the printing-surface, and in other cases the wheel has eleven divisions, and special carrying arrangements are fitted to enable the blank space to be passed over when carrying is effected, because once the wheel has begun to register significant figures, it is necessary that it should repeat the zero whenever it is required, and that the blank should never reappear.

The elimination of the zero appears to have been a most useless source of worry to inventors of these machines, because, having obtained a blank space in front of the significant figures, it was easily possible for a forger to substitute figures in the blank space. This disadvantage led to a further series of inventions for sliding or substituting other printing signs and characters—asterisks, ornaments, or special signs—so as to fill up the blank before the significant figure.

Still further inventive effort was directed to the elaboration of numbering-machines in which the carrying is performed in an inverted order; that is to say, the figure next to the designating sign commences the units, and on reaching the tens, the second wheel from the designating sign moves to zero and the first wheel to one, the operation of counting continuing with the first two wheels, giving significant figures till ninety-nine is reached, when the first wheel turns to one, and the second and third both turn to zero. This arrangement is equally open to the objection, mentioned in the case of those numbering-machines with drop-ciphers, that it leaves blank spaces for the use of the forger, unless special precautions are taken to fill them up. Yet other and more complicated numbering-machines have been made to print from the wheel a sign for the purpose of occupying the space preceding the significant figures.

PLATE XXX.

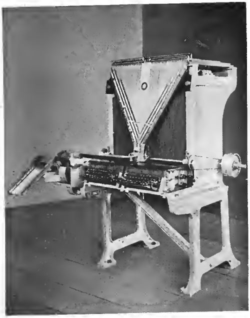
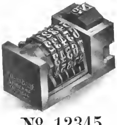
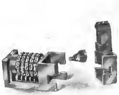


FIG. 317.—*Pulsometer composing machine.*



No 12345
Impression of figures.

FIG. 319.—*American numbering-machine and impression of figures.*



Parts released for cleaning and oiling.

FIG. 320.—*American numbering-machine; opened.*

To face page 335.]

The numbering of bond coupons involves the use of a group of numbering-machines, and much invention has been devoted to causing these to operate automatically and simultaneously in lines carried horizontally across the page or in columns vertically, or in combinations of both.

Although much of the composition of the printing-surface, where consecutive numbers are required, has been performed by these wonderful little machines, yet there are many classes of work such as duplicate check books, manifold books, and the like, which require the numbering-machine to act otherwise than consecutively. In some cases the same number is required in duplicate, triplicate, or even quadruplicate, while in other cases the machine is required to repeat a number indefinitely and to change that number only when desired; other machines again can be set to number in different arithmetical series, for example: 1, 3, 5, 7..; 2, 4, 6, 8,..; 1, 6, 11, 16,..; etc. This is necessary where a group of numbering-machines is used in printing simultaneously on a sheet which is to be cut up subsequently.

Though attention was given to these machines in Great Britain and on the Continent nearly twenty years before they interested American inventors, yet American manufacturing methods have resulted in the production of highly efficient pieces of mechanism, examples of which are shown in figs. 319 and 320, plate XXX.

Numbering hand-stamps for numbering documents consecutively were a comparatively early invention, most of these machines being self-contained and having an inking-device. In their earlier form they were automatically operated by the depression of the hand-knob to print consecutively, but as their scope increased, machines were adapted to numbering in duplicate or triplicate, or quadruplicate, or even to repeat indefinitely. Certain of these machines used for marking yardage or other measures on slips for packages are fitted with means for setting each of the typewheels independently by hand. A recent development of the hand-stamp is its adaptation to take the small type-high numbering-machines used in the printing-press.

Another direction in which numbering-machines have developed is that connected with the printing of railway and other tickets, and of tramway or street-car tickets, either singly or in strip. These tickets are used in huge quantities, with the result that numbering-machines have been devised for printing them, working with ten to fifteen numbering-heads in the case of single tickets, and operating at very high speeds in the case of strip tickets printed on the web. In dealing with this class of work, peculiar difficulties were introduced by the inertia of the carrying gear, which became liable to skip numbers, particularly when carrying takes place in a higher significant figure. Several devices for preventing this, and for enabling the numbering-machine to work more slowly while the printing proceeds at a high speed, have been evolved by the use of a series of numbering-heads, carried on a cylindrical printing-roller, which come into play consecutively in order that the carrying operations may be completed in ample time before the printing occurs.

Not only have machines been made for numbering consecutively in duplicate, triplicate, etc., but also for numbering either forwards or backwards, and in the case of special machines, devised for the numbering of bank-notes and bonds of great importance, special means have been sought by inventors for combining the control of multiple arrangements of numbering-machines in a single printing-forme, and ensuring their absolute agreement over the whole of the printed page.

The actual operation of numbering-machines differs from that of printing from the ordinary typographical surface because some portions of the numbering-surfaces only come into use intermittently or after long periods of rest; consequently the figures are not ready-inked when they take their place in the plane of the typographical surface, and they do not have that inked surface which invariably results from the pulling of a trial proof. This difference from standard conditions has led to the invention of means by which the carrying gear of the numbering-machines can be disconnected, the whole system of wheels rotated line by line and inked, so that once the machine is set to work a properly-inked surface comes into place when required.

In running the numbering-machines in practice, it sometimes happens that one job is required to follow another and to commence at some number different from that for which the machine is set. Devices have even been produced to deal with such cases as this, and to enable the future setting, at which the numbering-machine shall commence to work on the next job, to be decided and set on the machine while it is still occupied with other work.

When one considers the minute size of these appliances—generally less than one cubic inch in total volume—the extraordinary ingenuity displayed in their invention and construction is strikingly apparent. The difficulties overcome are the more remarkable when it is borne in mind that not only has a whole automatic composing machine been compressed within lilliputian limits, but a difficulty—from which most inventors of ordinary composing machines, themselves sufficiently complicated, have fled—has been overcome. In these interesting pieces of mechanism which form a link with calculating machines, the difficulty of producing characters, which in relation to the size of the machine that produces them would compare with six-inch type set by an ordinary composing machine, has been successfully met and mastered.

HAND-STAMPS, AUTOMATIC STAMPS AND RECORDERS.

In the section of this chapter dealing with numbering-machines, hand numbering-stamps and the range of numbering operations which they cover have been mentioned.

Apart from numbering, hand-stamps have been devised for many purposes, for instance for endorsements, for obliterations, and, as in the common stamp for crossing cheques, for adding restrictive marks. The face of these stamps is frequently in the form of a stereotype, and usually of rubber, though other materials are also used.

Obliteration with the addition of a reference is an extremely common form of stamp, and probably its commonest form is that of the postmarking stamp. These stamps are usually fitted with a die-head, on which is engraved in relief the name of the post office and through which pass slots to receive shouldered steel type for the date, etc., secured in place by screwing an internally flanged collar over the die-head and on to the end of the handle. This form of obliterating appliance has been developed into the machine which separates a mass of correspondence into individual mail-letters, passes them through rollers for defacing the postage stamps and postmarks them; while a still further development is a machine of the coin-freed class, which not only receives the letter and franks it for the post in consideration of the coin placed in the machine along with it, but also performs the dating and obliterating operations.

Following on the use of hand-stamps for obliterating comes their use for marking documents with some frequently-recurring sign, sentence, or symbol; of such instruments the ordinary office-stamp is the most familiar example: a very common form of this is the addressing stamp, from which the various kinds and classes of addressing machines have been evolved. These machines have been dealt with in an earlier chapter.

There are other hand-stamps in which a certain amount of hand-composition is performed: of these the dating stamp is a common example; some of these have numbering and dating wheels, while others have the characters raised on bands of rubber which can be shifted to bring the required combination of figures and letters, or logotypes, into the printing position. From the dating stamps have been evolved other stamps and stamping machines, which are controlled by clockwork—mechanically in the machine itself, or electro-magnetically from a distance—for recording the actual time at which certain impressions are made. Such appliances are used by insurance companies for dating the commencement of their policies, and are also used in some cases for tickets or contract-slips where time, as in the case of hired appliances for amusement or exercise, is the only factor considered in the payment to be collected.

The various recording machines cover a field so wide that it is a matter of great difficulty to divide them into any satisfactory classification, but the best method appears to the authors to be that of following the physicists' notation, with the addition of the money sign, \$, to the usually accepted symbols: length or distance, L; mass or its commercial equivalent weight, M; and time, T.

The particular class of machines dealing with abstract numbers only has already been partially considered in numbering-machines, but from the simple forms of counting and numbering machines have been evolved the more complex adding machines. These continuously add figures, and from this operation obtain a total that is printed by the machine when required. Adding machines are of considerable antiquity, their first invention being ascribed to Pascal in 1642, and, according to Babbage, one capable of adding small sums of money, the total not exceeding £100,000, was constructed "by Sir Samuel Morland" in 1666; this machine is in the Science Museum at South Kensington. Following these somewhat crude inventions came the adding machine of Viscount Mahon, afterwards third Earl of Stanhope, designed and constructed by James Bullock; this machine is also in the collection of the Science Museum, to which it was presented by Major-General H. P. Babbage. Out of these adding machines has been developed the calculating machine capable of performing the operations of multiplication or division, and in some instances of printing or typewriting a record of the results obtained.

Machines of this class to-day are the outcome of continued improvements upon the original calculator of Thomas de Colmar, which was followed by the Edmundson, and among the modern successors to these may be mentioned the Brunsviga, the Burroughs adding machine, the British adding machine, and the Comptometer, a machine which in its early form was termed the Comptograph, and in that form printed its record on paper.

Of much earlier date than the preceding and of far greater complexity is the Babbage calculating machine, or difference engine, which in its original form was never completed; parts of this machine were formerly in King's College, parts still remain in University College, London, and the portion put together for purposes of demonstration and illustrated in fig. 448, plate LXXXVII, is now preserved in the Victoria and Albert Museum. The typographical portion of this machine, according to "Babbage's Calculating Machines," was intended to make impressions from the type-wheels in a stereotype-matrix, and an ingenious method was adopted of impressing rules in the card between the spaces to be occupied by succeeding lines of figures so as to afford room for the material of the matrix displaced by the impression of the line of figures. By this means a stereotype-matrix of the page was obtained direct from the machine without any handwork. Altogether some £17,000 were expended by the Government, and at least an equal amount by the inventor, on this first difference engine.

The analytical engine invented by Babbage in 1834 and improved in succeeding years was unfortunately never made, although the drawings for it were prepared by the inventor. In this proposed machine the Jacquard card principle was adopted, and the machine itself could calculate and perforate cards for the logarithms or other constants which it would require in its subsequent operations. When started to work it would continue calculating till it required a new constant, when it would ring for its attendant to provide the requisite Jacquard card for which it showed the number; on being furnished with the card the machine would test it for correctness, and, if the wrong card were given to it, it would ring a louder bell and signal "wrong card." The mathematical capabilities of this machine were fully investigated by General Ménabréa in a memoir published in the "Bibliothèque Universelle de Genève," vol. xli, 1842, and translated with copious annotations by Ada Augusta, Countess of Lovelace, the daughter of the poet Byron. The results are summed up in the statement: ". . . the whole of the developments and operations of analysis are now capable of being executed by machinery." The principle of the first Babbage machine or difference engine, was, however, revived by Scheutz, a printer of Stockholm, later assisted by his son, by whom a difference machine was constructed. A replica of this was made subsequently under contract by Messrs. Donkin, in a form in which the printed results are produced by typewheels governed by a calculating apparatus and a numerator confined to quantities increasing by units. This replica of the Swedish machine was till quite recently in Somerset House; in January, 1857, the Scheutz machine was exhibited in the library of the Institution of Civil Engineers, together with a portion of a table of logarithms, calculated and impressed entirely on the machine without the use of loose type. It was estimated that these compound operations could be performed in less than half the time which a compositor would take to set the types by hand. Further reference is made to the machine in the "Proceedings of the Institution of Civil Engineers," April, 1857, and a brief description of the Babbage and Scheutz difference engines is given below in the chapter dealing with impression machines.

A history of the development of calculating machines from the simple engine-counter to the latest and most elaborate forms of calculating and costing machines is so broad a subject that it might well in itself form a highly interesting text-book. It is to be hoped that such a history will include descriptions of two important machines for calculating and summing costs, now in progress, and that these two machines will be completed and commercially available before long.

$.—Money: taking the classification under the headings given above, for reckoning in money alone many machines exist in the form of cash registers. Several of these appliances not only record the amount indicated by the key-depressions upon a strip, but also totalize the sums received, and, until reset to zero, carry forward the total.

L.—Length: machines for measuring continuous lengths exist for measuring fabrics which, while they are being manufactured or packed, pass over a roller from which the primary movement for the recording mechanism can be obtained. From the simple form of measuring machine so operated, others have been evolved which calculate the money value of the lengths so recorded=L$.

L^2.—The product of length by length, or surface, is measured and recorded by machines in the case of certain articles of irregular shape; of these hides are a common example. The operation of measuring an irregular area involves integration, and in the case of hides this is performed by a series of rollers spaced equally over a length at right angles to that in which the hide is caused to travel; each roller is caused to revolve by the hide as soon as it comes into contact with it, that is to say, the rollers measure the lengths of a series of equidistant ordinates, and the total aggregate rotation of the rollers is summed by the machine and recorded as an area on the hide.

L^3.—The product of length by surface, that is to say volume, is generally measured by some mechanical means in which a unit volume is adopted, as in gas-meters. In such cases it is merely a question of combining the existing known methods of recording abstract numbers with the counting appliance actuated by the measuring machine or meter. In the case of the volume of liquids, measurement is sometimes made by weight, but where large quantities are concerned the Venturi meter permits the measurement of volume while the fluid is actually in transit in its pipe or main. A meter based on this principle consequently measures volume as a product of time by velocity $= T(L/T)$, or in other words, as a simple length, L, and although such appliances should come, according to classification, into the class of recorders which deal with length alone, they are in practice of more complex nature.

The measurement of the volume of solids is usually determined commercially by the more simple method of weighing and dividing by the density, and most of the machines that record the volumes of solids are operated by weigh-gear; it is, however, quite conceivable that the measurement of certain solids, such as grain, could be effected by the measurement of length multiplied by the cross-section of the recipient, if the article measured is at rest, or by the cross-section of its stream multiplied by its velocity and by time if the article is in flow.

M.—Machines for recording mass, or rather weight, exist, and are generally operated by the setting in position of the jockey-weight on the weigh-beam of the machine. Some of these appliances not only determine and record the weight of the object handled, but being also set to a constant for the quality, as represented by the rate value per unit of weight, they record and calculate the total value from the automatically-received record of weight and the set figure for rate. Machines have also been devised for recording the weighing of such articles as coal, in the following manner: the number of the coal truck is noted by a key-operated section of the machine, which does not add or subtract, but merely records; the gross weight of the vehicle is also recorded upon the machine, and the tare weight of the truck which is also set by key-operation is subtracted automatically so as to give the net weight of the contents by difference. The summation of this difference is effected automatically by the machine, and a total of the differences is carried forward to be printed at the foot of each complete page; the Schooling machine is an example of this class.

T.—Time-records have already been mentioned in connexion with record stamps, but a very much larger class exists of machines which deal with the time-records of employees and others. Most of these machines are operated by means of typewheels producing the records on a rolled sheet, or strip of paper, or on inserted cards; the impression corresponding to the particular time at which it is made is effected by the agency of the employee, either directly by pressing a pointer into a hole in the dial as in the Dey time-register, or by means of a special key as in the Bundy time-recorder, or by inserting the employee's card in a slot and depressing a lever as in the Rochester recorder.

It may be considered that recording machines could better be divided into three classes according as they are operated by hand, or semi-automatically or automatically, but this method is open to the objection that nearly all classes of recording machines enter the field as hand-operated machines, become partially automatic in the adding, carrying, or recording operations, and finally pass into the stage of fully automatic machines when applications of sufficient magnitude or importance arise to warrant their existence in the final elaboration. Of a machine rendered purely automatic, an example is afforded by an invention for translating the Wheatstone perforated record-strip into ordinary printed characters.

It must not be supposed that this brief survey of miscellaneous stamping and recording machines has by any means exhausted the field of freak inventions, for amongst these appliances we find machines for printing on as different substances as paper, fabrics, and hides; for marking on curved surfaces such as those of golf-balls, eggs and hams; for recording on tickets, tags, and cards; for recording the various operations performed in railway signal-cabins, together with the times at which the respective operations are performed; and for recording the fluctuations of temperature in refrigerating chambers on board ship. Moreover, the hand-stamp has developed into machines for attaching to one's boots for marking characters in the form of tracks, for the training of boy scouts, and into a brobdingnagian stamp carried beneath a vehicle and intended for printing on roads, an appliance for which one can imagine a large utility, as a means for warning motorists of police traps, but which could only have an extremely limited sale owing to the objection of the authorities to the honest publication of the whereabouts of their ignominious *souricières*.

CHAPTER XX.

LINE-JUSTIFYING MACHINES.

"Some of the methods proposed are spring and rubber spaces; corrugated or hollow spaces to be afterward crushed to proper size; selection of proper spaces by calculating devices after measurement of the line; cutting spaces from space timber after measurement or casting of the spaces based on measurement of line or calculation of its constituent units; progressive substitution of spaces until justification is secured; the use of wedges to operate the space-selecting mechanism, or type metal wedges driven through the line and the surplus broken or cut off; the method of inserting thin spaces until the line is justified or oversetting and subtracting them until the same result is achieved; and finally the latest proposition, to use em spaces and cut them down to the size desired after oversetting and measuring the line."

John S. Thompson. History of Composing Machines.

Bourgeois No. 17 (Figgins).

In dealing with the subject of self-spacing type, the difficulties met with in spacing out a line of composed matter have been already briefly discussed, and perhaps there is no portion of the whole subject of the production of a printing-surface that has called forth more inventive ingenuity than the attempt to grapple with the mechanical line-justification of a composed line.

The main difficulties may be summed up in the facts (1) that the number of spaces in the line is variable, and (2) that the amount of white to be divided amongst these spaces is also variable.

Many inventors have endeavoured to effect line-justifying by the use of compressible spaces, but the difficulties have not been satisfactorily overcome. The compressible space should be capable of occupying the width of the em quad before compression and of being compressed to the thickness of the thick space. This should be possible without risk of throwing the sides of the adjacent type out of parallel, without lifting the type from their feet and without bending a character occurring singly, such as **a** or **I**, which may come between two spaces. Moreover, the space must not itself rise so as to interfere with the typographical surface. Some attempts to solve the problem of the compressible space are shown in figs. 321 to 323.

In addition to these, spring-spaces of various kinds have been proposed, but there are difficulties in their application owing to the varying pressure to which they would be subjected according to the spacing of the line, and to the large range between the maximum and minimum widths required in practice.

Other methods have been proposed such as (1) progressive insertion of thin spaces. In this method, thin spaces are inserted between the words or their equivalents, to the end of the line. This operation is repeated, if necessary several times, the final operation usually extending only over part of the line. (2) Spaces in the form of folding-wedges were proposed and tried, but had the disadvantage of requiring too much width between the words for practical purposes; they had the further disadvantage of

FIG. 321.—*Mackie compressible space.* Scale: twice full size.

FIG. 322.—*Wicks compressible space.* Scale: two and a half times full size.

FIG. 323.—*Dacheux compressible spaces; two forms.* Section: enlarged.

not giving the top of the spaces that uniform height which is necessary for stereotyping. (3) A form of multiple space arranged as a slug in graduated thicknesses nicked nearly through so that there was sufficient strength in the metal for this to be inserted in the line, and yet leaving a section so weak that the sizes not required for completing the line-justification could be readily broken off, fig. 324, was invented by P. F. Cox in 1898. (4) A further method which has been used in conjunction with composing machines, but so far as the authors are aware has not been employed independently, consists in setting a line with temporary spaces, passing it through a measuring and calculating piece of mechanism and subsequently inserting spaces of the nearest appropriate thickness in place of the temporary spaces. In some of these machines the line is remeasured after each such space has been inserted, so as to avoid accumulation of the error caused by the difference between the fractional width required and the fixed width available in the choice of spaces provided for insertion in the line. (5) Yet another method is the one described in chapter XXIII of casting spaces of the appropriate width determined by the measuring and counting gear and inserting these spaces in the line.

In fact, so many ingenious devices have been evolved with a view to overcoming the difficulties of line-justification that it is not easy to imagine any new operation for effecting the purpose, except that of temporarily spacing the type and filling the interspaces left with a congealable fluid, a colloid substance such as gelatine, or with plaster of Paris or some similar composition introduced under pressure and allowed to harden when line-justification has been brought about. The authors do not recommend any of these methods as suitable for the requirements of the practical printer.

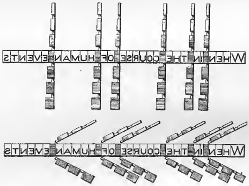


FIG. 324.—*Cox multispace.*

Various machines have been invented for carrying out line-justification, but with the exception of the machines which cut out spaces from hard-wood or metal and those which reduce spaces by saws or milling-cutters, all the methods employed are simply mechanical modifications of some of the methods already described.

The first inventor to produce a working machine giving justification by the reduction in the one case of a specially cut-out space was F. A. Johnson. The reduction of the ordinary quads of commerce by means of milling-cutters is a salient feature of the Stringer line-justifying machine.

The Stringer line-justifying machine.—A machine invented a few years ago by H. Gilbert-Stringer is shown in fig. 315, plate XXIX, attached to the Wicks composing machine, and separately in fig. 325, plate XXXI.

In this machine, within certain limits, a line of type as delivered by any suitable typesetting machine can be accurately line-justified.

PLATE XXXI.

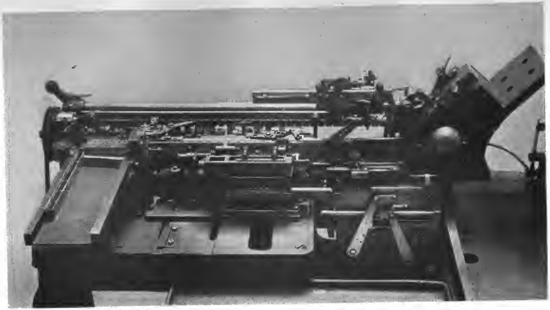


FIG. 325.—*Stringer line-justifier.*

To face page 344.]

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The method adopted is to set em quads throughout the line in place of spaces, and subsequently to reduce these by milling to the correct width for equably spacing the line. As it is essential that the justified line should contain em quads in some places, for instance at the end of a sentence and at the beginning of a new paragraph, these must not go through the reducing process for line-justification. It is therefore necessary that two kinds of quads be used. Those which are intended to remain quads are of shoulder height, while those which are to be reduced may be of stereo height. The former are supplied by the depression of the quad-key on the typesetter, and the latter, or space-quads, by the depression of the space-key.

Coupled to the space-key, by tappet action, is a rod which advances a bar step by step below one pair of folding-wedges for each space-quad set in the line in the automatic line-justifier. The line is composed into a measure longer than the finished line, which allows for the amount to be machined from the space-quads. Having composed a line in excess of the length required, the operator depresses a starting key and resumes composition. The line-justifier, acting independently while he is so occupied, first transfers the excess of length of the line to the wedge-box, and when those wedges which are above the counting bar are driven home by vertically lifting the bar, and with it the long part of each folding-wedge, the amount by which the bar is lifted divides the difference of length by the number of spaces automatically and sets the milling-device for reducing the space-quads. The machine then operates by pushing the line of characters forward along a race which has an opening at the side, provided for a reciprocating feeler. Any character having the requisite height stops the feeler, and is then pushed through by the pusher into the continuation of the race. When a space-quad occurs, the feeler passes over it and the space-quad is then gripped between narrow jaws on its front and back edges in a slide and carried vertically down past a rapidly-revolving face-mill, the depth of cut being proportional to the lift of the wedges of the measuring device. It is replaced in the line by the automatic release of the jaws and the forward pressure of the next character. The gear which drives the feeler and pushing-plunger is thrown out during the milling operation and comes into action again as soon as the milling is completed. When the composed line has been line-justified, it is automatically transferred to a galley.

About 0·5 horse-power is required to run the line-justifying machine.

Grant-Legros-Maw line-justifying machine, figs. 326 to 329.—A later machine of this class is a modification and improvement upon the one just mentioned. Invented in 1909 by the authors in conjunction with T. F. Maw, the complication of the older machine has been greatly reduced; various practical improvements and an entirely original method of dealing with the line and reduceable spaces have been introduced.

The complication of even the simplest of these machines is such that a better idea of one can be obtained from the patent specification than from any general description, however carefully written; the official abridgment is therefore given here.

The specification relates to a machine "in which the line is overset to a greater length than the justified line, and the spaces are reduced to the proper thickness by means of a milling-cutter. The justifying-spaces are so formed that they can be carried in the line of types with their lower ends considerably below the bottom of the type to facilitate the operation of the feeler which selects the spaces for removal. The projecting portions of the spaces also actuate a counting-mechanism for recording the number of spaces in the line, and set in operation the extractor-slide which removes the spaces for reduction. An overset-indicator is provided to show

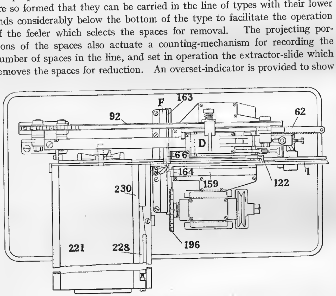


FIG. 326.—(Fig. 1. in patent abridgment.) *Grant-Legros-Maw line-justifying machine.* Plan.

the limits between which the composition of the line must be terminated, and the overset is measured and is divided by a compound-lever arrangement among the spaces in the line. The line of types is fed into a type-race 1, shown in plan in fig. 326, which may receive the types singly from the delivery-shoot of a setting-machine. The types are pushed to the left by a reciprocating plunger, the front end of the line being supported by a finger on a sliding rod which is connected by a cord to a weight. The spaces 50, fig. 327, are formed with a deep heel-nick 51 which engages a rule projecting from the bottom of the type-race so that the types rest at a higher level than the spaces. The spaces may be cut away at one or both sides for the same purpose. The overset-indicator consists of a fixed pointer, which is adjusted to a position corresponding to the end of a justified line, and a movable pointer, which, at each depression of the space-key of the setting-machine, is advanced by ratchet mechanism through a distance equal to the maximum amount removable from a space. The composition of the line must therefore be stopped when the front end of the line is between the two pointers, an alarm sounding when the end of the line passes the fixed pointer. The line is now moved to the left by a feed-slide operated by hand, and operates in its passage a space-counter comprising star-wheels, which are rotated through one tooth by each space. The star-wheels are connected with an escapement which releases step-by-step a spring-pressed rack-bar 62, fig. 326, connected to a member 64, fig. 328, carrying a series of stepped bars 65, which form part of the dividing-mechanism. The line is moved to the left until it strikes a measuring-jaw 66, fig. 326, mounted on a sliding carriage D. The jaw 66 is thereby moved slightly to the left, and the finger which supports the front end of the line

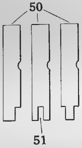


FIG. 327.—(Fig. 4, in patent abridgment.) *Grant-Legros-Maw line-justifying machine. Type with special foot-nicks.*

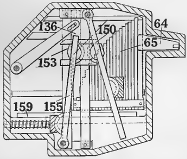


FIG. 328.—(Fig. 32, in patent abridgment.) *Grant-Legros-Maw line-justifying machine. Measuring-box.*

is withdrawn, and is pulled back to the right by the weight. The movement of the jaw 66 pushes down a measuring-wedge, whereby a clutch is closed and the measuring-mechanism is started. An adjustable jaw 122 carried by an arm on the carriage D is moved down into the type-race behind the line, and a pinion, which is frictionally held against rotation and is carried by a lever pivoted on the carriage, is raised into gear with a travelling pitch-chain 92. The measuring-wedge is pushed up by a cam, and the line is clamped between the jaws 66, 122, a measuring-slide, which operates the dividing-mechanism, being simultaneously moved by the wedge through a distance depending on the amount by which the line is overset. The measuring-slide rocks a lever 150, fig. 328, which acts through a slide 153 upon a second lever 155 which adjusts a measuring-surface slide 159, fig. 326. The slide 153 is carried by a transversely-moving slide 136, the position of which is determined by the stepped bars 65, and therefore varies with the number of spaces in the line. The parts are so arranged that the final position of the slide 159 determines the amount to be removed from each space in order to justify the line. The measuring-slide is locked in position, and the carriage D is released and is moved to the left by the chain 92 until the first space enters the extractor-slide F. The extractor-slide consists of two flat slides 163, 164 capable of slight relative movement and having between them an opening which forms a continuation of the type-race 1. Between the slides is pivoted a trigger of which the top is engaged by the lower ends of the spaces. The movement of the trigger sets in action the driving-gear of the extractor-slide which carries the space out of the line and past a milling-cutter 196. The space is meanwhile moved laterally between the parts of the extractor-slide by a pusher into contact with the measuring-surface slide 159 so that it projects from the extractor-slide by the amount which is to be removed by the cutter, after which it is clamped between the two parts of the slide. As the space is removed from the line, it is raised by an inclined ledge so that it is returned to the line at the same level as the types. After the return of the space, the line moves on until arrested by the next space when the operation is repeated. The milling-cutter is detachably secured to a spindle provided with spring-pressed thrust-bearings. The cutter may have two distinct sets of teeth, an outer set for roughing-down the space, and an inner set for finishing, and may be in one, two, or more pieces. At the end of its travel, the carriage D is locked in position opposite to a galley 221 into which the line is pushed. The pinion on the carriage is then moved into gear with the lower part of the chain 92 whereby the carriage is returned to initial position. If a line is prevented from entering the galley, the pusher yields and the return of the carriage is prevented. The galley is inclined, to obviate the necessity for guard-rules, and may be adjustable in width by means of a movable side-piece 230 and wedges 228 operated by a screw. The lines are supported by a bar which is frictionally locked against one side of the galley by a spring. In a modification of the machine the measuring-surface bears against the space during its reduction by the milling-cutter. The type-race is made up of two parts, a fixed race 250, fig. 329, into which the line is fed from the setting-machine, and a movable race 251 which can be moved by a hand-lever 252 into alinement with the fixed race. The movement of the hand-lever also causes the engagement of a clutch which starts the mechanism. The line is embraced between two jaws 276, 277 mounted to slide on a bar carried by the movable race. A cord 264 attached to the jaw 277 passes round a pulley 279 on the jaw 276 and is attached to a winding-drum. The jaws close on the line which then moves to the left, operating in its passage the space-counting gear B. The right-hand jaw is arrested by a stop 286 which is so adjusted that the jaw 277 moves a measuring-finger 292 through a distance equal to the overset. A dividing-mechanism similar to that before described is thereby operated so that a measuring-surface slide 300 is set. The race 251 is then moved back to initial position and the line is moved to the left by the cord 264 until the first space enters the extractor-slide F where it is arrested by a trigger as before, the winding-drum being now frictionally driven. The extractor-slide carries a plunger of which the projecting end strikes a bevelled part of

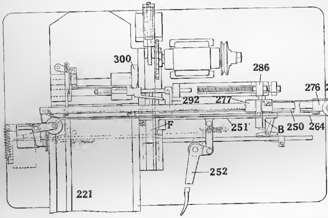


FIG. 329.—(Fig. 36 in patent abridgment.) *Grant-Legros-Maw line-justifying machine.* Side elevation.

the slide 300 and is thereby caused to push the space out of the slide F by the amount to be removed by the cutter. After all the spaces have been reduced, the line travels on and is pushed into a galley 221. The galley-pusher carries with it the jaw 277 which is mounted to slide. A spring catch retains the end of the line and prevents its return with the jaw."

CHAPTER XXI.

DISTRIBUTING MACHINES.

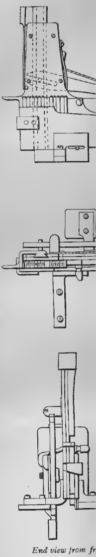
"The sad mechanic exercise."
Tennyson. In Memoriam.

10-point monarch (Shanks & Sons).

ORIGINALLY matter, after it had been used for printing, was distributed by hand back into the cases. This simple method is followed in devices such as the *Hattersley*, in which the operator is required to read the matter in a manner similar to that adopted in hand distribution, but with the modification that, in this instance, the line of matter is inserted in a distributing-stick somewhat resembling a pistol, fig. 330. This is successively presented against teeth in a vertical plate forming a guide above the mouths of the various channels of the magazine which is secured to a frame. In pressing the distributing-stick into place, a bearing-slip on the under side which supports the type is pushed back to the appropriate distance and timed to allow the trigger action of the distributing-stick when pushed home by the operator to depress the end type into its place at the mouth of the channel. As the line has been read in advance by the operator and the order of the characters and sorts is known, the stick can be rapidly moved from place to place and the distribution effected quickly and accurately. This work in the case of the Hattersley machine is usually performed by girls, who attain a speed of up to 4000 ens per hour; hence a set of Hattersley machines consists of two distributors to one composing machine.

An example of another simple form of distribution is afforded by Clay and Rosenborg's reversed composing machine, patented in 1840, the operator of which by reading the type as it passed along and touching corresponding keys of a keyboard caused the letters to be distributed into separate channels. These machines were for some time in commercial operation.

A later machine, very similar in principle, is the *Pulsometer distributing machine*, fig. 331, plate XXXII. The galley containing the matter to be distributed is inclined at 45°, and slopes downwards towards the keyboard. The lowest line is raised into the receiving trough, where it is read by the operator and is distributed through shutters on a guide-plate inclined at 45° to the horizontal and at right angles to the galley. There are twenty-four



End view from fr

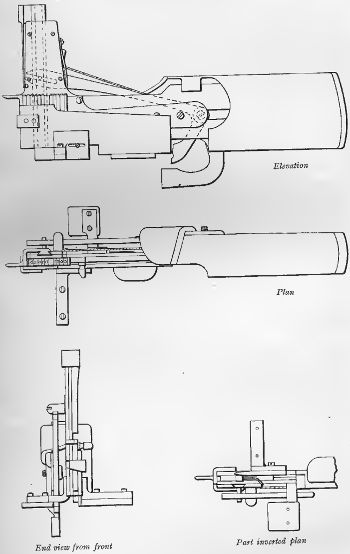


FIG. 330.—*Hattersley distributing-stick.*

keys, fig. 286, p. 299, and each generally corresponds to a group of three type which are selected so as to differ by at least 0·008 inch in set width among themselves. The distribution of the three sorts of type is performed automatically by two bridge-pieces, arranged at different heights, which divert the character to the mouth of the corresponding tube, fig. 332. A brass follower is placed in each tube to keep the type upright; the type as they fall are pushed into the tubes by a series of eccentrics, one to each tube, carried on a continuously-rotating shaft.

The power required is stated to be about 0·1 horse-power.

Automatic distributing machines perform the work by means of nicks cut on the back, and occasionally on both back and front, of the type. The type are nicked so that each sort dealt with by the distributor has a different combination.

In the *Empire automatic distributing machine*, fig. 333, plate XXXII, which was in use for some years at the office of "The Times," and subsequently in the office of "The Hereford Times"—to the proprietors of which the authors are indebted for some of these data—the type were nicked on the back, fig. 334, by means of a planing machine with two sliding tool-holders. The setting of the tools could be effected rapidly by putting dowel pins into numbered holes in each slide. A table was provided with the machine giving the numbers of the holes to be used on each slide for each character. Actually the combinations in the nicking machine were arranged in a somewhat haphazard manner. The type in the distributing machine was automatically removed from the galley in a line and then pushed by a pusher, one character at a time, into a series of carriers. The carriers had a step-by-step motion and stopped consecutively in front of feelers which were formed to the counterpart of the nicks cut in the type. The feeler-slides advanced against the type, and when a feeler fitted the nick combination it carried, both could move forward releasing the type from the carrier and thereby allowing the type to fall into the magazine of tubes. The machine distributed eighty-four sorts.

The Thorne distributor, fig. 335, shows a method in which the nicks at the back of the type are utilized, by means of selecting wards, to effect the distribution of dead matter. In this machine the dead matter is filled into grooves in the upper one of two coaxial cylinders, which in its intermittent movement of rotation carries the type round step by step till it brings any individual type over the particular wards in the groove of the lower stationary cylinder that correspond with the nicks cut in the type. The lower stationary cylinder itself now forms the magazine of the Thorne composing machine.

The Dow automatic distributing machine, fig. 336, plate XXXIII, was designed and constructed by Alexander Dow to work in conjunction with his composing and line-justifying machine described later in this work (p. 364). The type for distribution by this machine, as for other automatic distributors, requires to be specially nicked. The dead-matter galley is capable

FIG.

FIG. 33

PLATE XXXII.

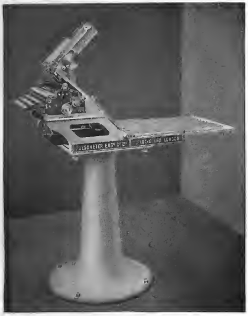


FIG. 331.—*Pulsometer distributing machine.*

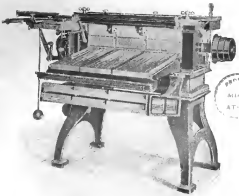


FIG. 333.—*Empire automatic distributing machine.*

[*To face page* 352.

PLATE XXXIII.

FIG. 336.—*Dow automatic distributing machine.*

To face page 353.]

machine.

of holding about 40,000 ens of 6-point type as a charge, and it is not

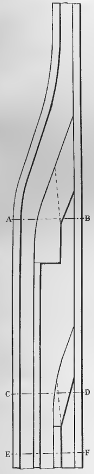


FIG. 332.—*Pulsometer distributing machine channels.* Sections.

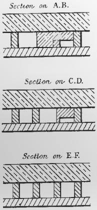


FIG. 332.—*Sections through the Pulsometer distributor channels.*

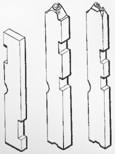


FIG. 334.—*Type nicked for the Empire distributing machine.* Twice full size.

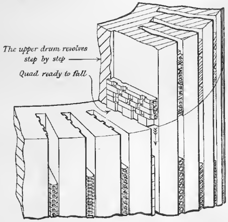


FIG. 335.—*Thorne distributor. Method of distribution.*

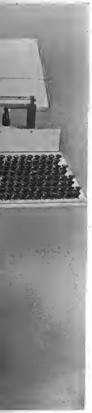
necessary to remove the leads from leaded matter before placing it on the galley of the distributor. The tubes for receiving the type are arranged in a plane slightly inclined to the vertical and disposed radially to a central revolving disk which supports on its periphery thirty-six type-carriers. As these are rotated past the distributing channel each carrier receives a single type and carries it round until it arrives opposite its proper channel. When a type comes opposite the channel, which has wards corresponding to its nicks and is intended to receive it, it is pushed out of its carrier into the channel, the disk meanwhile rotating continuously. The mechanism is all positive in action and distributes at the rate of 30,000 ens per hour. A safety-lock prevents the type from being broken during the operation of transference to the channel from the galley. An equipment of Dow machines consisting of two distributors operated by one man could supply sufficient type to keep about six Dow composing machines in regular work.

In the opinion of the authors, without question the best method of distribution is that proposed by Church and subsequently elaborated and carried out by Wicks on single type—a system which has been almost universally adopted in all modern typecasting and composing machines—namely, distribution through the melting-pot.

PLATE XXXIV.

FIG. 337.—*Rototype composing and casting machine.*

To face page 355.]



ine.

CHAPTER XXII.

CASTING AND COMPOSING MACHINES.

"GRÃO GRÃO ENCHE O PAPO A GALLINHA."
PORTUGUESE PROVERB.

Long primer condensed sans serif (Stephenson, Blake & Co.).

An example of a machine of this class, one that produces its line type by type, is to be found in that of Charles H. Westcott of Elizabeth, New Jersey, who, in 1871, originated a machine in which the type was cast as its keyboard was operated. The authors believe this to be the first compositor which combined typecasting and typesetting unit by unit. In this machine dies were mounted on levers or arms similar to those of an ordinary typewriter, and the depression of a key in the keyboard caused a corresponding matrix to be swung to the central point and clamped before a pot of molten metal, from which a single type was cast. This operation was repeated at each stroke of the keys.

According to J. S. Thompson, this machine of Westcott's was exhibited at the Centennial Exposition at Philadelphia in the year 1876.

A machine which followed the same lines and presented various improvements upon that devised by Westcott was made in 1894 by Joseph C. Fowler, who provided typecasting arrangements which cast the type and deposited it directly into magazines from which it could be assembled in the usual manner. He had a mould for each type character and a matrix adjacent to it adapted to lock against the mould and receive the charge of metal from the metal-pot. After casting, the type were ejected into channels directly beneath them, keeping them always supplied.

The Rototype machine, fig. 337, plate XXXIV, the invention of F. Schimmel, is operated by a keyboard having 123 keys and producing 120 characters. The matrices, one of which is shown in fig. 191, p. 226, are decagonal and arranged coaxially in a group of twelve to form a polygonal roller capable of both rotational and longitudinal movements in front of the mould-opening. Some four or five of these rollers are arranged in a vertical frame which runs in slides and permits any desired roller to be brought opposite to the mould. The rotational movement of the roller is stopped by one of ten pins on the end of the frame which enters a hole in the matrix-roller.

This stop arrests the rotational movement approximately, while the flats of the polygon give the exact rotational position ; the end-way movement is set approximately by levers regulated by twelve stops, and is set exactly by lugs on the frame above the matrix-roller, with which other lugs on the mould engage, thus setting the mould to the correct set width of character for the matrix presented to it.

The mould in opening has a movement of the top half upwards and towards the left, freeing the type which is ejected by horizontal cylindrical pushers passing through holes in the fixed mould-body. The type is ejected into a galley which, when full, is rotated through 90° into a vertical position.

The operation of composing on the Schimmel machine involves the presentation of a matrix to the mould for each key-depression, the casting of a type from the matrix, and its ejection from the mould ; after this the operation of setting another character can be commenced ; the speed of the operator is therefore directly dependent on the speed at which the casting portion of the machine works. No provision is made for line-justification, but an indicator shows the amount of space required to complete the line, and spaces can be cast to approximate to this amount for subsequent use in the hand-justification of the line after the composition has been completed. The theory of the inventor is that as composed matter usually requires correction, and as justification involves a large amount of extra and complex machinery, it is considered unnecessary to provide this seeing that the line will probably require correction before going to press.

CHAPTER XXIII.

CASTING AND LINE-JUSTIFYING MACHINES.

"Now in the setting of Space with Word, and Word with Space, there is Work that breaketh Bone at the Beginning, for they be Funded but few, and men's Words do stand apart, lean and large, of divers Distance, and with Labour enow be they Brought truly into Lap with meet Measure of Line."

Mirrour of Pryntyng.

Long primer De Vinne italic (American Type Founders Co.).

In chapter XVI, which deals with the classification of typecasting, composing, line-justifying and distributing machines, brief allusion has been made to machines of the class treated here. It must be obvious from the conditions implied in the classification that the operations performed by such machines must be confined to the measurement of the aggregate width to be filled by the spaces, the counting of the spaces in the line of type to be justified, the division of the aggregate width by the ascertained number of spaces, and the casting and inserting of this number of spaces of the desired width into their proper places in the line.

It must be further noted that it is possible to use such a machine as an adjunct to a simple composing machine in the same manner as a simple line-justifying machine may be applied to the line-justification of matter independently composed.

The McGrath casting and line-justifying machine.—P. H. McGrath of Randolph, Massachusetts, applied in 1891 for a patent granted in 1898, for performing the operation of line-justifying by measuring the total set width of the spaces required, dividing automatically by mechanism which adjusts a mould to the appropriate set width, and casting and inserting the required spaces in place of temporary ones in the line. Such a machine could combine the advantages of the loose-type setter with the accuracy of length of line obtained by machines of the monotype class, and it would be possible to run the casting mechanism at a comparatively slow speed.

Though this idea has been set forth in patents, the authors have not been able to trace that any machine working on this principle has been actually constructed, though two other American inventors, F. A. Johnson and William Berri, have independently worked upon somewhat similar lines.

CHAPTER XXIV.

CASTING AND DISTRIBUTING MACHINES.

"Voici, ma foi, la chose en propre original."
Molière. Sganarelle.

Long primer ronaldson (Monotype Co.).

Machines for combining the operations of casting and distributing type do not form a large class. The question of the automatic distribution of the product of the Wicks rotary typecaster was considered by the inventor of that machine, but the idea was abandoned by him as he was rightly of the opinion that the extra complication would prove more costly than the cheap girl-labour then available which could effect the distribution of the product of the Wicks machine for about one-third of a penny per 1000 type. Under other conditions, however, mechanical distribution of the product of a casting machine may prove advantageous. The only machine which combines the operations of casting and distributing, known to the authors, is the one here described.

The Bhisotype casting and distributing machine, fig. 338, plate XXXV, consists of a rectangular sliding block on the top of which L-shaped uncovered moulds, varying in number from ten up to sixty according to the size of the machine, are fixed in a line and provided with a sliding cover-plate which, when brought into position, completes the series of moulds. At one end of these moulds there are two plates fixed, to form a slot for the tang and for allowing the molten metal to enter, and there is a ridge to form a groove in the feet of the types. The opposite ends of the moulds are of course closed by matrices when in action—one for each mould —which are fixed in a row in a frame itself attached to the sliding cover-plate. Fingers F, figs. 339 to 341, are provided—one for each mould—on the lower side of the matrix-frame for extruding the types from the mould. Molten metal is supplied to these moulds from the metal-pot in the usual way. There is water-circulation through the mould-block and cover-plate for the more rapid cooling of the injected metal; the machine can be made in various sizes, in which case it will consist of one or more mould-blocks, each containing ten or a multiple of ten moulds and supplied from a single pump. Each mould casts a single type and is provided with projections to produce such nicks as may be desired in the type-body.

FIG. 338.—

FIG. 338.—*Bhisotype casting and distributing machine.*

To face page 358.

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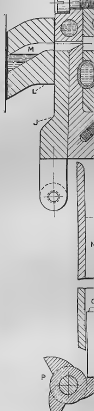

FIG. 339.—*Bhisot*

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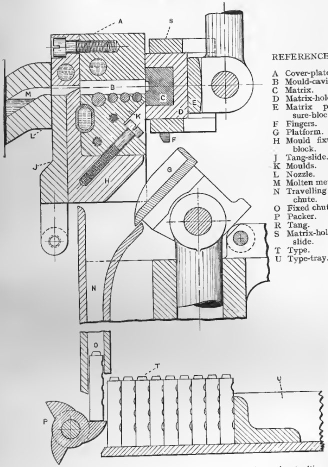
In working the typecaster, the mould-block holding the moulds with the cover-plate, firmly closed by a pressure device, is pushed forward by cams to come into contact with the mouth of the metal-spout and to receive

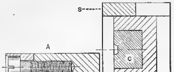


REFERENCES.

A Cover-plate.
B Mould-cavity.
C Matrix.
D Matrix-holder.
E Matrix pressure-block.
F Fingers.
G Platform.
H Mould fixture-block.
J Tang-slide.
K Moulds.
L Nozzle.
M Molten metal.
N Travelling chute.
O Fixed chute.
P Packer.
R Tang.
S Matrix-holder slide.
T Type.
U Type-tray.

Fig. 339.—*Bhisotype; vertical section through a mould in the casting position.*

the charge of molten metal driven forward by the pump-plunger; at each operation ten or more single types are cast simultaneously, one in each mould; the largest size of machine casts sixty types at a time.



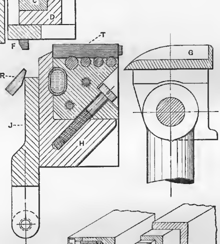


FIG. 340.—*Bhisotype; vertical section through a mould open for delivery of the type.*

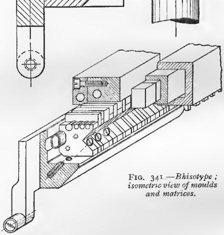


FIG. 341.—*Bhisotype; isometric view of moulds and matrices.*

REFERENCES.

A	Cover-plate.	L	Nozzle.
B	Mould-cavity.	M	Molten metal.
C	Matrix.	N	Travelling chute.
D	Matrix-holder.	O	Fixed chute.
E	Matrix pressure-block.	P	Packer.
F	Fingers.	R	Tang.
G	Platform.	S	Matrix-holder slide.
H	Mould fixture-block.	T	Type.
J	Tang-slide.	U	Type-tray.
K	Moulds.		

After the cast has been made the mould-block is drawn backward from the metal-spout, the type tangs are broken off, and their removal leaves a groove in the foot of the type. This done, the matrices are released and the cover-plate raised sufficiently to clear the top of the moulds, after which the matrices are made to slide away from the face of the mould. The types are then extruded from the moulds on to a turning platform by means of the matrix-frame. The whole mould, including the platform, now travels horizontally away from the nozzle for a short distance, and during this time the matrix-frame with its fingers has moved vertically into a position which enables it to clear the top of the moulds. The platform also commences to rise into position to receive the type. The lower part of the mould containing the type continues to travel, leaving behind the cover-plate, fingers and matrices; during this time the fingers have dropped into position ready to extract the type and the platform has risen into the position ready to receive the type. Also the tang-slide has separated the tang from the type and dropped to allow the tang to fall away. The mould-carriage now moves back to the nozzle, where pressure is applied by means of two balanced wedges to close the moulds which are now ready for the next casting. During this movement the type are extruded on to the platform by means of the fingers. The type are thence delivered first into the travelling chute and then into the fixed chute and assembled in separate channels on a tray, ready for making up into founts for hand-composition, or they are automatically distributed to the magazines of one or more composing machines for composition, or they may be assembled for putting up into founts.

After the type has been ejected and the parts returned to position, the mould-block with the empty moulds is again ready for the cast of another set of types. All the movements of the above series are automatic and occur during a single revolution of the machine. Each mould is made up of two pieces, a set-piece, which also determines the body, and a wall-piece, fixed together to form an L-shaped rectangular slot, varying according to the body or size of the particular type it is designed to cast. The mould-plate is so shaped as to form with the cover-plate a tapered slot in which the tang is cast, and through which the molten metal is forced. The matrices are of comparatively simple construction and may carry two different faces. It is stated that the ordinary Linotype matrices can be used with this machine. Each mould and each Bhisotype matrix are on a fixed unit system and are interchangeable to effect a change in type-body, or can be grouped together to form logotypes; and quads of any length can be cast by the use of a plain block of the length required. Each mould occupies about a quarter of an inch for type up to 12-point, so that a row of ten moulds to cast ten single 12-point type is about two and a half inches long. To effect a change from one body to another it is stated that all that is required in this machine is the mere substitution of one simple L-shaped mould-piece for another, the cover-plate, being common to all moulds, remaining undisturbed. The peculiar form of the Bhisotype moulds enables the operator to cast, side by side, type of varying bodies and set widths together with any logotypes within the capacity of the machine. A machine with only a few moulds, the authors are informed, can be made for the use of small printers.

It is claimed that a standard-size machine consisting of sixty moulds carried on two mould-blocks will cast sixty single types at every revolution of the machine. This latter, working at a speed of forty revolutions per minute, casts about 2400 types per minute and automatically assembles them into lines for distribution as desired, either into the magazines of composing machines or into paged founts.

This description is based on information furnished to the authors by the inventor, Prof. S. A. Bhisey, of Bombay.

The types from this machine are stated to be of excellent quality, and the data given appear to show that the output is greater than that of any other typecaster known to the authors.

CHAPTER XXV.

COMPOSING AND LINE-JUSTIFYING MACHINES.

"If I justify myself, mine own mouth shall condemn me: if I say, I am perfect, it shall also prove me perverse."

Job.

Pica typewriter (Marr).

The invention of the *Mackie composing machine* by Dr. Alexander Mackie of Warrington was made in 1867. Although the use of the Jacquard ribbon for composing had been proposed earlier, this appears to be the first machine in which automatic composition from a previously perforated ribbon was satisfactorily effected. In the earlier pattern of this machine the perforations were made in the strip in fourteen rows giving ninety-one combinations taken two at a time. In the later model used in 1877 there were twenty-four type-receptacles each containing seven or eight sorts of type and spaces. Thirteen rows of perforations were made in the strip, but the central continuously perforated row was used as a guide, and, to obtain the larger number of combinations required for dealing with the greater number of sorts, combinations of three holes at a time as well as of two holes at a time were used. A specimen of this strip is shown in fig. 342.

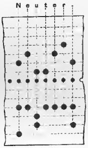


Fig. 342. — *Mackie composing and line-justifying machine; perforated strip.*

A picture of the Mackie machine is impressed on the outside cover of each copy of the folio volumes of "Lords and Commons," a reprint of important speeches of both houses of Parliament, composed upon the Mackie composing machine. Compressible spaces were used to effect line-justification.

The Empire composing and line-justifying machine.—A later form of the simple composing machine which has already been described in its particular class, dealt with in chapter XIX, is the Empire composing and line-justifying machine which, though in other respects very similar to its predecessor, is combined with an automatic line-justifying appliance, invented in 1894 by Frank McClintock. The principle on which this line-justifier works has formed the subject of further inventions by F. B. Converse and later by J. D. Chalfant. The type are contained in three cases, each of about thirty channels, which are carried on cradles with glass fronts. The cradles can be placed horizontally for receiving the cases and then turned vertically with the face of the type to the front so as to be visible through the glass. The arrangement of guide-plate, pendulum-check and type-race is very similar to that of the Kastenbein compositor. Tapered space-bars are used temporarily in composing, and are put into position by the space-key. When the line is nearly completed a bell warns the operator, and he either completes the word or divides it. The temporary space-bars are then driven home to expand the line to the proper measure. The bars are arranged to correspond to six different set widths of spaces, namely, 0·25, 0·375, 0·5, 0·625, 0·75, and 0·875 of the body. The distance that the space-bar projects decides the width of space supplied; the machine supplies a space not greater than the setting, and at the same time withdraws the space-bar. After each operation of inserting a space, the remaining space-bars are driven home, so that the final maximum possible error is 0·125 of the body. This is a considerably larger error than that usually obtained in spacing by hand, in which the limit of accuracy attainable in the most favourable circumstances is given by the product of the fractions of the body represented by the thin, middle, and thick spaces: $\frac{1}{5}\times\frac{1}{4}\times\frac{1}{3}=\frac{1}{60}$ of the body.

The Dow composing and line-justifying machine, fig. 343, plate XXXVI, is an invention of Alexander Dow, of New York City, the son of Lorenzo Dow, of Boston, Mass., who was also a clever inventor and mechanic. This machine was invented in 1896 and came under the notice of one of the authors in New York in 1901, at which time it was doing excellent work. The Dow composing machine is an extremely ingenious piece of mechanism. It occupies about 17 square feet of floor-space, stands over 6 feet high, and weighs about 2000 pounds. The type-magazine, on account of its weight, is divided into two parts for greater ease in handling, particularly when it is desired to change from one face to another. The machine is capable of composing all sizes of type from 5-point to 12-point. The type lie with their faces towards the operator and with the set vertical in channels which are 4 feet in length and afford a large capacity for type; this is still further increased by the duplication of the channels most used. Thus there are four channels for quadrats, three for **e** and two each for **t**, **o**, **h**, **n**, and **a**. Moreover, it is possible to refill any channel by means of a type-grab which can be used by hand to take a charge of type from the corresponding distributor-channel.

As in the Paige compositor, the movements are effected from a cam-shaft at the back of the machine, but with the difference that the type

FIG. 343.—Do

PLATE XXXVI.

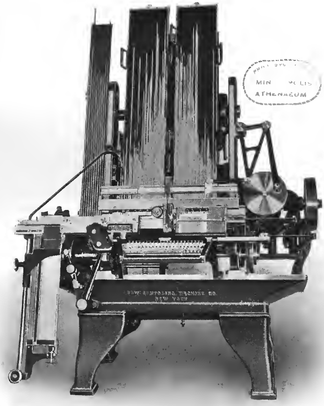


FIG. 343.—*Dow composing and line-justifying machine; front view.*

[*To face page* 364

PLATE XXXVII.

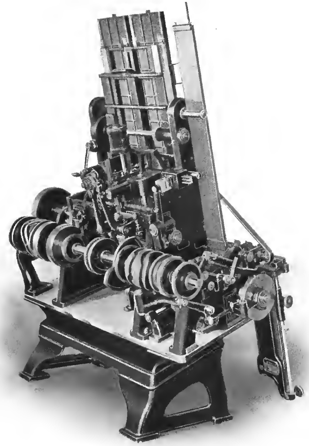


FIG. 344 —*Dow composing and line-justifying machine ; back view.*

FIG. 345.—*Dow composing machine; line in process of composition.*

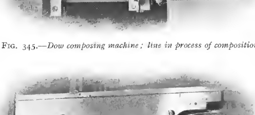


FIG. 346.—*Dow composing machine; stick rotated through 90°, ejection of line.*

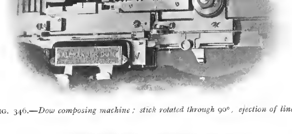


FIG. 347.—*Dow composing machine; line of composed type on the bridge; justification in progress.*

To face page 365]

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XXXVIII, shows the
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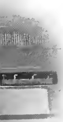

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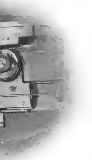

ugh 90°; ejection of line.

osed type on the bridge;

are placed in the channels with the set-dimension vertical. The back view of the machine, fig. 344, plate XXXVII, shows the arrangement of the cam-mechanism, while fig. 345, plate XXXVIII, shows the line in process of composition into the stick in its vertical position; fig. 346, plate XXXVIII, shows the stick rotated to its horizontal position ready for the ejection of the type on to the bridge; and in this position, fig. 347, plate XXXVIII, it is line-justified.

In the Dow composing and line-justifying machine the type is released by positive action, and the touching of the keys, which are only depressed about a tenth of an inch, merely serves to set in motion certain releasing mechanisms. As in other key-released, power-driven keyboards the keeping of a key depressed fills the line with the corresponding character or with quads; in this instance it does so at the rate of ten per second. An average of 12,000 ens per hour is stated to be obtainable from the keyboard. The types are ejected into a raceway, and rapidly-reciprocating type-drivers traversing this raceway push the ejected types to a central channel where another blade, synchronized with the drivers, pushes them down into the assembling-stick which occupies a vertical position during the composition of the line. As the types are assembled, temporary type-high brass spaces are brought into place between the words. When the line is complete the depression of a line-key causes the stick to make a half-turn about a horizontal axis and the types are ejected on to a second raceway, where the line is automatically measured and the exact total amount it requires for complete justification is registered by the calculating device which has already registered the number of times the space-key was depressed in composing the line. The registered shortage is thereupon divided by the registered number of spaces in the line, and the quotient obtained by the machine is the proper thickness for those spaces which, if inserted between the words, will accurately justify the line. If the calculation shows that no even division of the ten available spaces will exactly justify the line, the mechanism will select a combination of these spaces that will do so, and will place them between the words. Thus if the shortage on a line is equal to 0·350 inch and there are eight spaces in the line, the machine may select five spaces each 0·040 inch thick, and three spaces each 0·050 inch thick, and the aggregate of these will equal the amount required. The line is then separated word by word, the temporary brass spaces are removed and returned to the magazine and the proper justifying spaces, brought from the space-magazine, are deposited after each word respectively as the word advances in turn to the galley, where the line is delivered either leaded or solid as may be desired. This automatic line justifying apparatus is really the most ingenious part of the Dow machine, and it is not interfered with by changes in the measure of the line.

It is further claimed for the Dow machine that, as positive mechanical movements are employed throughout, it is possible to operate the machine with type in any condition, moist, oily, or dirty. As the type does not fall the face is not subjected to risk of injury or to heavy wear and tear. The mechanical arrangements and speed of drive admit of possible composition at the rate of 24,000 ens per hour, so that there is no risk of the speed of the operator exceeding that of the machine. The authors are not aware if this machine has made any great commercial advance, but at the commencement of the century, regarded as a piece of mechanism, it was certainly quite in the front rank of composing and line-justifying machines.

CHAPTER XXVI.

COMPOSING AND DISTRIBUTING MACHINES.

"Their office was to distribute." Nehemiah.

Long primer italian (Reed).

IN its earlier forms the *Thorne machine* did not line-justify the type, but in a later form it was combined with an automatic line-justifier. It is here, therefore, regarded simply as a composing and distributing machine.

The Thorne machine, fig. 348, plate XXXIX, is not an experimental machine in so far as it is an automatic distributor and setter, apart from the line-justifier, which latter, as stated above, is a later addition. The machine, taken as a distributing and setting machine setting up into line, in a galley, has been manufactured for many years and is the oldest machine of its kind on the market in the United States, where it is stated to be still in use in many places for small country newspapers.

In the early form of the Thorne machine there are two coaxial vertical cylinders having radial channels to receive the type. The upper cylinder is charged with matter for distributing without special preparation except that, as in the Empire machine, the type are specially nicked in the back with a different combination for each character. The channels in the top cylinder are plain without any projections, as shown in fig. 335, p. 353. The channels in the lower cylinder, on the other hand, bear the combinations of raised wards corresponding to the nicks at the back of each individual character. The lower cylinder remains stationary, and the upper revolves with a step-by-step movement, and pauses when the grooves are in alinement. When the wards in the lower cylinder channel agree with the nicks in a type above it the latter descends, and is available in due course for composition. The composition is effected by ejecting the lowest type, from the channel in the lower cylinder corresponding to the key depressed, on to a revolving circular disk. The type are brought round by the disk to the point of delivery, where they are received on a belt and thence travel to the receiving race.

In a later form of the Thorne machine, referred to above, and known as the *Simplex*, shown in fig. 349, plate XXXIX, line-justifying was added, and this line-justifying mechanism comprised a summing device, which registered the total set of the line, and a registering device for the number of spaces. There were four set widths of spaces, and the justification took account of any tendency to under or over space the line as in the Empire composing and line-justifying machine; but owing to the smaller number of sizes available, the result was not even so close an approximation as in the case of the Empire composing machine in combination with the MacClintock line-justifier.

In a still later form of the Thorne machine, which may be considered as an early form of the Unitype, the design was modified so as to make the delivery of the type positive, with a view to permitting the attachment of a line-justifying machine. The construction of the machine may be briefly described as follows :—

There were two cylinders each having ninety-six longitudinal grooves or channels similar to those already described. The upper cylinder, known as the distributor, had plain channels, while the channels in the lower cylinder, known as the stationary cylinder, were fitted with wards to correspond to each character. The lower end of the stationary cylinder was formed as a hollow cone for receiving the type when liberated from the respective channels corresponding to each character. The distributor was turned step by step by a worm-gear which permitted a dwell, whenever the channels in the two cylinders came into alinement, for a period sufficient to enable the bottom characters in the distributor channels to drop into those of the stationary cylinder, which occurred when the wards in the channel, usually five in number, corresponded with the special nicks in the back of the type.

When the distributor channel in the upper cylinder was emptied, a whole line of characters was pushed into it for distribution. By this means the distributor was kept continuously at work sorting characters into their respective channels so that the channels in the lower or stationary cylinder were kept supplied.

A stationary shaft in the centre of the machine carried the distributor as well as the stationary cylinder with its attached cone. A cam running on this shaft revolved at three hundred revolutions per minute within the cone; the function of this cam was to carry a plunger up and down as follows. When the key corresponding to a character was depressed, a catch was released allowing the plunger to engage with the revolving cam. The plunger in rising caused the corresponding bottom character in the stationary cylinder to be ejected, the character falling by gravity down the surface of the hollow cone in a groove; while the character was dropping, the plunger descended more rapidly, in a tenth of a second, and pushed the character, which had previously remained at the bottom of the cone from the last preceding operation, into a circular channel or raceway by a positive action. A revolving sweep cleared this channel or raceway and picked up any character that might be there. The sweep was met by a packer, fig. 350, which in turn picked the character from the sweep and pushed it towards the galley.

The keyboard, like that of the Wicks composing machine and several others, was so arranged that combinations or chords could be struck, such as **and**, **of**, **tion**; this was effected by arranging the characters so that they fell into the channel in their correct relative position, the sweep and packer picking up the combination instead of a single character. The sweep revolved at the same speed as the cam, namely, three hundred revolutions per minute, so that it was difficult to strike the keys quicker than the machine could deliver, one-fifth of a second being available for each character: a speed of 10,000 ens per hour is stated to have been obtained quite easily. The striking of combinations or chords has not, however, been approved by the operators in practice for the reason that the time saved in striking the combination **the**, for instance, over that occupied in striking the three characters **t**, **h**, **e**, singly, is small as compared with that which is lost in rectifying the errors liable to be introduced by striking the keys simultaneously as a chord.

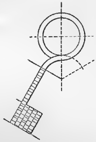

FIG. 350.—*Thorne machine; packing device.*

In connexion with this machine the line-justifier of Johnson has recently been tested. This justifying machine is similar in principle to the Stringer and Grant-Legros-Maw justifiers elsewhere described in this work, but instead of acting on the ordinary commercial em quad, the spaces for insertion in the line are prepared by being cut off with a saw from a suitable bar or slug of type-metal. The machine is so designed that should the space break before it has entered its place in the line, a second similar space is cut off and pushed into place. This method facilitates distribution of the spaces by remelting. Experiments previously made with compressible spaces had shown that considerable difficulty arose in the distribution of these spaces, and this appears to have been an important factor in the selection of the Johnson method of justification.

A serious difficulty with the Thorne machine or any other machine that sets up and line-justifies individual lines of type is the fact that thin characters such as **i** and **t** break easily when cast in hard type-metal, and are even more liable to fracture when they are specially nicked at the back for automatic distribution, and this breakage is likely to occur both in distribution and in line-justifying. When any such breakage occurs time is wasted in replacing the letter and this reduces the efficiency from the output point of view.

In its still later form the Thorne machine is manufactured by the Unitype Company of Brooklyn, New York, and is generally known as the Unitype. The Thorne machine patents for England were acquired by the Linotype Company after the machine had been worked here commercially for some nine to ten years, and had performed successful work on several leading newspapers among which may be cited the "Manchester Guardian" (some 18 machines), the "Bradford Observer" (8 machines) and the "Sportsman," London (8 machines). At the latter office an average speed of 10,000 ens per hour, maintained for a week, was obtained on two of these machines.

The body of the *Unitype*, figs. 351 and 352, plate XL, of which machine the Thorne composing machine was the prototype or forerunner, consists of two cylinders having a common axis, one being placed above and rotating upon the other. In both these cylinders, and extending vertically for their full length, are ninety parallel channels. The channels in the lower cylinder form the magazine into which type is distributed from the channels of the upper cylinder and is stored for resetting. These channels are slightly wider than the body of the type which the machine is constructed to set.

On the forward side of each channel in the lower cylinder, a series of steel strips are inserted and project partially across it. They are called wards, as they have the same functions as the wards of a lock. The combination of wards in each particular channel differs from that in all other channels. Each type-character is given a combination of nicks corresponding to the combination of wards in one particular channel, so that it can enter this channel and this channel only. The central ward extends nearly the full length of the channel and is cut off just short enough to permit one type to be pushed out at the bottom when the proper key is touched.

The channels of the upper cylinder have no wards, so that lines containing all characters will enter any channel in this cylinder. In each distributor channel there is a sliding weight, the function of which is to press down lightly on the line of dead type contained in the channel and make the bottom type drop quickly when it comes to its proper channel in the lower cylinder. The weight is lifted when a channel is to be loaded, the line of dead type is inserted in the channel, and the weight is lowered again on top of the line ; all these actions are automatic.

As the channels of the upper cylinder are supplied with lines of dead type, the cylinder is rotated step by step, bringing each channel in turn directly over each channel in the lower cylinder. At each step or movement of the distributor, the bottom type in each of its channels is tested on the wards of the channels of the lower cylinder. Any bottom type having a combination of nicks which matches the combination of wards in the channel over which it stops, drops down into its channel, while those type which differ in combination rest on the top of the wards, though in turn dropping when the rotation of the cylinder brings them to their respective channels. As the distributor can supply type much faster than operators can set it, it is not necessary to keep it working all the time.

The mechanism with which these results are accomplished is accurately

PLATE XXXIX.

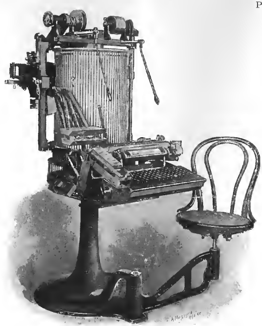

FIG. 348.—*Thorne composing and distributing machine.*

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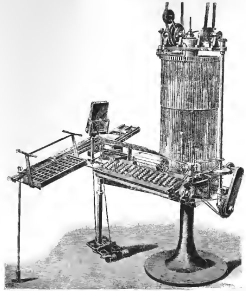

FIG. 349.—*Simplex composing and distributing machine.*

PLATE XL.
[To face page 371.]

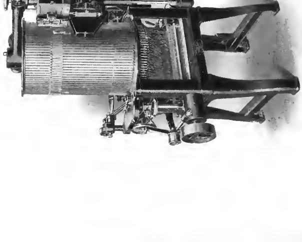

FIG. 352.—*Unitype composing and distributing machine; back view.*

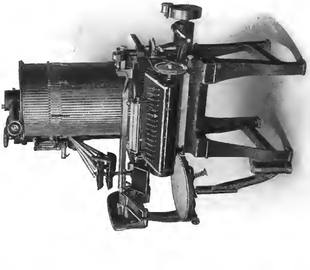

FIG. 351.—*Unitype composing and distributing machine; front view.*

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FIG. 352.—*Unitype composing and distributing machine; back view.*

FIG. 351.—*Unitype composing and distributing machine; front view.*

made, and precision of movement is obtained by using a cam to operate the step-by-step movement of the revolving cylinder. This cam revolves on a horizontal shaft supported by a cross-head on the top of the machine, which in its turn is firmly attached to a rigid vertical stationary main shaft extending through both cylinders. Motion is imparted to the cam by shafting and gears, which connect with the main driving shaft of the machine placed beneath the lower cylinder. The cam thrusts against rolls which bear on pins driven solidly into the top of the cylinder. These rolls, forty-five in number, form a circle about four inches less in diameter than the cylinder. As there are just half as many rolls as there are channels, each revolution of the cam gives the cylinder two forward thrusts, moving it each time a distance equalling the distance between the channels. The rolls are shaped to conform to the shape of the cam, and revolve on their bearing-pins when the cam thrusts against them, thus preventing friction and wear on the cam. Means are provided for adjusting the cam when necessary.

Should anything prevent the type from dropping freely from the upper to the lower cylinder, or if a channel in the lower cylinder fills up, or if the forward movement of the distributor is stopped or blocked by any cause, an automatic clutch acts instantly, releasing the pressure of the cam, thus stopping the driving mechanism and preventing injury to the machine or type. The cylinder cannot be moved forward again until the cause of the block has been removed. The clutch requires no attention from the operator.

The mechanism for loading the channels of the distributing cylinder with lines of dead type is attached to an upright, the upper end of which is fastened to the cross-head and the lower end to one of the lugs which extend upward on the base of the machine to support the cylinders. The shaft that actuates the loader is connected with the shaft of the cam that moves the cylinder so that the two work in unison. A bracket on the loader serves as a shelf on which the galley of dead type for distribution is placed.

The working parts of the loading mechanism consist of an arm which lifts the weights in the channels of the distributing cylinder; a plunger that pushes a line of dead matter into the channel when the weight is raised; and a trigger device which causes these parts to act whenever an empty channel reaches the loading point as the distributing cylinder rotates. These parts are all driven by a single shaft situated beneath the loader, this shaft in turn being driven by a vertical shaft that extends up from the main driving shaft beneath the cylinder. This vertical shaft also imparts motion to the distributor cam-shaft on the cross-head.

A galley of dead type is placed in position on the loader bracket, with the type facing outward, and the distributing cylinder is started rotating. When an empty channel in the cylinder approaches the loading point, a projecting lug on the top of the sliding weight in that channel trips the trigger on the loader, thereby releasing a spring and starting the loader;

the lifter arm raises the sliding weight high enough to allow a line of dead type to enter the channel beneath the weight; and the plunger then moves forward, pushing a line of dead type from the end of the galley into the channel. The continuing movement of the loading mechanism then returns the plunger and the lifter arm to their position of rest. As the lifter arm lowers, it leaves the sliding weight resting on top of the line just loaded into the channel. The pressure of the weight holds the line in the channel and accelerates the dropping of the type when a character reaches its channel in the lower cylinder. As the plunger withdraws, the column of dead type in the galley is moved forward, bringing the succeeding line into position for loading into the next empty channel.

The instant that the sliding weight is raised by the lifter arm the trigger is released and then returns to its position of rest, simultaneously setting in position a connected part which stops the loader when it has completed the work of loading the line of dead type into the channel, and the loader then remains stationary until the continued rotation of the cylinder brings the projecting lug on the sliding weight in another entirely empty channel into contact with the trigger. The various movements of the loading mechanism are performed in the intervals between the steps or forward movements of the cylinder, so that loading and distributing proceed simultaneously. The loader acts quietly, and its parts are so constructed that the type is not subjected to strain or injury.

If leaded matter is being distributed the plunger is adjusted, by a very simple arrangement, to remove the leads; as it recedes after having carried a line of type into the distributor channel, the plunger withdraws the lead which follows that line and drops it into a box situated below the loader. As they drop into the lead-box the leads pile themselves up in proper order for use. The distributing cylinder is not delayed by loading, but rotates at its normal speed.

The lower-case letters and other characters most frequently used are located in channels in the lower cylinder directly in front of the operator, and as they become filled or emptied, the operator stops or starts the distributor by pressing a button. When the dead-type galley becomes empty it is removed, and a full galley of leaded or solid matter is substituted.

The sorts distribute into the channels of the lower cylinder in about the proportion needed by the operator. This depends to some extent upon the character of the matter which is being set and distributed; so provision is made for removing from their channels in the lower cylinder any sorts which distribute faster than is required, or for replenishing the supply of those which do not distribute rapidly enough.

The machine distributes and sets matter up to 30 pica ems (5 inches) in width and the method by which the setting is effected is as follows.

The plungers, operated by depressing the keys, eject the type on to the flat upper surface of a rapidly revolving disk which encircles the bottom of the cylinder, its upper surface being on a level with the bottom of the channels, and having a projecting vertical rim on its outer edge to keep the type on the disk. This disk carries the types round to the right-hand side of the machine, where a switch raises them between the flanges of a vertical revolving wheel; the flanges of this wheel, immediately above the disk, are held just far enough apart to enable type to pass between them freely, but as the wheel continues its revolution, the flanges close together, gripping any type which has run between them, and carry the type in a vertical position to a point about three inches above the surface of the disk. Here the types are released from contact with the flanges, and pass between two rapidly revolving rolls that carry them forward, on their feet, to a channel or type-way leading across the front of the machine, where they are line-justified by hand and divided.

The lifting wheel picks up type as fast as they are guided between its flanges by the switch, regardless of whether they reach this point at regular intervals or not; if the type should arrive at this point in a continuous stream, the head of each type pressing against the foot of its predecessor, the wheel would pick them up one after the other without delay, and is thus capable of raising hundreds of type each minute. The type then follow one another through the rolls, forming a long continuous line, which extends, in the type-way, clear across the back of the keyboard, the face of the type in this line being in convenient view and reach of the operator. If it should happen that two types arrive together at the point where they are deflected to the lifting wheel, the one nearest the cylinder is detained by a light spring until the one next to the rim of the disk has passed; the detained type then slips away from the spring and follows to the wheel. This separation prevents the type from clogging.

The Unitype occupies about 6 feet by 6 feet of floor-space, including room for the operator to work it. It weighs about 1500 pounds and takes about 0·25 horse-power to drive it. It is stated to be capable of setting upwards of 4400 ens per hour with one operator, and this output can be considerably increased by the employment of a second operator assisting the first in line-justification and in recharging the loading-galley.

CHAPTER XXVII.

CASTING, COMPOSING, AND LINE-JUSTIFYING MACHINES.

"Is there anything whereof it may be said, See, this is new? it hath been already of old time, which was before us." Ecclesiastes.

10-point hawarden (Haddon).

A CASTING, composing, and line-justifying machine is that called the *Castotype*, fig. 353, plate XLI, which was produced in 1902 by J. C. Fowler and J. C. Fowler, junior, of Baltimore, Md., U.S.A. In this machine a series of moulds were provided, the matrices being similar to those used in the Monoline machine. All the letters of a certain width were upon a single bar. The operation of one of the keyboard keys caused the corresponding matrix to be lowered to register with its mould and a single type to be cast. In the case of characters running from right to left on the keyboard, they could be operated at a single stroke, that is, a chord could be struck, and the several corresponding letters cast simultaneously, otherwise the casting mechanism was operated for the casting of a single type at each stroke of the keys. Soft-metal quads were used as spaces, the line was overset and pressure was applied from the ends to bring the line within the limits of its proper measure. The completed line was afterwards passed between two trimming-knives which removed any metal protruding from the crushed spaces. It may be noticed that in this machine the use of quads as spaces, and the oversetting of the line are features common to the Stringer and Johnson line-justifiers, and similar methods are also used by the inventors of the Grant-Legros-Maw line-justifier.

The series of moulds in the Castotype has in it the basic idea, further extended in other typecasting machines, the Bhisotype for instance, of casting at will a variable number of type.

Another machine of this order is that invented by B. A. Brooks of Brooklyn, New York, who in 1904 took out a patent for a machine which caused a duplicate type to be cast and deposited in the type-magazine whenever one was ejected in the course of composition. There was one mould and for each letter a corresponding matrix. In this machine also, certain characteristics of the Bhisey casting and distributing machine

FIG. 353.—*Castoty*

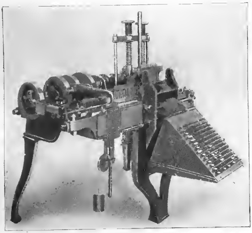

FIG. 353.—*Castotype casting, composing and line-justifying machine.*

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were displayed. A measuring and calculating device computed the size of spaces necessary to accomplish the justification of the line, and the casting mechanism then proceeded to produce and insert them into their places in the line.

The idea, however, of multiplicity of moulds and corresponding matrices is a very old one. William Church in 1822 is stated to have constructed a typecaster in which the letters were cast and deposited in tubes ready for his composing machine at the rate of 75,000 type per hour, the object being, like that of later inventors such as Frederick Wicks, to cast new type instead of distributing dead matter. Church used a group of moulds with a matrix for each adapted to lock against its mould while type was being cast. A whole fount was cast at each operation.

Joseph Mazzini's patent of 1843 covered a machine for a similar purpose. Both of these patents were taken out in England and show how very old are often the latest novelties, so called.

That these inventors were proceeding upon right lines, though perhaps, like many of their class, somewhat ahead of their generation, is proved by what is really the practical triumph of the system in the modern matrix-composing, line-justifying, and type or slug casting machines described in chapter XXIX. Whether these are Monotype, Dyotype, or Stringertype as representing the basic monotype differentiation; or Linotype, Monoline, Typograph, or Grantype, as representing the basic linotype differentiation; all these machines distribute their product through the melting-pot. Church, Mazzini, Wicks, and those who believed with them, are fully justified by the best of all tests: the test of time, and the survival of the fittest.

CHAPTER XXVIII.

COMPOSING, LINE-JUSTIFYING, AND DISTRIBUTING MACHINES.

"The application was filed in 1887 and was pending eight years, mainly owing to the work of examination by the Patent Office. One of the examiners died while the case was pending, another died insane, while the patent attorney who originally prepared the case also died in an insane asylum."

John S. Thompson. *History of Composing Machines.*

Brevier condensed sans serif italic (*Stephenson, Blake & Co.*).

Two very interesting patents, machines constructed under which were capable of performing the entire cycle of operations of composing, line-justifying, and distributing, were that taken out by C. W. Felt in America in 1860 (and in England in 1861), and that of J. W. Paige taken out in America in 1895. In many respects the earlier patent is the more remarkable for its curious anticipation of much that has followed. The Paige patent is perhaps, as far as size is concerned, the most voluminous ever taken out in the history of inventions.

The Felt composing, line-justifying, and distributing machine.—Felt's machine, fig. 354, is remarkable for containing, among other things, the earliest complete scheme for the use of a perforated record strip, though this method of control had been suggested at least a decade earlier; and he describes and illustrates a machine for producing this strip as a subsidiary part of his invention. Not only is the perforated record strip intended to be used alternatively as a method of composing, but also for effecting the distributing of the type when used in the reverse direction. The difficulty which would arise in the distribution of matter in which corrections had been made was apparently overlooked by this very thorough and capable inventor. The bell or indicator now long familiar on typewriters and other composing machines, is mentioned in this patent as the means of indicating when the line is nearly filled. The problem of conveying a large supply of type to any channel that required it is provided for by arranging the type in a spiral line or column wound on a drum by means of a flexible band. This is only one of many original and remarkable ideas proposed by this inventor.

The drawings of the Felt machine are extremely lucid and complete, and provide for effecting the various operations described in a direct and workmanlike manner. The machine, though not complicated when compared with some of the elaborate machines of the present day, was, however,

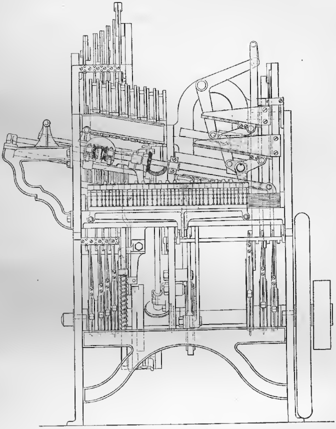

FIG. 354.—*Felt composing, line-justifying, and distributing machine.* General arrangement.

evidently much in advance of the period at which it was designed, when, it must be remembered, manufacturing operations could not be performed so cheaply as at present, and for this reason mainly, the authors believe, the machine failed to attain commercial realization.

The Paige typesetter, or composing, line-justifying, and distributing machine.—The history of the Paige typesetting machine, which in its final form was named the Paige compositor after the inventor and patentee, is an interesting story of inventive and constructional evolution, several minds being concentrated upon the complex problem of distributing, setting and line-justifying movable type by positive, but controlled, mechanical action.

The authors are indebted for their history of the Paige machine to the distinguished mechanical engineer, Charles E. Davis, who, at an early period in its progress, took over charge and control of the drawings and mechanical engineering work connected with it, and superintended its manufacture from the first stage of its development, down to the completion and operation of all the models and machines which were built. The description here given is in his own words.

"J. W. Paige lived in Rochester, New York, and early in the seventies, while interested in the oil-fields, conceived the idea of a simple typesetter, and built his first machine to handle agate ($5\frac{1}{2}$-point) type. From the start, the method of handling the type, edge upon edge, as against the universally accepted method of side upon side, was adopted: in other words, the type was always in the order of hand-composition, the same as in the compositor's stick. [Evidently this statement can only refer to American practice as several of the earlier European machines handled their type in this manner.]

"At first no provision was made for distributing from the dead matter for resetting. The final arrangement of the keyboard for setting type by syllables and words [a plan conceived from the first] was the result of an analytical study of the language, covering all subjects, made by Charles G. Van Schuyver, a printer in the employ of Paige, and to his patient work all praise is due. The keyboard was so arranged that there was one, and only one, combination available for setting a word or syllable when reading from left to right. During the study of this portion of the problem four variations were tried; first 89 characters, then 141 characters, and then 115. Finally 109 was adopted as the number of the best practical value.

"Early in his work Paige discovered the necessity for a machine which would either distribute the dead matter or recast the type for his typesetting machine. At about this time, the Shanks typecasting machine, a very rapid power-actuated typecasting machine, was invented in England. Paige secured the American rights for this and imported two of these machines for use in connexion with his typesetter.

"While Mr. Paige was working in Rochester, many others were studying the problem, notably J. M. Farnham, of Hartford, Conn., where the manufacture of the Farnham typesetter was in progress, a gravity machine with converging channels using type side upon side. The Farnham

Typesetter Company was also developing the Thompson distributor with a view to its use for supplying the Farnham machine by distribution of dead matter.

"About 1877, Dr. George F. Hawley, President of the Farnham Typesetter Company, entered into a contract with Paige to use his typesetter and the Thompson distributor.

"The Farnham Typesetter Company had their own works in the building of the Colt's Firearms Company, which were in charge of E. S. Pierce, as mechanical engineer and superintendent. A few months after the contract had been made with Paige, he produced a plan for a combined typesetting and distributing machine; it was decided to build a machine upon the new lines, and to abandon the separate machines. The new machine was planned upon the lines of the Paige, and used the Thompson principle for forwarding the type for distribution to the common type-case to avoid the necessity of transference. The work progressed rather slowly, and not until about the close of 1878, was it possible to show anything tangible; six characters were distributed from a temporary channel into the main type-case, and were set from the same case, thus demonstrating the possibility of the combined type-case.

"It was shortly prior to this period, Pierce having resigned, that the services of Charles E. Davis were secured by those interested in the matter.

"Soon after the test of the principle of the combined machine, various defects in the plan of the mechanism developed, and it was necessary in order to accomplish successfully the desired results to redesign the machine, using only such parts of the mechanism as could be made to meet the required conditions, and it was at this time that the plan was adopted, and never departed from, of working always to figures on fully-dimensioned drawings.

"Some months after the completion of the test referred to, Samuel L. Clemens, better known as Mark Twain, first became interested in the machine through the purchase of stock in the Farnham Typesetter Company, at the solicitation of Dwight Buell. It would be fruitless and tedious history to detail all the delays that followed due to limited capital and other causes. During the period which elapsed up to the time when the first combined machine was completed and used as a composing machine handling brevier type, operated by two men, one at the keyboard, and the other to justify the type, Dr. Geo. F. Hawley, William L. Matson, William Hammersley, Samuel Coit, William Gaylord, and many others were identified with the enterprise. It was a difficult task to interest new capital, for at this time no one believed it possible to line-justify automatically and mechanically a line of movable type. Delay occurred until Paige conceived the idea of a printing-telegraph, operated by his combined keyboard, to be used either with Morse or roman characters, as a quick means of raising money to enable the composing machine to be proceeded with.

Several of these printing-telegraph machines were built, Samuel Coit being largely instrumental in furnishing the money, and Clemens being also called in to assist in the matter.

"It was while following the telegraph instrument that Clemens renewed his interest in the composing machine, and quite a number of his MSS. were set up on the machine. While the work on the telegraph instrument was in progress, Charles R. North, a skilled mechanic in the employ of Paige, invented an automatic justifier to work in combination with the Paige machine. After this matter had been presented to Clemens and a detailed estimate made at his request by experts from the Pratt and Whitney Company, covering the cost of building the first combined machine and its subsequent manufacture, he decided to undertake the responsibility for the construction of a new machine, combining North's Justifier with the Paige Typesetter and Distributor; for this purpose he deposited the first royalties received by him from the publication of his wonderfully successful book 'Huckleberry Finn.'

"With Whitmore as Clemens's financial representative work was commenced with Carl Grohmann, Chas. I. Earle and others as assistants in the engineering department; drawings were furnished to the Pratt and Whitney Company, and the machine was built at their works in Flower Street, Hartford, Conn., George A. Bates acting as their foreman.

"A grave error was made at this point which caused trouble later on; many parts of the first combined machine were used in the construction of the new machine, with the result that when the machine was completed and in operation it contained features which prevented its use as a model upon which to base a plant for manufacturing. The machine as built at the Pratt and Whitney works, was, however, a successful machine in its operation, and demonstrated the possibilities of distributing movable type dead matter, and simultaneously setting, line-justifying, and assembling in column-form live matter on a single, power-driven, positive-action machine, operated by one man.

"It was when this result had been achieved that Clemens said one day: 'We only need one more thing, a phonograph on the distributor to yell, "Where in H—— is the printer's devil, I want more type."' The late Dr. Thurston, the eminent mechanical engineer, said when he saw the machine in operation: 'This is thought crystallized;' and it was Theodore De Vinne of the Century Company who said, when somebody compared the Paige compositor to the Jacquard loom: 'True, but the Paige compositor unravels any old fabric, and from it reweaves any new design which the imagination of man can conceive.'

"Upon the completion of the Paige compositor at the works of the Pratt and Whitney Company, all the leading newspapers and publishing houses expressed their confidence in the project, and were ready to contract for its use. It was at this stage that George S. Mallory and Marshall H. Mallory undertook to finance the enterprise. The capital required was, however, large and the reason the Paige compositor was never manufactured in quantity was due to the fact that at this time Paige, who controlled the patents, refused to part with a sufficient interest to induce other capitalists to invest the large amount required to conduct the business successfully, and was not attributable to any mechanical failure or defect in the machine. In this way three years were lost. It was during these three years that Philip T. Dodge assumed control of the Mergenthaler Linotype Company, and by a very successfully drawn contract with the newspapers and publishing houses, practically secured control of their composing rooms, and placed the Mergenthaler Company in a position to set the price at which the Paige machine could be marketed.

"Finally, in 1892, Ward, Frink, and Kneval of New York formed the Compositor Company, and contracted with the Webster Manufacturing Company, of Chicago, to build the machines, and the first compositor and the enterprise were moved from Hartford to Chicago in that year. An addition to the Webster factory was built, and a force of draughtsmen and mechanics employed to redesign and build a model machine.

"Again there were delays owing to the lack of funds, and although every effort was put forth to complete the machine in time for exhibition at the World's Fair, it was not ready, and late in the fall of 1893 work was stopped. Once more Clemens came into the breach, and through his influence Henry H. Rogers became interested, and the Regius Company was formed, a concern which subsequently became the Paige Compositor Company. Work was resumed and the machine carried to completion. When the Compositor Company went to Chicago, Mr. Scott, manager of the "Chicago Herald," agreed to test the machine on the "Herald." In September, 1894, the compositor was erected in the "Herald" office, and although it had not been tested on dead matter from which stereotype matrices had been made, a sixty days' run was started on copy taken from the 'hook.' For this test neither machinery nor repair tools were allowed to be erected. Any work that required to be done had to be taken to the company's works two and a half miles away. During this test two or three radical changes were necessary, but even in the face of this handicap the Paige compositor, with all delays counted against it, delivered more corrected live matter to the imposing stone, ready for the formes, per operator employed, than any one of the thirty-two Linotype machines which were in operation in the same composing department, although the latter had had several years' use on newspaper work. This record may fairly claim never to have been equalled by any composing machine on its maiden trial; moreover, the composition which the compositor turned out was, in artistic merit, equal to the finest book-work ever set by hand.

"The Paige compositor has been pronounced by competent engineers to be the foremost example of cam mechanism ever produced in the United States, if not in the whole world, and to have performed by positive mechanical devices the largest amount of brain labour ever undertaken.

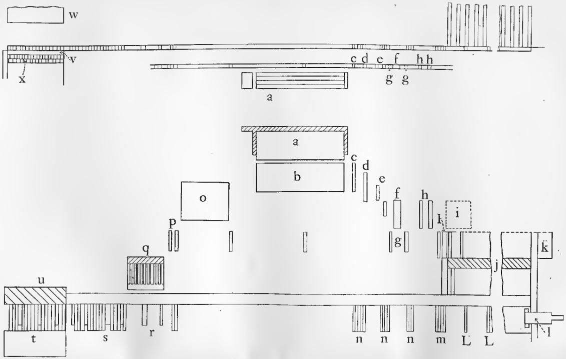

FIG. 355.—*Paige composing, line-justifying, and distributing machine; diagram of operations.*

The upper view: front elevation at 25° to the vertical, showing assembly. The lower view: plan at 25° to the horizontal.

EXPLANATORY STATEMENT.

The types were guided on the feet and always under a light tension from the top; all the wearing parts were made easily interchangeable and readily replaceable.

The machine was built with parts parallel to or at right angles with the plane of the table, and when this was placed on the feet the whole of the upper part of the machine was inclined 25°, so that the type channels leaned backwards 25° from the vertical and the tables sloped downwards to the back at 25° to the horizontal. This ensured that the type remained on their feet, that the heaviest pressure was towards the face of the type, and that the columns in the channels were prevented from buckling forward.

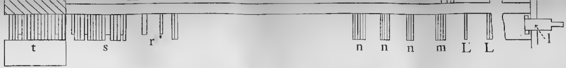

FIG. 355.—*Paige composing, line-justifying, and distributing machine; diagram of operations.*

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REFERENCES.

a Dead matter; two or three columns of matter assembled in the distributor galley.
b Type line moved forward.
c Type separated.
d Type registered from the foot.
e Broken type removed.
f Wide type selected.
g Spaces selected and forwarded to the left.
h Type forwarded to the right.
i Pie-box.
I Support for type-case.
j Type-case and channels.
k Regular pie-box for odd characters not nicked.
l Elastic collector.
L Composed type moved forward.
m Words measured and spaces determined.
n Words kept separated and forwarded to the left.
o Space-selecting plates.
p Space registered by backward and forward movement from the foot.
q Space-case or magazine.
r Spaces inserted between words.
s Line formed and forwarded to the live-matter galley.
t Leads inserted in live galley. 1, 2, or 3 leads could be inserted before the line was pressed down into the galley.
u Live-matter galley.
v Room left for leads below supporting shelf and above live matter.
w Depressing plunger.
x Live matter.

It will be noted that the types were moved forward to the right and registered for distribution before being received in the magazine, whereas the spaces moved, after selection, to the left until received in their magazine. The characters, after being composed, moved to the left, but at a higher level than the distribution level, and the words, as moved to the left, were kept separated until the space of separation was filled by the proper selected spaces, after which the words with the selected spaces completed their travel to the left with the live matter.

The spaces went through the same operation of separating, registering, removal of broken spaces, selection for distribution, and forwarding to their magazine channels as did the type, though the movement of the spaces was made in the direction opposite to that of the type.

"Some conception of the problem may be had if we follow the various operations required to deliver a finished column of live matter.

"After coming from the forme the dead matter was made up in the galleys for distribution. These galleys were inserted in the machine without a stop, and the top line was raised and advanced towards the front of the machine for the separation of the individual types. The type were then separated from the line by a mechanism, which handled them as though of equal width, though they were of every width and arrangement required in composition. When separated the type were raised a short distance, and a series of tests was automatically made to remove wide type, broken or cracked type, dirt or foreign matter of any kind, and to pass along into the distributing mechanism only such type as were perfect for resetting. Distribution was made possible by a series of nicks. Here again the greatest care was necessary so that no two different type had the same nicks, and that it was not possible for a type which had been broken in any way to cause a wrong distribution. All quads and spaces were so nicked that if reversed they would still distribute correctly. The selecting mechanism was so arranged that it would detect two type that might become stuck together in stereotyping; if they reached the body of the machine they were thrown out, and the distribution was automatically stopped until these type were removed. Whenever any particular magazine channel became full, the feed stopped automatically until the type had been set out of that channel, or until any excess of sorts in that channel had been removed by special pincers provided for that purpose. During the whole of the operation of distributing, the movement of the type progressed towards the right, and of the justifying spaces towards the left of the machine, and of both forward towards the operator, fig. 355.

"When the type in process of distribution was moved forward into the plane of the common type-case, a lifting mechanism removed the type from the end of the forwarding plunger, and lifted and placed it upon a supporting shelf at the bottom of the channel from which the type was taken in composing, so that it was possible in the machine to distribute a type into the magazine and set the same type out of the magazine during the same revolution of the cam-shaft. This distribution continued until any one channel became filled up by the insertion of some 200 characters, when a weight carried on top of the column of type in the channel came into contact with the mechanism which stopped the feed of the machine. The operator at the keyboard could set out syllables and words into a race in which a collector operated for transferring the type set to the line of composition. During composition the movement of the type was again towards the front of the machine, but the subsequent movements were towards the left instead of towards the right. At this point the operation of the automatic justification of the type commenced, the mechanical problem which the machine solved, being as follows: after adjustment to a predetermined length of line of composition, the machine automatically measured the words and syllables as set up by the operator, added the sum of these measurements together, subtracted the sum from the length of the line required, divided the remainder by the number of words less one, and automatically selected a space, or a combination of spaces, for insertion in the line which would justify the line within the limit of 0·005 inch. When a word had been composed and delivered to the line by a collecting mechanism in the type raceway, a key was touched which caused another mechanism to operate positively in harmony with the remainder of the machine, and to move the word forward a sufficient distance to allow another word to follow: no spaces were inserted in the line at this stage. This process continued until the indicator showed the operator that the line in process of composition had reached a length which would not permit of the setting of another syllable or word. The operator then touched a key known as the line-key, and mechanism was brought into operation to send each of the words forward in harmony with the other words previously set in the line in such way that when the first word in the line passed the justifying-case—which was a duplicate in principle of the regular type-case, but located some distance to the left—the points of this mechanism acted as an automatic key for inserting in place the space or spaces which would justify the line. When the last word of the line passed the case no space was inserted, and a mechanism was automatically brought into play for moving the completed line forward ready for insertion into the live-matter galley. At this stage provision was made for automatically inserting one, two, or three leads into the column of live matter, before the line of type, which had now been justified, was moved downward; by this means it was possible for the operator at the keyboard to set either solid, single, double, or treble leaded matter at his discretion into the live-matter column. This live matter was placed in galleys ready for removal to the proof galley, and from thence, after correction, to the imposing stone.

"One very important, in fact *the* most important element in connexion with this machine was what was termed the 'time-lock;' this was purely mechanical in construction, simple in formation, yet so designed that it was possible for the operator to finger the keyboard without regard to the beat of the machine while the positive mechanism of the machine would operate so as to perform all its various functions without interference one with the other, and without danger of knife-edge contacts or damage to the mechanisms. It is true that there were a large number of mechanisms in the machine, but the subject had been so carefully worked out and charted that even an operator who was not familiar with the machine, by simply looking at the degrees shown on the indicator dial, could, by reference to the chart, know exactly what mechanisms were in operation at that particular time, and so be able to locate accurately any difficulties that might have arisen, or which might have caused the machine to stop automatically; this it did whenever any undue strain was applied to any of the mechanisms.

"The speed of the machine shaft was 220 revolutions per minute. At this speed it was possible to distribute approximately 7500 ems (15,000 ens) of solid matter per hour, and it was possible for an expert operator to set up and justify over 9000 ems (18,000 ens) per hour, and 12,000 ems (24,000 ens) on rush matter; under these conditions, however, more frequent sorting of the case would be necessary, and provision was made for its easy accomplishment by the glass front of the case being spring-balanced, and so arranged that the removal of two screws, each turned one-half turn, would permit the case to be opened down to the bottom type.

"After the completion of the test at the offices of the "Chicago Herald," the matter of the continuation of the manufacture was thoroughly discussed, and a report was made on the mechanical reliability of the machine, which was favourable in every way. At one time the Mergenthaler Linotype Company had offered to exchange half-interests with the proprietors of the Paige machine, but Paige would not accept this offer. During the three years of delay the Mergenthaler Linotype Company had secured the field in such a way as to be able to fix the price of the Paige machine, and this caused the capitalists to come to the decision that money could be made faster in other channels than in the manufacture of the Paige machine. As a consequence, about two years later Philip T. Dodge purchased the patents and the two machines for the Mergenthaler Linotype Company, who loaned to the Cornell University the machine manufactured in Chicago and tested in the "Chicago Herald" office, and to the Columbia University, in New York, the machine manufactured in Hartford by the Pratt and Whitney Company, and at these universities they now are."

The Paige compositor, figs. 356 to 360, plates XLII to XLVI, used on the "Chicago Herald" test, was approximately eleven feet in length, three and one half feet wide, and six feet high. It weighed about 5000 pounds, and the power required was transmitted through a $\frac{1}{4}$-inch round belt to a grooved pulley 14 inches in diameter; it consumed about $\frac{1}{4}$ to $\frac{1}{3}$ horse-power. It could be started and turned up to speed with one finger at a 7-inch leverage. It was specially designed for newspaper work, and used nonpareil type; the distributing, setting, justifying, and leading mechanisms were adjustable to any width of column desired for newspaper or book work.

Various statements have been made in regard to the amount of money expended in the development of the Paige compositor.

According to C. E. Davis, who was closely associated with the matter and who examined the accounts, the total expenditure did not exceed one million dollars. Davis believes that about eight hundred thousand dollars represents the actual expenditure on the engineering, experimental, production and patent work for all of the Paige machines manufactured.

The authors subjoin another description of the Paige compositor for which they are indebted to the good offices of Philip T. Dodge, President of the Mergenthaler Linotype Company, who has had it abstracted

PLATE XLII.

PLATE XLII.

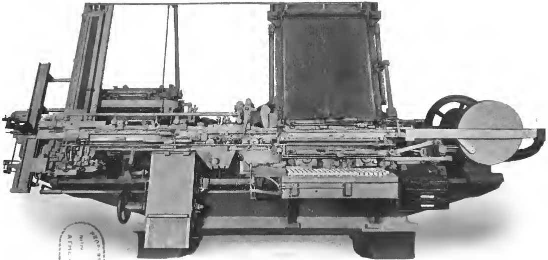

FIG. 356.—*Paige composing, line-justifying, and distributing machine; general view.*

To face page 386.]

PLATE XLIII.
[To face plate XLIV]

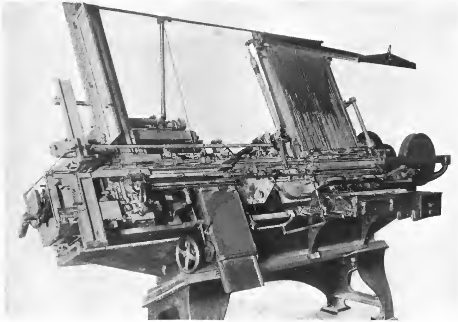

Fig. 357.—*Paige machine; front view from left end.*

PLATE XLIV.

FIG. 357.—*Paige machine; front view from left end.*

PLATE XLIV.

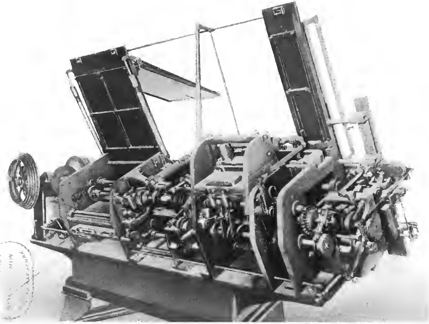

FIG. 358.—*Paige machine; back view from left end.*

To face plate XLIII.]

PLATE XLV.

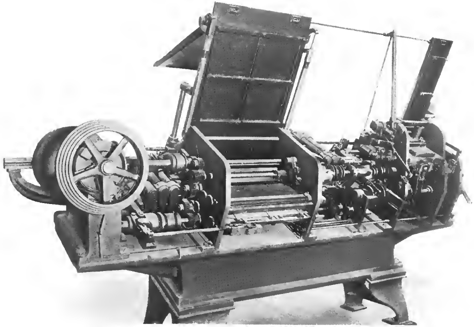

FIG. 359.—*Paige machine ; back view from right end.*

PLATE XLV.

PLATE XLVI.

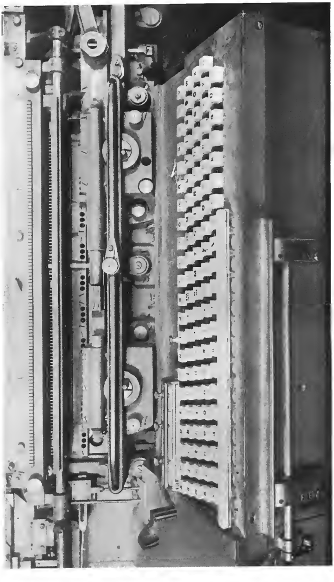

FIG. 360.—*Paige keyboard.*

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FIG. 360.—*Paige keyboard.*

To face page 387.

for them from a contemporary official booklet. The Paige machine is of such interest both mechanically and typographically that the authors think any repetition which may occur is excusable, and that the more personal description of the engineer responsible for its construction is well supplemented by the more prosaic information contained in the official account published by the Connecticut Company.

"The Paige Compositor, using movable type and consequent perfect face, covers the whole problem in every detail, so that we claim for the machine, without fear of contradiction, that by no known method can a printing surface be produced which equals, or in fact approaches, in artistic merit, legibility, hair-line effects, perfection of justification, economy of space occupied by given amount of reading-matter, or speed and economy of composition, that produced by this machine.

"The Paige Compositor really performs the entire work of the 'compositor' at the 'case' automatically, for while the machine does require a person to touch the keys which the copy to be printed calls for, as in a typewriter, the machine sets the type itself automatically and harmoniously with the action of the other parts of the machine, which, as a whole, acts as follows: When the type has been printed from and is ready to be distributed it is called 'dead matter.' This 'dead matter,' in column or page form, is taken to a Paige Compositor in a galley, as it is called, placed in position in the machine while the machine is running, and then the Compositor works as follows: The machine separates one line from the top of the page or column, then separates each individual type from the line and puts it in position for the other operations of distribution. The machine then removes any type which may have been damaged in the press or stereotype, or turned bottom-side up, or end for end, by the hand compositor in correcting or otherwise, takes the spaces used in justifying out of the line, distributes them into a separate case or channels provided for them, and distributes the types which remain into another case or channels, putting the spaces and types into the bottom of their individual channels which are slightly inclined back from a vertical position. The types are then built up one on another from the bottom. On top of the type in each channel is placed a piece of metal, and, when any one of the channels of type reach up to a certain fixed line in the case, the piece of metal is brought in contact with a bar which stops the feed of type from the galley, preventing an overflow of the case, no matter how careless an operator may be. Whenever a type is called for by the person who is operating the machine, from the channel which stopped the feed, the feed is automatically started and the distribution is resumed.

"At the same time that the distribution is in process the person operating the machine is causing the part which sets the type to forward the letters called for in the copy into the line of composition. That is to say, the machine is so constructed that it distributes and sets type at the same time, and a type can be put into and taken out of any of the channels during the same revolution of the machine.

"We next come to the justification; and while this has been always considered impossible of mechanical accomplishment, its practicability will, we think, be clear to any one if considered on the mathematical side. Of course to make any number of things the same length one must start with some one length as a standard or unit. This unit can be made whatever length the work to be done requires, as, for instance, the width of any book, page, or newspaper column. With this length known, the problem is simply this: Take the length of any number of words which are to compose a line and subtract their sum from the unit or standard, and the remainder will be the length which is to be filled out by spaces to separate the words of the line. It is clear that the number of spaces would be one less than the number of words in any line as no space is needed at the end of the line. Hence, if we divide the remainder, found as above, by one less than the number of words, we shall have for the quotient the amount of space which, put between the words, will fill out the line and make it of standard length—or, in other words, justify the line.

"In the Paige Compositor the mathematical problem proposed above is automatically performed, and any one looking at the person operating the machine and following its automatic action incident thereto, would see type taken automatically from the case and assembled into column form or 'live' matter; and the novel features which would fasten his attention and hold it to the end would come in order as follows:—

"Observing that the person operating the machine touched words instead of letters would bring out the fact that the keyboard was a study of the living language as in every day use in all the various avenues of life, and that the man who spent ten years of his life on its arrangement had placed every key in its most valuable position in relation to every other letter, so that all the keys which go to make up common words and syllables in constant use can be touched simultaneously, as one touches the chord on a piano, and maximum speed with minimum mental effort can be attained. It follows also that the type will be set out and delivered to the line of composition by words, letters, or syllables as called for.

"Turning now to the type which has been started on its journey to the column, he sees the machine take the length of the first word, record it and move the word out of the way of the second word, already on its way to join the first; then it takes the length of the second and adds it to the first, and moves the two words out of the way of the third, and continues this operation until there is no room left in the standard line for more words to come in, which fact is indicated to the person operating the machine by an indicator placed in the direct line of vision and by a bell which sounds when he has reached a point in advance of the place where the longest word in the language which cannot be divided would go into the standard line. If the next word in the copy is so long that the indicator shows it will not go into the line, then a key, called the 'line-key' is touched, and those parts of the machine are put into position which automatically accomplish the operations required to complete the justification of the line, and the parts connected with the operation of the keyboard are returned to their normal or first positions ready for the commencement of work on another line. The machine having now the sum of the lengths of the words which compose the line, the next operation is for the machine to subtract the sum of the lengths of the words of the line from the standard line and divide the remainder by one less than the number of words in the line, and to put into position for later action certain parts of the machine (which can be seen by the observer) which will at the proper time in the action of the machine cause to be inserted between the words which compose the line, and which words are separated for that purpose, one or more spaces of such a character as the quotient obtained by the above division may require to make the line of standard length. When the last word which was set in any given line has passed the case which contains the spaces used in filling out the line, then another part of the machine, which has been put in position by the touching of the 'line-key,' operates and takes the now completed line out to, and puts it down into, a 'galley' arranged to receive the 'live-matter' column. When this 'galley' or column is filled, the action of putting in the last line locks all the keys, so that the mind of the person at the keyboard is free from any thought other than that connected directly with operating the keyboard or the copy to be composed. In connection with the 'live-matter' column the machine is provided with means for inserting, between the lines composing the column, 'leads' for purposes of display or emphasis, this part being also controlled from the keyboard (as called for by the copy) by means of a switching lever at the volition of the operator. It also keeps a record of the number of lines composed by the machine, so that when the number of 'ems' which the standard line contains is known, the number of 'ems' set by the machine is found without taking duplicate proofs or any measurements whatever.

"It will thus be seen that the Paige Compositor has in its plan and fulfilment canvassed the whole problem and covered the entire work of composition. The machinery employed to do this work is of the most positive, substantial, and successful character known to mechanics, and is the result of twenty years and over of the most careful study—the strength, durability, accessibility, and simplicity of parts having been points which have always ruled in determining what should be used to accomplish the results desired. The machine in no way limits the operator, the speed of composition already obtained is from twelve to fifteen times that of the hand compositor.

"It may be stated in brief that the Paige Compositor does the entire work of composition; setting ordinary movable type with far greater speed, accuracy, and artistic effect, than has ever before been accomplished by any method. It automatically distributes, and at the same time sets the type indicated by the operator, automatically spaces and justifies the matter, without mental effort on the part of the operator, places it in a galley ready for use on book or newspaper as desired, records the number of lines set, and leads the matter as and when required, and does all this by the employment of positive mechanism.

"The machine is not to be confounded with any other machine, as it is entirely unique in design, principle, and method of working.

"It is not a mere typesetting machine. It is a compositor in the truest sense of the word, as it performs simultaneously all the work of a human compositor."

Lest any wrong impression should be conveyed by the quotation at the head of this chapter, which refers to persons other than those who actually carried out the onerous work of preparing the Paige specifications, and lest it be thought that others had found the work too much for them, the authors wrote to David H. Fletcher of Chicago, the patent attorney who prepared the final specifications; his reply is of such interest that it is printed here *in extenso*.

Chicago. *April 6th*, 1913.

"I am in receipt of your favour of March 25th, 1913, in which you make inquiry as to my connection with the Paige Type-setting and Justifying Machine. I have never seen Mr. Thompson's History, but can readily imagine what was meant by the 'disastrous end' to which you refer. Fortunately, as you suggest, I am 'still alive,' although the words: 'sufficient unto the day is the evil thereof,' haunt me occasionally.

"I acted as Mr. Paige's attorney and took out his three patents, although the first two applications were filed by another—their apparent complications possibly having had something to do with the 'disastrous end.'

"The first application, although embodying a number of essential principles, was of minor importance. The second, which included the typesetting and distributing features, was, however, very elaborate. The patent issued thereon is known in the Patent Office as 'The Whale.' This harmless leviathan, in its original proportions, greatly exceeded its present size. Its author evidently became lost in the wilderness of appalling details. With a view of severing the Gordian knot, he drew his specification like the sermon of an old-fashioned clergyman, with corresponding mystifying results. As a beginning, the machine was, regardless of construction, function or operation, divided into three 'Grand Divisions.' Each division was in turn, divided into sub-divisions, and these again divided until the 'Sixteenth sub-sub-Division' was reached.

"Paradoxical as it may seem, this clarifying treatment tended only to confuse the mind of the Patent Office Examiner who held that there was a multiplicity of inventions and division was accordingly required. An appeal was taken from the examiner's ruling. As an indication of the complications involved, it required thirty days for the Assistant Commissioner to read the specification in order to decide the question.

"It was at this stage that I was employed. The Office required a 'working model' which could not be furnished. A compromise was finally made by having the Examiner come to Chicago, where, for a month he studied the working machine. In the meantime, disregarding all previous work, I rewrote the entire specification, in which process I eliminated forty of the two hundred and six sheets of drawings originally deemed necessary to illustrate the anatomy of this wonderful creation. The revision was accepted without question.

"The justifying application filed by me, although not quite so voluminous in appearance, was in fact more complicated and subtle than the other. Every sheet of drawing was packed to the limit with detail; and, inasmuch as it was necessary to associate the operation of many detached mechanisms, some of which were in continuous operation while others were intermittent in varying degrees from minutes to months, the problem became somewhat involved.

"Eliminating the divisions and sub-divisions mentioned, the applications were accepted as embodying unitary inventions.

"You ask 'if this work produced no ill effects upon my mind.' Viewed from a purely human standpoint—yes; viewed from the standpoint that the universe is not a blunder and that man is here for some great purpose—no. This extraordinary creation was both a triumph and a tragedy. Notwithstanding all of the trying experiences and disappointments associated with it, it was in many ways uplifting, broadening, and inspiring. In judging of it as an invention, I have tried to dismiss prejudice and to measure its merits with those of the great inventors of the world, and, as an automatic device, considering the character of the varying problems solved by it, I am of the opinion that it is the greatest thing of the kind that has been accomplished in all of the ages. Commercial failure as it was, for reasons which need not be mentioned, it was an intellectual miracle and its relation to men, as indicating the creative power of mind, is a suggestive verification of the prophecy that 'they shall become as Gods.'

"If I have gone beyond the answer to your simple question, please treat it as 'off the record,' and disregard it. Trusting that I have not made myself tedious, and that I have shown no marked signs of that mental decay which would seem to be the natural corollary of the work in question, I remain, with best wishes for the success of your work.

"Yours sincerely,

"(*Signed*) D. H. FLETCHER."

CHAPTER XXIX.

MATRIX-COMPOSING, LINE-JUSTIFYING, AND TYPE OR SLUG CASTING MACHINES.

"Individual types may be said to be essential to economical production of this class of printing [high-grade book-work], and the machine of the future will unquestionably be one which casts, sets and justifies single types in one machine and witb but one attendant."

John S. Thompson. History of Composing Machines.

Bourgeois old-style (Miller & Richard).

INTRODUCTORY.

THIS class, whose various representatives are of course all hot machines, is, historically speaking, comparatively modern, though at the speed at which progress, more especially commercial progress, moves to-day, several of its members have already grown up into middle age. The family may be broadly divided into two main branches, whose typical representative in the one instance is the Lanston Monotype, and in the other the Mergenthaler Linotype. Their characteristics in the case of the first mentioned, are the division of the composition and the casting into two processes, generally carried out by separate human supervision and separate machines, as opposed to the linotype class in which they are generally carried on simultaneously or conjunctively by one machine and by a single human supervisor. A further characteristic, differentiating these two classes, is the fact that in the first case every letter is cast successively as the final result of a series of operations, while in the other either the slug, the commonest product of the second class of machine, or the line of individual type in its latest development, is cast at a single operation of pouring or casting. This classification and these definitions may not be scientific, but speaking broadly and from a general commercial standpoint, they are believed by the authors to be sufficiently accurate to serve even in a text-book devoted to the subject of typographical printing-surfaces.

The only exceptions, so far as known to the authors, to the foregoing classification—and was there ever a classification without its exceptions—are the Stringertype and the Grantype. The Stringertype, which is described later on in part I of this chapter, belongs strictly to the

PLATE XLVII.

PLATE XLVII.

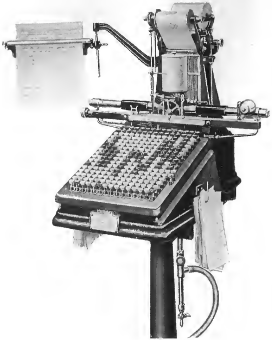


FIG. 361.—*Monotype composing and casting machine; "C" keyboard machine (now obsolete).*

FIG. 362.—*Monotype composing and casting machine; "D" keyboard machine.*

To face page 392.]

PLATE XLVIII.

[To face page 393.]

FIG. 363.—*Monotype composing and casting machine; "DD" keyboard machine.*

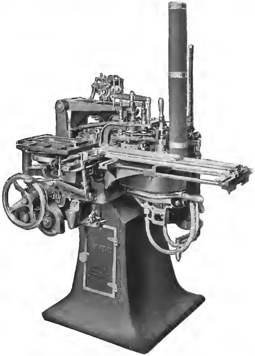


FIG. 364.—*Monotype composing and casting machine; typecaster.*

monotype class of machines, for though the matrices are assembled as the result of operations and mechanisms almost identical with those of the linotype class, brought into action by a single operator on a single machine, the fundamental or casting portion of the machine is carried out on the monotype principle of casting each individual character separately as the culmination of a series of separate operations necessary for the casting of that character.

The Grantype conforms to the broad general distinction governing the linotype class, the only difference being that the product is a line of justified loose type in the place of a slug bearing a justified line of characters in relief upon its upper surface, and it still retains the fundamental difference between the linotype and the monotype classes, namely, the casting of its whole line at a single operation of pouring, even though that line is composed of individual letters, spaces, and quads.

PART I.

MACHINES OF THE MONOTYPE CLASS; CASTING THEIR TYPE SUCCESSIVELY TO FORM THEIR COMPLETED LINE.

Видите ли, что человѣкъ оправдывается дѣлами, а не вѣрою только?

JAMES ii. 24.
Russian, corps 12 (*Monotype*).

The Monotype composing and casting machines.—These machines consist of two separate and quite distinct parts; firstly, the composing and line-justifying machine, figs. 361 to 363, plates XLVII and XLVIII, frequently called the keyboard; and secondly, the casting and setting machine, shown in fig. 364, plate XLVIII.

The keyboard of the composing machine, as already shown, figs. 274 to 276, pp. 292–3, is very much like that of a typewriter, but with a larger number of keys. The inverted comma and apostrophe are repeated in two set widths, to suit individual tastes, as some printers prefer more white.

A ribbon of paper is fed through the machine, guided, as in the Wheatstone telegraph perforated strip, by side perforations. The perforated ribbon was proposed at least as early as 1848, and was actually adopted by Mackie, of Warrington, in 1868, for his composing machine. The latter used fourteen rows of holes in combinations of two at a time, the available combinations being $(14 \times 13)/2 = 91$.

In the original A, B, and C patterns of Monotype keyboard the arrangement, fig. 274, p. 292, corresponds to the arrangement of the matrices in the grid, fig. 371, p. 400; the two top rows of (red) keys, fig. 274, bearing numbers, fulfil the function of line-justifying described later. The right-hand vertical row of keys and the bottom horizontal row of keys each effect one perforation only in the ribbon. The other keys each effect two perforations. Each key when depressed about a quarter of an inch admits compressed air to the required combination of thirty-one plungers, equally spaced, which perforate the ribbon; fourteen of these perforations produce variation of the position of the matrix-grid in x and fourteen in y, so that a total of 225 characters, spaces, and quads can be produced (the case of $x = 0$ and that

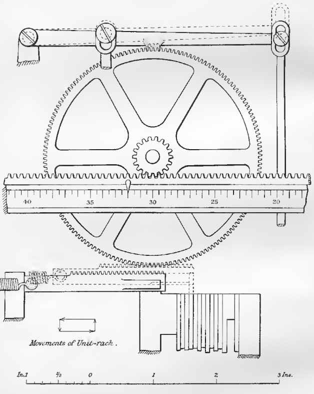


FIG. 365.—*Monotype composing and casting machine; keyboard unit-counting mechanism.*

of $y = 0$, being provided for by the keys which give one perforation only). For the functions of the three remaining positions of the perforations, see fig. 370, p. 399, references A, B and C.

Above the keyboard proper is a pointer which rises step by step for each depression of the space-key, and a drum, somewhat like the cylinder of a Fuller's slide-rule, on which are figures giving the resulting spacing required for the line. This drum can be rotated up to a movable stop by depressing the upper of the two (green) keys on the extreme right of the B or C keyboards. The justifying-scale key is depressed when ready to justify, and causes the line-justifying scale to rotate until it stops with the correct number at the end of the pointer. The bell rings five ems before the completion of the line; this is sufficient to ensure the acceptance or rejection of the longest indivisible word. The mechanism driving the drum stop, fig. 365, aggregates the total set of the letters on a scale like that of a typewriter, and enables the operator to see whether he will proceed with the space and the next word, or will divide the word, or complete the line at the

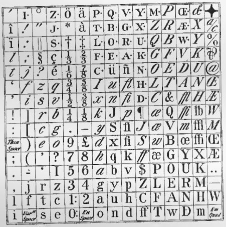


FIG. 366.—*Monotype matrices arranged as are the keys of pattern C keyboard.* To enable the small capitals to be distinguished they are followed in the diagram by a dot. For a similar reason the figures 1 and 0 are each followed by two dots. The actual lay-out is as shown in figs. 368 and 371.

end of the word. Having completed the setting of the line, he depresses the upper (green) key, fig. 274, p. 292, and then refers to the reading shown on the drum, which is of the form $\frac{2}{7}$. This reading gives the two (red) keys to be depressed in the top row and second row respectively; the reading corresponds to the settings of two differential wedges on the casting machine which divide the surplus space, left on completing the line, amongst the whole of the spaces in the line.

To enable different faces and different bodies to be cast from the same arrangement of matrix-grid two difficulties had to be overcome in the A, B and C keyboards:—

1. The difference in set widths which exists in certain sorts between old-style, modern or other faces.

2. The increased or decreased set width which the sorts occupy as the body-sizes are varied, or when an extended or condensed face is required to be cast.

The first difficulty is overcome by designing the old-style face of modernized form so that the lower-case **r**, **s**, are wider, the **h**, **k**, **n**, **u**, etc., narrower, the **a** and the **o** much narrower, while the **e** remains unaffected. The resulting face is very legible, though many of the distinctive features of old-style are almost absent. It was, however, possible by altering the lay-out or arrangement of matrices, in the A, B or C pattern keyboards, and by marking certain keys for a character different from that originally shown on them, to cast an old-style face having the full peculiarities of old-style. The growing requirements of the printer engaged in jobbing work such as

The small figures below the columns show the set-values in eighteenths of an em for the type in each column. The em here referred to is the set width of the widest sorts.

′	I	°	Z	Ö	ä	P	Q	V	Y	M	*P*	Œ	*&*	✦
î	*/*	″	J	*	à	T	B	G	X	*Z*	*R*	Æ	*X*	a/c
ï	:	‖	S	†	‡	L	O	R	U	*Q*	*B*	W	*Y*	%
l	;	§	ç	⅓	⅔	F	E	A	K	*G*	*F*	*V*	*K*	℔
t	*j*	*?*	é	⅙	⅞	C	ü	ñ	N	*O*	*E*	*D*	*U*	@
‘	*f*	*z*	*q*	¾	⅝	*I*	*u*	*fl*	H	*L*	*T*	*A*	*N*	*Œ*
’	*i*	*s*	*v*	½	⅜	*x*	*n*	*fi*	D	*C*	&	*ffl*	*H*	*Æ*
!	]	*r*	*b*	¼	⅛	*k*	J	*p*	¶	*œ*	Q	*ffi*	℔	*W*
:	[	*c*	*g*	.	-	*y*	S	fl	*J*	*æ*	V	*m*	ffl	*M*
	)	*e*	*o*	9	£	*d*	x	fi	*S*	*w*	B	œ	ffi	Œ
;	(	’	?	7	8	*h*	q	k	*ff*	æ	G	Y	X	Æ
.	-	‘	I	5	6	*a*	b	v	$	P	O	U	K	..
,	j	r	z	3	4	g	y	p	Z	L	E	R	M	—
l	f	t	c	1	2	a	u	h	C	F	A	N	H	W
i		s	e	0		o	n	d	ff	T	w	D	m	
5	6	7	8	9			10		11	12	13	14	15	18

FIG. 367.—*Monotype composing and casting machine; standard lay-out as cast in long primer modern.*

railway time-tables, trade circulars and even dictionaries, have rendered necessary the simultaneous use of different founts, such as clarendon, sans serif and old-style. This could only be effected on the A, B or C models of keyboard by marking the keys to correspond to the altered characters, with the disadvantage that the alteration of character involved an alteration also in the fingering. Pattern C keyboard is shown in fig. 361, plate XLVII.

In the new D keyboard machine, and also in the DD keyboard machine, different lay-outs can be obtained with practically the same keyboard arrangements, figs. 275 and 276, p. 293, modelled, moreover, on that of the typewriter as was previously done in the case of the Monoline machine. The lay-out of the D and DD Monotype matrix-grids for book or news founts is shown in fig. 368, and that for jobbing founts in fig. 369.

The method by which the alteration of the keyboard can be effected, while the gear operating the perforating and counting device remains

normal, consists in the in

EN

FIG. 368.—*Monotyp*

FIG. 369.—*Monotype*

bank and the operating

normal, consists in the insertion of a key-bar frame between the button-

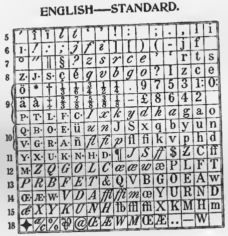


FIG. 368.—*Monotype composing and casting machine; book or news lay-out of matrices*

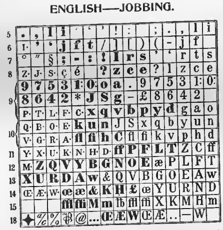


FIG. 369.—*Monotype composing and casting machine; jobbing lay-out of matrices.*

bank and the operating rods which run transversely to the keyboard.

The key-bars, of which there is one for each key, run at right angles to the operating rods; each key-bar carries on its upper edge a single projection which engages with the corresponding button bell-crank, and two projections, or in some cases one only, on its lower edge to engage with the operating rods of the perforating and counting mechanism.

The second difficulty is overcome by increasing the whole of the set widths proportionately; the quads are thus no longer square or half-square, though the em is double the en. A different drum is used on the keyboard corresponding to the number of points in the set width of the special em quad, and a wedge corresponding to this drum is used for determining the width of the characters in the typecaster.

The actual perforation of the ribbon is effected by means of compressed air from the same supply used for controlling the casting machine.

The lower of the two additional (green) keys to the extreme right of the keyboard, fig. 274, p. 292, serves for returning the counting gear to zero, ready for commencing a new line.

The appearance of the perforated ribbon is shown in fig. 370. The ribbon is rolled on a spool as it is perforated, and on completion is removed from the composing machine. The completed ribbon can now be fed into the typecasting machine, and is in proper order for this, as it travels in the direction opposite to that in which it was perforated, for the casting machine begins work at the end of the matter, and works back to the beginning. The last operation in composing was the depression of the two line-justifying keys in the two upper rows, fig. 274, p. 292; the perforations corresponding to these key depressions are now the first to come into operation, and provide for the adjustment of the space-wedges which retain their setting till the casting of the line is completed.

The perforated ribbon passes over the air-tower of the caster between a long port and a drilled surface which communicates by pipes with the cylinders of thirty-one plungers; these correspond to the thirty-one rows of holes which can be punched in the ribbon. The holes in the ribbon act like ports in a valve, and admit air only to those cylinders the plungers of which are to be actuated. In the first instance the space-adjusting wedges for controlling the opening of the mould are set, and this setting remains constant till the line is completed and a new setting is given. Then for each character a third wedge comes into operation, determining the set width to be given to the mould for that character. The position of this wedge is dependent on the position of the matrix-grid in the direction of the set width relatively to the mould. The matrices in the earlier machines, fig. 177, p. 221, are secured in the grid, fig. 371, by wires passing through the cross holes. They are arranged in fifteen rows of fifteen each, all the characters of a row, body-wise, being of the same set width. The matrix-grid is controlled by a cam and lever movement through the intervention of buffer-springs, so that it tends to be driven the maximum distance in both directions, that is to travel to the origin in both x and y, and it actually travels the full distance in both, to the fixed stops, when there is no perforation in the ribbon (em quad). The movement in other positions is checked by fourteen plungers, for each direction, which rise vertically and stop the travel of the

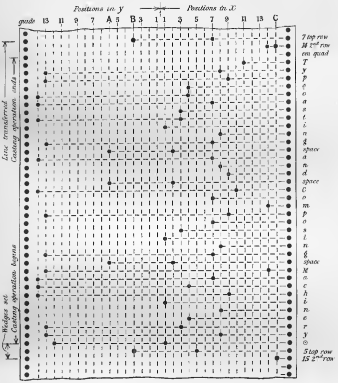


FIG. 370.—*Monotype composing and casting machine; perforated ribbon for typecaster.*

Scale: about full size.

A Space transfer. **B** Coarse wedge. **C** Fine wedge.

When **C** and **B** are operated the line is transferred to the galley. The caster can be so set that consecutive strikes of **C** and **B** do not transfer the line, enabling double or multiple justification to be performed for tabular work. The final justification is effected by striking the required key of the top row, and then striking key No. 1 of the top row simultaneously with the required key of the second row.

grid horizontally. The plungers are operated by compressed air at a pressure of about 12 to 15 pounds per square inch.

The plungers also perform another function: the two justifying keys of the two upper rows on the keyboard, which are last depressed in composing the line, operate the plungers in x and y respectively; the one controls the distance moved by the coarse space-wedge and the other by the fine space-

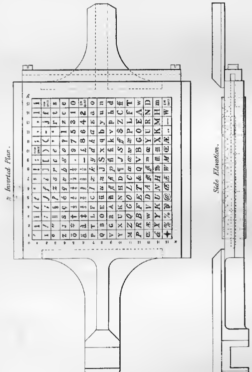


FIG. 371.—*Monotype composing and casting machine; matrix-grid. Pattern C; lay-out of matrices.* Scale: about half full size.

wedge, the taper of which is one-fifteenth of the taper of the coarse wedge. Once set, these wedges retain their position for the whole of the line; hence all these spaces are equal in set width. The whole travel of the fine wedge may correspond to only 0·0075 inch in the mould, the minimum difference of width for each space being 0·0005 inch. The maximum error of line-justification in a line containing ten spaces will then be 0·005 inch, and in small pica body it will be nearly double the minimum error obtainable by hand-justification, but probably nearly equal to the error actually obtained in practice. The coarse wedge will move 0·0075 inch for each step, and the total range will be represented by $14 \times 0{\cdot}0075$ inch $+ 14 \times 0{\cdot}0005$ inch $= 0{\cdot}1120$ inch. In the case of small pica or 11-point the space already represents 4 units (each of about 0·0085 inch) or 0·0338 inch. The limits of width between which the space can be varied are therefore from 0·0338 inch to 0·1458 inch, or from rather less than the middle space up to nearly the em quad.

In the event of a line being cast of wrong length, the machine stops automatically. Multiple-justification for tabular work can now be obtained in the Monotype.

The machine presents some very special features. The ribbon, if rolled up, can be used again an indefinite number of times. The ribbons moreover represent a much smaller amount of locked-up capital than is the case when type or stereotypes are stored.

A different drum must be used on the keyboard machine, however, and a different ribbon produced if the matter is required to be printed in a style which necessitates variation in the measure of width of column, in the space-wedge settings or in the lay-out. These requirements are met by the DD keyboard, fig. 363, plate XLVIII, which enables two ribbons to be produced simultaneously, so that an *édition de luxe* and a popular edition of a work may be produced by the same compositor, at one cost of composition, with pages of different size and of varying type faces.

When the keyboard is being used for two editions and a word occurs which would require to be divided on one of the drums only, the other drum can be temporarily disconnected by a lock on the drum. The perforation for the hyphen accordingly appears on the drum in question.

A switch placed between the two drums is used to cut out either drum for breaking the line; the use of this switch permits of the line-justifying perforations being made in one ribbon only; this device is also used for the line-justification of matter of greater width than the galley of the casting machine. The operation of hrowing the switch over to the one side or to the other sets the line-justification drum to give the requisite key-readings for the line-justification perforations.

This double tower keyboard can also be used for the composition of matter of double the ordinary width which the casting machine is capable of turning out; this is effected by composing alternate lines on each tower and combining the two galleys side by side when they have been cast.

The speed of the Monotype caster should not be greater than 170 type per minute on the smallest body-size, and in ordinary work 150 type per minute are obtained.

The power required to run the keyboard and the casting machine is about 0·5 horse-power.

The Monotype machine is also capable of being used as a typecasting machine or sorts-caster. When it is so used the die-case adjusting mechanism, and the assembling and galley mechanisms are not required, consequently their action is suspended by locking the paper-feeding mechanism and locking the normal wedge to correspond to the set size of the type required.

A special grid, fig. 372, can be used for holding a single matrix in sorts-casting, while the standard matrices, moulds, die-cases, and galley

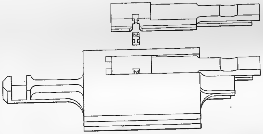


FIG. 372.—*Monotype casting machine; matrix-holder for sorts-casting up to 14-point.*

equipment can be used for sizes ranging from 5-point to 14-point. The matrix-holder or die-case resembles the ordinary die-case in outer form, but is provided with a seating and a sliding clamping piece. The sliding piece is first withdrawn from the holder, the matrix is then put into place, and the slide is pushed home, securing the matrix as shown in fig. 372.

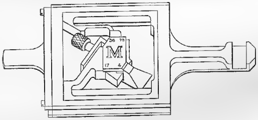
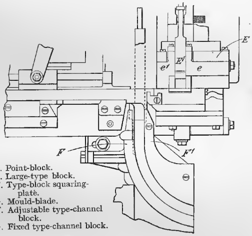


FIG. 373.—*Monotype casting machine; large-work matrix-holder for sorts-casting.*

The range of the Monotype machine as a sorts-caster has been increased to enable it to cast up to 36-point, while in America it has even been used for casting as large as 48-point. When used for above 14-point a special form of matrix is used, fig. 178, p. 221, which consists of a rectangular piece of metal having two bevelled or chamfered corners and the character impression sunk into one of the flat faces. This matrix is held in a special holder or die-case, fig. 373, which is provided with a seating having two stationary gauging-faces, against which the top and bottom edges of the matrix abut; it is also fitted with two adjustable clamping-jaws which bear against the bevelled corners of the matrix and are simultaneously adjusted by a knurled screw to bring the matrix to its proper position and to secure it. The large work matrices are not provided with a cavity for the centring-pin, but the matrix-holder has a bushing into which the centring-pin enters.

Special moulds are used for casting from 14-point up to 36-point, two adjustable moulds being used for these sizes, the one ranging from 14-point to 20-point inclusive, and the other from 24-point to 36-point inclusive. Several blades for the different sizes are used in the same mould with



e. Point-block.
e^1. Large-type block.
E. Type-block squaring-plate.
E^1. Mould-blade.
F. Adjustable type-channel block.
F^1. Fixed type-channel block.

FIG. 374.—*Monotype casting machine; large-work mould-delivery and raceway.*

corresponding point-blocks and mould-blade stops; the side blocks of the mould are made adjustable to accommodate the proper blade for the body-size to be cast. As in the case of the ordinary mould, the slide-block is reciprocated by the type-carrier from which latter the type is ejected by the mould-blade.

A few changes of details are necessary to accommodate the machine to the altered conditions. The pump-well is changed and a new piston and nozzle are fitted, while the strength of the centring-pin spring is altered. The special normal wedges for casting sorts are set by hand from holes for the wedge positions, instead of being set automatically as is the case when the machine is casting automatically from the perforated ribbon. The type-channel blocks used for casting and composing are removed, and the special adjustable blocks shown in fig. 374 are used instead. These blocks, as is shown in the figure, are curved round so that the type, instead of being assembled in the channel, are delivered directly to the galley. The speed at which the casting machine can be run for casting large type depends upon the length of time required to chill the metal before the type is ejected from the mould, and a special speed-reducing gear is provided which effects this reduction. The gear is fitted with three controlling levers by means of which nineteen different speeds can be obtained.

The Tachytype, invented by F. A. Johnson of America, is a very similar machine. The perforated strip is narrow, being about 2 inches wide; the line-justification is effected automatically by the machine; at the same time that the holes are perforated the character represented is typed on the strip so that the operator or any other person can read the record. The English rights in this machine have been acquired by the Linotype Company; the machine has not been worked commercially in this country.

The Graphotype, figs. 375 and 376, plate XLIX, invented by George A. Goodson of America in 1893, had a keyboard similar to that of the typewriter and comprised 100 keys; these operated a typewriter which gave a

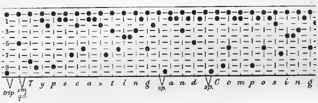


FIG. 377.—*Graphotype composing and casting machine; perforated ribbon.*

written record of the work of composition as it proceeded, and, in addition, made certain electric contacts by means of pins which dipped into wells of mercury, closing electrical circuits by which any one or any pair selected by the key from two sets of ten perforating punches could be operated by electro-magnets. The perforated strip was narrow and had guide perforations on one side only, fig. 377; the perforations corresponding to any character, or space, occupied two consecutive transverse units of its length. The typewriter had, connected to it, a dial scale to show the amount of line to be made up by increasing or decreasing the spaces. The face of type used was of the self-spacing kind, having six units to the em quad. Five different set widths were used comprising two to six units. Corrections, should any be required, could therefore be made very easily by hand.

The line-justification was effected by pairs of perforations similar to those used for the characters; a single hole at the left of the ribbon (as composed) and in the upper of the two possible positions formed the space, while another single perforated hole, in the lower position, formed the trip for the end of the line As in the other ribbon machines described, the ribbon had to be

PLATE XLIX.

FIG. 375.—*Graphotype composing and casting machine (Goodson); keyboard machine.*

To face page 404.]

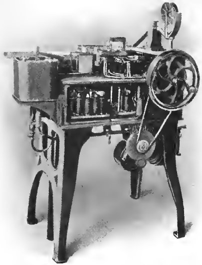


FIG. 376.—*Graphotype composing and casting machine (Goodson); typecaster.*

put into the machine in re
the spaces was controlled b

The matrices were all c
produced by electro-deposit
set up in type and accura
correctly placed both for b
of the type from it, was fi
holes for setting the respecti
were light. The stop-mecha
the Monotype, but the perfo
connexions to be made whic
operated the stops. The
matrices, but some of thes
2-unit, two rows 3-unit, th

sp.	Q	P
W	R	O
ffi	T	N
—	U	L
M	V	G
em qd.	Y	F
H	&	E
ffl	X	D
w	Z	B
m	C	A
Units 6	5	5

FIG. 378.—*Graphotype cast*

6-unit. The arrangement o
The matrix-block being in o
very close together. This
the matrix-block.

The adjustment of the r
occupied by the grid. Th
or occasionally, in the case
was water-cooled, and spe
taken to keep the tempe
distance (about 15 inches)
it to the nozzle was heate
this arrangement was foun
the metal temperature to l
while the removal of the
of the mould and adjacen

put into the machine in reverse order. The increase or decrease in set of the spaces was controlled by an electrically-operated escapement.

The matrices were all combined in a square matrix-block which was produced by electro-deposition. The counterpart of the matrix-block was set up in type and accurately justified, so that all the characters were correctly placed both for body and set. The matrix-block, after removal of the type from it, was finished and secured to a steel back with conical holes for setting the respective matrices into true position; the moving parts were light. The stop-mechanism for the grid was somewhat similar to that of the Monotype, but the perforations in this instance enabled certain electrical connexions to be made which brought electro-magnets into play, and these operated the stops. The matrix-grid comprised ten rows each of ten matrices, but some of these were used for quads. There were: one row 2-unit, two rows 3-unit, three rows 4-unit, two rows 5-unit, and two rows

	sp.	Q	P	(	[	o	qd.	$\frac{7}{8}$	qd.	q
	W	R	O	)	I	9	‘	$\frac{1}{8}$	S	p
	ffi	T	N	]	?	8	’	$\frac{1}{2}$	J	k
	—	U	L	£	!	7	l	$\frac{1}{4}$	u	ff
	M	V	G	*	:	6	f	$\frac{3}{4}$	g	o
	em qd.	Y	F	en qd.	;	5	j	$\frac{1}{3}$	fl	d
	H	&	E	.	z	4	i	$\frac{2}{3}$	fi	b
	ffl	X	D	$	t	3	-	$\frac{5}{8}$	x	n
	w	Z	B	s	c	2	.	$\frac{3}{8}$	v	h
	m	C	A	e	r	1		K	y	a
Units	6	5	5	3	3	4	2	6	4	4

FIG. 378.—*Graphotype casting and composing machine; lay-out of matrix-block.*

6-unit. The arrangement of matrices in the block was as shown in fig. 378. The matrix-block being in one solid piece enabled the characters to be placed very close together. This saved weight, as well as distance of travel of the matrix-block.

The adjustment of the mould for set width was dependent on the position occupied by the grid. The set width could be one of those enumerated, or occasionally, in the case of spaces, the single unit width. The mould was water-cooled, and special precautions, peculiar to this machine, were taken to keep the temperature down. The pump was placed at some distance (about 15 inches) from the mould, and the metal-tube connecting it to the nozzle was heated by means of a low-tension electric current; this arrangement was found to work very well in practice, as it enabled the metal temperature to be kept very accurately within the desired limits, while the removal of the metal-pot to a distance permitted adjustments of the mould and adjacent parts to be made with ease and comfort. A peculiarity of type cast on this machine was that it was hollow, owing to the suction applied to the mould immediately after the cast was made, with the result that a hard shell instead of a solid type was left in it.

The above brief description relates to the small machine, constructed under Percy W. Davis's supervision in England. As originally made it ran at 140 revolutions per minute, and was capable of casting up to 12-point. By modifying the shape of the cams it was enabled to cast type at the rate of 170 per minute, which it effected with but little noise and without evidence of undue wear.

In the meantime, work had been steadily proceeding on the Graphotype in America, and an improved machine was evolved in which the matrix-plate comprises 225 characters and spaces. This new model is due mainly

<table>
<tr><td>œ</td><td>Q</td><td>W</td><td>E</td><td>R</td><td>T</td><td>Y</td><td>U</td><td>I</td><td>O</td><td></td><td>|</td><td>⅞</td><td>⅓</td><td>J S.</td></tr>
<tr><td>&</td><td>A</td><td>S</td><td>D</td><td>F</td><td>G</td><td>H</td><td>J</td><td>K</td><td>L</td><td>‡</td><td>||</td><td>⅜</td><td>⅝</td><td></td></tr>
<tr><td>æ</td><td>Z</td><td>X</td><td>C</td><td>V</td><td>B</td><td>N</td><td>M</td><td>P</td><td>*</td><td>†</td><td>¼</td><td>½</td><td>¾</td><td>⅛</td></tr>
<tr><td></td><td>Q</td><td>W</td><td>E</td><td>R</td><td>T</td><td>Y</td><td>U</td><td>I</td><td>O</td><td>fl</td><td>ffl</td><td>?</td><td>[</td><td>]</td></tr>
<tr><td>&</td><td>A</td><td>S</td><td>D</td><td>F</td><td>G</td><td>H</td><td>J</td><td>K</td><td>L</td><td>ff</td><td>ffi</td><td>!</td><td>'</td><td>°</td></tr>
<tr><td>£</td><td>Z</td><td>X</td><td>C</td><td>V</td><td>B</td><td>N</td><td>M</td><td>P</td><td>6'</td><td>fi</td><td>:</td><td>;</td><td></td><td>¢</td></tr>
<tr><td>¶</td><td>q</td><td>w</td><td>e</td><td>r</td><td>t</td><td>y</td><td>u</td><td>i</td><td>o</td><td>'</td><td>7</td><td>8</td><td>9</td><td>0</td></tr>
<tr><td></td><td>a</td><td>s</td><td>d</td><td>f</td><td>g</td><td>h</td><td>j</td><td>k</td><td>l</td><td>-</td><td>4</td><td>5</td><td>6</td><td>$</td></tr>
<tr><td>@</td><td>z</td><td>x</td><td>c</td><td>v</td><td>b</td><td>n</td><td>m</td><td>p</td><td>,</td><td>.</td><td>1</td><td>2</td><td>3</td><td>/</td></tr>
<tr><td>7d</td><td>Q</td><td>W</td><td>E</td><td>R</td><td>T</td><td>Y</td><td>U</td><td>I</td><td>O</td><td>fl</td><td>ffl</td><td>?</td><td>(</td><td>)</td></tr>
<tr><td>&</td><td>A</td><td>S</td><td>D</td><td>F</td><td>G</td><td>H</td><td>J</td><td>K</td><td>L</td><td>ff</td><td>ffi</td><td>!</td><td>8d</td><td>..</td></tr>
<tr><td></td><td>Z</td><td>X</td><td>C</td><td>V</td><td>B</td><td>N</td><td>M</td><td>P</td><td>5'</td><td>fi</td><td>:</td><td>;</td><td>–</td><td>—</td></tr>
<tr><td>6s</td><td>q</td><td>w</td><td>e</td><td>r</td><td>t</td><td>y</td><td>u</td><td>i</td><td>o</td><td>'</td><td>7</td><td>8</td><td>9</td><td>0</td></tr>
<tr><td>5s</td><td>a</td><td>s</td><td>d</td><td>f</td><td>g</td><td>h</td><td>j</td><td>k</td><td>l</td><td>-</td><td>4</td><td>5</td><td>6</td><td>$</td></tr>
<tr><td>16s</td><td>z</td><td>x</td><td>c</td><td>v</td><td>b</td><td>n</td><td>m</td><td>p</td><td>,</td><td>.</td><td>1</td><td>2</td><td>3</td><td>8s</td></tr>
</table>

FIG. 379.—*Graphotype, improved; lay-out of keyboard.*

to the inventive effort and mechanical skill of W. Nicholas and W. Ackermann.

In the first place, the keyboard and its electric connexions were modified so that the typewriter lay-out, repeated for each fount, capitals and lower-case, both roman and italic, could be adopted. A machine with this keyboard lay-out was exhibited in Madison Square Garden in May 1907, and the claim is advanced that the adoption of this principle by the Graphotype was made prior to its adoption by the Monotype. The range of set widths available was increased by dividing into sixteen equal parts the body, or the maximum set width selected for the quad, as in the Monotype. The set widths range from 4-unit to 16-unit inclusive, there being three rows 8-unit (en quad), and two rows 10-unit. This arrangement may, however, be modified or changed according to the width of the alphabet to be adapted.

The lay-out of the keyboard is shown in fig. 379, and that of the matrix-plate in fig. 380. The method of preparing the matrix-plate has been greatly improved, and the use of the micrometer microscope has been adopted to ensure the correct relative positioning of the matrices in the plate with reference to the drilled centring-holes on its upper surfaces. This is effected by making a trial cast of each character from a matrix grown from foundry type with the centring-pin in the centring-hole placed in its

12	14	8	8	5	7	6	8	9	10	10	11	13	15	16	INDIVIDUAL
√	Q	8	9	’	/	′	$	ﬂ	q	x	¶	K	X	⅓	15
÷	V	J	7	i	‖	|	‡	ﬁ	v	b	¢	F	Y	⅝	14
–	O	?	3	l	!	f	4	u	d	p	ﬀ	L	ﬃ	⅜	13
P	A	z	2	.	I	;	0	o	h	n	+	R	N	¾	12
Z	D	g	5	,	s	:	a	q	y	ﬂ	×	T	U	W	11
B	w	c	1	j	r	·	e	g	ﬀ	ﬁ	=	E	&	M	10
C	m	5	1	-	I	t	e	b	h	k	S	C	G	H	9
w	m	2	0	▌	s	▌	▌	d	n	u	k	E	ﬄ	■	8
L	N	4	3	i	r	t	a	o	p	U	Z	A	M	—	7
B	R	7	6	,	?	f	c	y	Q	D	P	T	H	W	6
F	G	9	8	l	!	;	z	v	O	V	S	O	ﬃ	..	5
æ	U	-	J		°	:	$	x	T	G	&	D	ﬄ	½	4
£	K	*	6	;	]	‘	.	R	F	L	X	Y	&	¼	3
M	X	†	(	‘	[	I	Z	C	Y	K	N	V	œ	⅛	2
	W	P	)	’	.	J	S	B	E	A	H	Q	@	⅞	1
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	

ROW

FIG. 380.—*Graphotype, improved; lay-out of matrix-plate.*

normal position for each character. The error obtained in the cast is measured, and the centring-pin moved micrometrically to correct for this error, and a new cast is then taken.

The corrected casts, or slugs as they may be termed since the faces are cast on a stem having its sides, both in body and in set, equal to the pitch of the centring-holes, are then built up into a block and a complete matrix-plate is grown from them.

A further improvement introduced is to make the unit for justification also equal to one-sixteenth of the full set, or body measurement, and to provide for the distribution of from one to sixty-four of these units, by which the line may be short when measured, over the spaces in such manner that no one justifying space shall differ by more than one unit from any other in the line. That is to say, the method adopted is to cast spaces each a multiple of the unit, but not necessarily equal to each other; it is furthermore arranged that where inequality occurs the wider spaces are cast first in one line and last in the next line, so as to keep the appearance of the justification more uniform. The perforated ribbon has guide-holes at one side only, as in the Goodson machine, and two sets of perforations, each in one of the fifteen positions available, are used for the production of each character; two sizes of hole are used, a large one for determining the row, and a small one for defining the individual character in the row selected. The fifteenth or last perforation of one set is devoted to the trip, and of the other is devoted to the spaces; these holes also are large and small respectively.

In this form of the Graphotype the composing mechanism or keyboard perforates the paper strip which is then rolled up and is worked backwards in the casting machine in the same manner as in the Monotype. The perforating and selecting devices as well as the other mechanical movements of the Graphotype keyboard and casting machines are electrically operated; the current for operating can be obtained from any ordinary continuous-current electric lighting or power supply.

A new model of the Graphotype machine has been produced which is a one-man machine, for the whole work of composing and casting is performed on it; this machine contains several novel and original features, and is illustrated in figs. 381 to 384, plates L to LIII. The principal difficulty present in this class of machine is that of line-justification, for it is essential that the whole line should be composed and measured, and that the width of the spaces to be cast in the line should be determined, before the first space is cast. In this case a totally different form of control is adopted, consisting of a number of controller-elements, each of which can be set to represent any character or space, or to effect the change from character to space-width setting for line-justification, the change back again to character being made automatically.

To understand this it is necessary to refer to the drawing, fig. 385, of the controller-element and the escapement which frees it. The element consists of a parallel spindle carrying two fixed end-rollers and three intermediate rollers capable of longitudinal adjustment and of remaining held frictionally in any position to which they may be set by the selecting mechanism of the keyboard. The central adjustable roller is for purposes of line-justification only, and, when so used, may be shifted from its central position; the other two adjustable rollers are set to position by the selecting device controlled from the keyboard, and they fulfil the same functions as are performed by the agency of the double perforations in the casting machines, using the perforated paper strip. The controller-elements are stored in a magazine, one being released by an electro-magnet operated

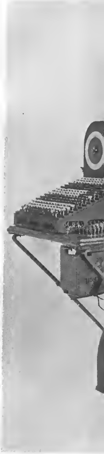


FIG. 381.—*Graphotype* (nev

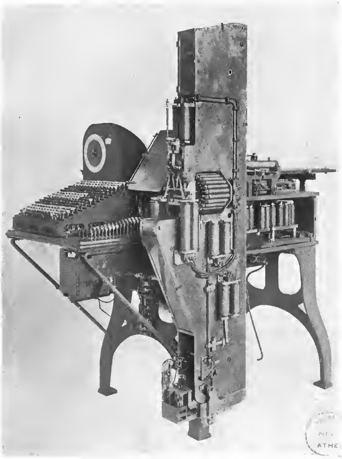


FIG. 381.—*Graphotype (new model) composing and casting machine ; view of right-hand side from the front.*

[*To face page* 408.

PLATE LI

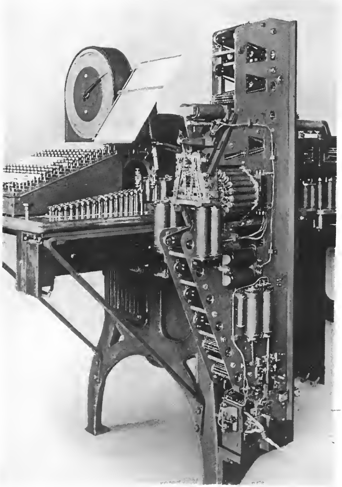


FIG. 382.—*Graphotype (new model) composing and casting machine; enlarged view of right-hand side showing controller magazines and controller-elements.*

To face plate LII.]

PLATE LII.

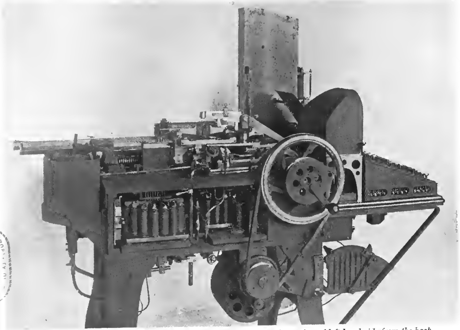


FIG. 383.—*Graphotype (new model) composing and casting machine; view of left-hand side from the back.*

To face plate LI.]

PLATE LIII.

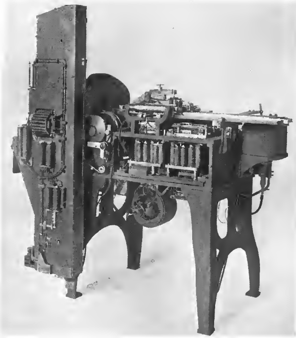


Fig. 384.—*Graphotype (new model) composing and casting machine; view of right-hand side from the back.*

To face page 409.]

when each key is depresse
gear to correspond to the
able rollers for row and i
Subsequently these roller
in the rows, in x and y
the required character
blade or body-slide to g
the character to be cast.

After the controller-el
space controller is fed to
of the measure or line a t
and a justification contro
of the controller-elemen
in their respective maga

Fig. 385.—*Graphoty*

through the index-head
in fig. 386. The trip
or line causes the justifi
setting portion of the
the spaces for the lines
the spaces are cast each
of the rollers on the ju
this measure or line th
cation controller-elemen
play.

It is therefore possib
casting portion of the m
of characters and spac
structured in the form of
justification mechanism

when each key is depressed, and they are adjusted by an electrically-operated gear to correspond to the character selected by setting the two outer adjustable rollers for row and individual position of the matrix-plate respectively. Snbsequently these rollers make the contacts which control the position in the rows, in x and y respectively, of the matrix-plate so as to bring the required character over the mould-opening, and to set the mould-blade or body-slide to give the proper number of units of set width to the character to be cast.

After the controller-elements for the characters of a word are assembled, a space controller is fed to the receiving magazine and following the completion of the measure or line a trip controller is delivered to the receiving magazine and a justification controller to a supplementary magazine. The arrangement of the controller-elements and that of the justification controller-elements in their respective magazines, together with tbe order in which they are fed

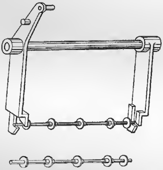


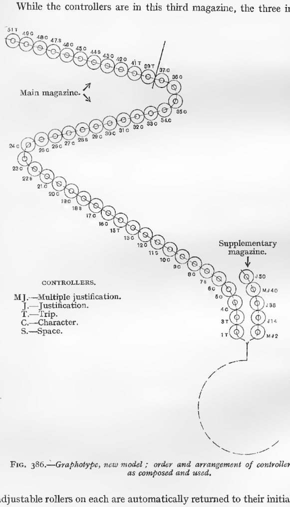
FIG. 385.—*Graphotype, new model; controller escapement and adjustable controller-element.*

throngh the index-head and dealt with in the casting machine, are shown in fig. 386. The trip controller from the end of the preceding measure or line causes the justification roller to be the next to be received by the setting portion of the casting machine, and thus sets the justification of the spaces for the lines to be cast. As the casting of the line proceeds, the spaces are cast each to the proper width determined by the position of the rollers on the justification controller-element, and at the close of this measnre or line the trip controller which follows causes the justification controller-element for the next measure or line to be brought into play.

It is therefore possible for the operator to work several lines ahead of the casting portion of the machine: the controller-elements set for the selection of characters and spaces being stored ready for use in one magazine constructed in the form of a zigzag raceway, and those set for the setting of justification mechanisms being stored in a similar supplementary magazine.

A third magazine receives all the controller-elements after they have successively served to control the operations of the casting portion of the machine.

While the controllers are in this third magazine, the three intermediate



CONTROLLERS.

MJ.—Multiple justification.
J.—Justification.
T.—Trip.
C.—Character.
S.—Space.

Order.

Composed.	Used.
51.T	51
50.J	49
49.C	48
48.C	47
47.S	46
46.C	45
45.C	44
44.S	43
43.C	42
42.C	50
41.T	41
40.MJ	40
39.T	39
38.J	37
37.C	36
36.C	35
35.C	34
34.C	33
33.C	32
32.C	31
31.C	30
30.C	29
29.C	28
28.S	27
27.C	26
26.C	25
25.C	24
24.C	23
23.C	22
22.S	21
21.C	20
20.C	19
19.C	18
18.S	17
17.C	16
16.C	38
15.T	15
14.J	13
13.C	12
12.C	11
11.S	10
10.C	9
9.C	8
8.C	7
7.S	6
6.C	5
5.C	4
4.C	14
3.T	3
2.MJ	2
1.T	1

FIG. 386.—*Graphotype, new model; order and arrangement of controller-elements as composed and used.*

adjustable rollers on each are automatically returned to their initial position: thus each controller-element is restored to its original setting ready for use in another cycle of the whole series of operations.

The system adopted for composing and justifying a line of type is as follows :—

The first action of the operator is to set a trip controller, which is deposited in the main receiving channel or magazine. Next, controllers for each character of the first word of the line are successively set. Then a controller for the first word-space of the line is set. The setting of a word-space controller gives no indication of the size of that particular word-space. Every word-space controller when set is exactly like every other word-space controller, that is it simply denotes that at that place in the line there shall be a word-space ; it gives no indication of what size any word-space shall be. The sizes of word-spaces are attended to when the end of the line is reached. After the first word-space controller is set, controllers for the successive characters and word-spaces of the line are set in their order. When the units-register indicates that no further whole syllable can be included in the line, the operator sets a line-justification controller, the function of which is to set the various movable parts of the casting-machine justifier so that the word-spaces of the line are of such a size or sizes as to fill out exactly the predetermined measure to which both the type-galley and the units-register have been previously set. Obviously, the units-register will indicate that some of the predetermined units of length of line have not been used up by the sum of all the various unit values of the type and word-spaces in that line—the units-register having registered four units for each word-space, although the line-justification mechanism may subsequently give these word-spaces a greater width.

When a justification controller has been set, it is deposited in the channel of the supplementary magazine separate from that which contains the trip controllers, character controllers, and word-space controllers.

The outlets of these two separate channels meet, and there is a mechanism provided for removing controllers from these channel outlets, one at a time, and presenting them in proper order to the index-head which controls the circuits of the casting machine. Further mechanical arrangements present the controllers automatically to this index-head in the following order :—

(1) Trip controller ; (2) justification or justifier-setting controller ; (3) character controllers ; (4) word-space controller ; (5) character controllers ; and so on until the end of the line, when another trip controller is presented ahead of the justification controller for the following line.

The trip controller serves to trip into action those mechanisms which annul any previous setting of the justifier and which bring forward its movable components so that they are in position to fall back on such movable stops as may be set by the justification controller which follows.

When the justifier has been set, as described above, it retains its setting during the entire line, because none of the movable stops can drop, for they are all provided with lips or undercutting to prevent dropping.

The mould does not receive a setting for line-justification word-spaces at the beginning of every line—as in the Monotype—but is set each time it is required for that purpose during the casting of the line, that is each time a word-space controller is presented to the index-head.

After a word-space has been cast, the setting for that space is annulled, and the mould is set for the size of the following character.

Whenever a word-space controller is presented to the index-head, a movable escapement contact-finger in the justifier is indexed one notch thereby automatically counting the spaces until the finger rests on another contact which causes the remaining word-spaces in the line to differ in size from those already cast in that line. This is the only portion of the justifier moved during the composition of the line.

The description given above relates to ordinary justification, in which the justification slide and the end-of-line slide are manually locked together, in which case the combination of trip and justification causes the necessary operations to be performed for the transference of the finished line to the galley.

The machine is rendered capable of performing multiple justification by manually unlocking the two slides for justification and end-of-line. This condition is shown diagrammatically in fig. 386, in which fifty-one controllers are shown composed for multiple justification; the left and right columns of figures to the right of the diagram give respectively the order in which the controllers are composed into and used from the magazines. The order of passing through the index-head is as follows:—

1. Trip; trips the justification cam to draw up the justification slide.
2. Multiple justification; operates an electro-magnet so that:
3. Trip; causes the justification cam to be tripped a second time and the justification slide and the end-of-line slide to be drawn up as one slide causing the delivery of the finished line.
14. Justification; sets the justification mechanism for the line-justification of the section of the line 4–13, the controllers for which then pass from the main magazine and cause the required characters and spaces to be cast:
15. Trip; trips the justification cam to operate the justification slide for:
38. Justification; sets the justification for the section of the line 16–37, the controllers for which cause the required characters and spaces to be cast; and so on.

The machine occupies a floor-space of 3 feet by 6 feet; it weighs 1250 pounds, and, including two 16-candlepower lamps, requires 1 kilowatt to drive and control it.

The Graphotype machine has also been adapted for use as a sorts-caster, and has been used successfully for casting from the limit of machine composition (18-point) up to 36-point inclusive. Each large-work fount is carried on three matrix-plates, and it is stated that a complete fount of 200 pounds of type has been obtained from the machine in a run of eight hours.

PLATE LIV.

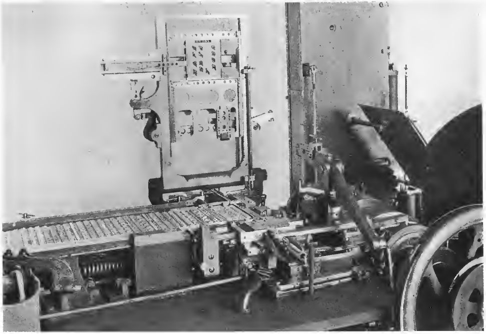


FIG. 387.—*Graphotype (new model) used as a large-work sorts-caster; enlarged view taken from the left-hand side.*

To face page 412.]

PLATE LV.
[To face page 413.]

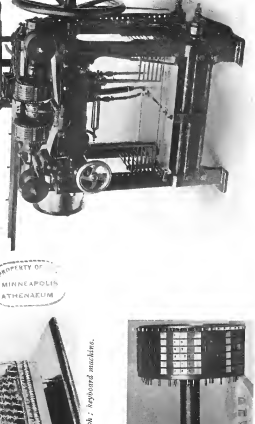


FIG. 389.—*Dyotype composing and casting machine; typecaster.*

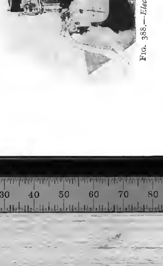


FIG. 388.—*Electrotypograph; keyboard machine.*

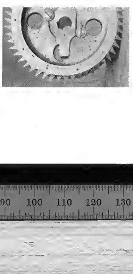


FIG. 390.—*Dyotype composing and casting machine; matrix-wheel.*

It is further claimed that it is
type with extended kerns. Figu
Graphotype used as a large-work

The Electrotypograph composin
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of Budapest, and was patented in
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typewriter, a teletypograph may
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perforated ribbon is used to contro
casting mechanism. The justify
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on the wire, about 540 letters pe
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newspaper "Le Temps," but c

A somewhat further develo
of one of the authors a little
known Danish inventor, prop
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The Dyotype composing an
machine, the invention of J
Paris, and differs in several re
which have been described.

It is further claimed that it is possible to cast all kinds of script, and even type with extended kerns. Figure 387, plate LIV, shows the new model Graphotype used as a large-work sorts-caster.

The Electrotypograph composing and casting machine.—This exceedingly ingenious machine, fig. 388, plate LV, is the invention of C. Méray-Horváth, of Budapest, and was patented in 1897. It is a perforated-ribbon machine, and to its perforator, which has somewhat the appearance and size of a typewriter, a teletypograph may be attached. This apparatus effects the electric duplication of a perforation at a distance and thus permits simultaneous identical composition of the same matter in different places. The perforated ribbon is used to control the movements of the die-case of the typecasting mechanism. The justifying mechanism is the invention of Colomon Rozár, of Nuremberg. It is highly ingenious and exceedingly complicated, but practical in its working. The casting machine is of solid construction, and again somewhat complicated, but is stated to be practical in working. The perforated ribbon is used, not as in the Monotype in conjunction with compressed air, but in conjunction with an electrical apparatus which, every time a perforation passes under one of the feelers, transmits an electric current; the passage of this current determines the position of the die-case and the thickness of the set of the letter to be cast. The spaces for the line are cast at the beginning of each line, and the metal in the melting-pot is maintained at an even temperature by means of a mercurial regulator which keeps the heat uniform all the time the machine is running. The machine casts at the rate of from 4000 to 5000 characters per hour, and the paper ribbon can be run through the machines over and over again to produce duplications of the matter set. By the teletypograph a speed of 180 characters per minute can be obtained, which is about double the speed of the typecasting machine, while if the triplex system of telegraphy is used on the wire, about 540 letters per minute can be sent and received, sufficient to keep six or seven Méray-Horváth-Rozár typecasting machines supplied with ribbons. The authors have seen it stated that a factory has been established in Paris and that machines have been constructed for the daily newspaper "Le Temps," but of this they have no personal knowledge.

A somewhat further development on similar lines came under the notice of one of the authors a little while back in which H. Knudsen, a well-known Danish inventor, proposed and effected the working at different centres from a single machine and operator, of a number of linotype machines by wireless methods of telegraphy.

It is obvious that in Great Britain such machines would have to be licensed by the postal authorities, owing to the government monopoly and control of telegraphic intercommunication of all kinds.

The Dyotype composing and casting machine, fig. 389, plate LV.—This machine, the invention of J. Pinel, has recently been constructed in Paris, and differs in several respects from the other machines of this class which have been described.

The matrices, fig. 179, p. 222, are of trapezoidal shape, and a number of them are built up into a wheel, fig. 390, plate LV, having solid longitudinal dividing-bars of the same section as the matrices. These solid dividing-bars serve for casting spaces of the various thicknesses and for quads. The matrices are secured in the matrix-wheels by cylindrical pins which lock them to each other, to the dividing-bars formed on the solid portion of the matrix-wheel, and to the ends of the matrix-wheels.

Each matrix is provided with a small steel plate at one side which engages with the upper end of the bell-crank levers, l_1 l_2, fig. 235, p. 263, when the matrix-wheel is presented to the mould, and the other end of the lever depresses the body-slide against the pressure of a spring, so as to give the characters a set width proportional to the distance moved by the upper end of the bell-crank.

Each matrix-wheel contains twelve solid dividing-bars with four rows of matrices arranged circumferentially between each pair of dividing-bars. There are six circumferential rows of matrices, each of which contains forty-eight matrices arranged thus: the first row for roman lower-case; the second row roman capitals; the third row italic lower-case; the fourth row italic capitals; the fifth row small capitals; and the sixth row the various signs and figures. Thus each matrix-wheel contains 288 matrices for characters, apart from the twelve solid dividing-bars from which spaces can be cast. There are two matrix-wheels on each casting machine.

Unlike the Monotype in which compressed air is used, or the Graphotype, in which electro-magnets are used, the selecting needles are caused to enter the perforations in the ribbon by means of spring blades.

The perforated ribbon is very similar to that prepared in the Graphotype perforator. There are, however, two lines of guide-perforations, one on each side of the strip, fig. 391, which are made by the keyboard itself. The strip may receive perforations on thirteen longitudinal lines, of which the perforations on lines 1, 2, 10, 11 and 12 indicate the kind of type or fount (and consequently the lateral position of the matrix-wheel), while perforations on lines 4, 5, 6, 7, 8 and 9 indicate the different characters, letters, or signs, and control the rotational movement of the matrix-wheel. Perforations on line 3 control the casting of spaces, giving a middle space when there is a perforation on line 3 alone, and a justifying space when the perforation on line 3 occurs in combination with another perforation. The perforation on line 13 is of larger diameter than the others, and sets in operation the trip gear for transferring the line to the galley.

A very important feature of the Dyotype is that it avoids the disadvantages of requiring the use of unit systems or self-spacing type. The keyboard is arranged to effect the summation of any widths of characters, this being performed by a metal piece which is changed for each fount used. The wheel, which is used for the summation, is a toothless ratchet, driven and held by friction. This arrangement allows the matrices to be struck from existing punches, and therefore permits the work to conform to the faces already in use by the printer, a matter of considerable importance.

The line-justification of the line when composed is the same for all bodies and permits any shortness of length, from one point up to twenty-four points, to be made up. The line-justification is effected by an arrangement connected with the keyboard.

At the end of the line, the operator presses the line-justifying lever, and the machine modifies the space-perforations already made, without the further intervention of the operator, the strip being held in readiness for the purpose.

Unlike other machines of this class, the line-justifying perforations occur at the beginning of the line and the strip is put into the machine so as to start at the beginning of the matter. In order to obtain the requisite total

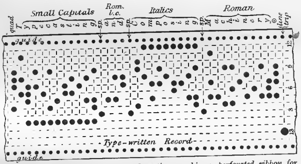

FIG. 391.—*Dyotype composing and casting machine; perforated ribbon for typecaster.*

of combinations, the number of perforations varies for different characters, some characters being formed by one perforation and others by two, three, four or five perforations respectively.

It has been proposed by some inventors of machines of this class that the ribbon should be held by a portion of the perforating apparatus, after the trip perforation has been made and until the end of the line is reached, when this part of the perforating mechanism should be again brought into operation to punch the perforations corresponding to the set width of space required throughout the line. Such an arrangement would enable the ribbon to be used in the same direction as that of composition, but the ribbon would require to be rewound before it could be used on the casting machine.

The Stringertype machine, fig. 392, plate LVI.—In this machine a line of matrices is composed, and the operations of line-justifying, casting a justified line, and setting are performed automatically. The Stringertype matrix, fig. 188, p. 224, differs from the Linotype matrix, fig. 180, p. 222, the strike being on the flat. The matrix is notched at the side, and this notch serves to set the mould to the correct width for the character, the dimension from the bottom of the notch across the flat being the set width plus a constant. The matrices are assembled as in the Linotype and measured in a vice together with the space-matrices, fig. 203, p. 231, the measurement being made on the aggregate thickness of all the matrices.

In the original machine, when the line has been composed, the space-wedges are driven up to fill the vice. The set width of the spaces is obtained in just the same way as with the type-matrices; the Stringertype space-matrix is tapered in side elevation, and the width at any point is equal to the set desired plus the same constant as in the type-matrix. It is not essential that the thickness of the matrix should be the same as the set width of the type cast from it, but all the matrices of a fount may be a constant multiple of the set width in thickness. The space-matrices must then be arranged with different tapers in front and side elevation. If θ_1 is the inclination of the wedge surface to the vertical in front elevation, and θ_2 in side elevation, and C is the constant multiple in the case of the type-matrices, then

$$\tan \theta_1 = C \tan \theta_2.$$

It is thus possible to set the vice and its details to the dimensions of any convenient body-size, such as pica, and the difficulty of obtaining a sufficient thickness for the matrices of the thin sorts of small body-sizes is overcome.

The type during the casting and composing operations is horizontal; when the line is completed it is automatically turned through 90° to the vertical position and placed in the receiving galley.

The matrices travel from the vice to the left of the machine after the measuring operation; they are then pushed successively one at a time into the cross race and travel from the operator in front of the mould; the last matrix cast from remains in the slide until the first of the next line comes along, when this matrix is pushed along the cross race. After the matrix has been cast from, it is pushed along the cross race by the pressure of the next succeeding matrix, and when it has travelled its own width past the casting point a plunger pushes it into the elevator race. On the completion of the line the elevator lifts the matrices then in the race to the slide where the space-matrices are transferred to their magazine, and the type-matrices elevated to the distributor-bar, which operates in the same way as in the Linotype machine.

Safety cut-outs are provided, and operate in any circumstances which would involve damage to the machine; in the event of a line being cast of incorrect length the machine is also stopped.

The advantages of casting separate type are many: corrections can be made by hand and away from the machine if necessary, while in the slug machines it is necessary to recast the whole of the line, even when the correction consists only of two transposed letters or a point omitted; the depth of the strike can be deeper, and therefore a clearer impression can be

FIG. 392.—*Stri*

PLATE LVI.

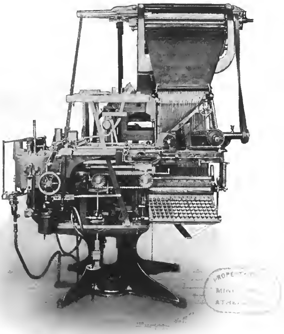

FIG. 392.—*Stringertype matrix-composing and casting machine; front view.*

[*To face page 416.*

PLATE LVII.

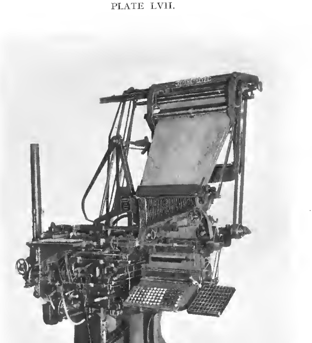

FIG. 393.—*Stringertype matrix-composing and casting machine,* 1913 *model.*

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the line. This result is
a movable fulcrum block

obtained, and the breakaway tang permits a hard metal to be used (similar to that of which ordinary type for hand-composition is made), while the metal used in the slug machines, and even in those similar to the Monotype, must necessarily be softer.

The normal speed of the Stringertype mould is stated to be 160 characters per minute; as mentioned above, this does not represent the limit of output of a single mould; the total output possible, if the mould were kept in continuous work, would be nearly 10,000 ens per hour.

It is not generally intended to distribute the type, but to remelt it; when, however, it is desired to do so, a matrix can be left at rest in the machine and type cast from it continuously, so that sorts can be obtained from the machine for hand-composition, if both machine-work and hand-work are used.

The machine requires about 0·5 horse-power.

Important modifications have recently been made in the design of this machine, chief among these being a new method of justification, and a novel form of matrix distribution, by which the machine has been rendered more efficient and easy of operation, and its field of usefulness increased. The 1913 Stringertype machine is shown in fig. 393, plate LVII.

The distensible wedge-spaces of the earlier machine have been replaced by single non-expanding space-matrices similar in configuration to a character-matrix, and of a thickness proportional to the maximum justifying-space; the set notch is of sufficient depth to permit of the production of the minimum justifying-space.

The matrices are assembled to a greater length than that corresponding to the length of the line of types in the galley, and justification is effected by measuring the overset or excess of length and dividing the latter equally among the number of spaces; the mould-blade is then set to the appropriate position to give the correct space.

The essential parts of the mechanism for effecting line-justification are shown diagrammatically in fig. 394. The line-measuring vice *a* is fitted with a longitudinally slidable spindle *c* carrying the clamping-jaw *b*. The jaw *b* is adjustable and can be set for different measures by running it along the threaded spindle *c* and locking with the nuts *d*. The closing of the vice-jaw *b* on to the line is effected by raising the slide *e* which carries the line-justifying wedge *f*; the latter then engages with the block *g* on the spindle *c*, displaces the latter to the right, and thus moves the jaw *b* till it grips the line. The distance through which the slide *e* moves is therefore dependent on the length of the line of matrices between the vice-jaws, and this movement is transmitted through the knife-edge *h*, the measuring-beam *j*, and the lever *k* to the mould-justifying wedge *m*. The extent of the movement transferred from the line-justifying wedge *f* to the mould-justifying wedge *m* is properly proportioned to the number of word-spaces in the line. This result is obtained by providing the measuring-beam *j* with a movable fulcrum block *n*, and arranging that the position of the fulcrum block n is determined by means of a series of equally-spaced stops on the surface of the drum o, which is mounted on the spindle p. On one end of this spindle is an escapement wheel q having teeth equal in number to the stops; an escapement mechanism working in co-operation with the wheel and connected to the space-key r permits a stop of different length to be brought into position at every depression of the space-key.

The sequence of operations is as follows: on completion of assembly, the line of matrices is transferred to a position immediately above the vice. Simultaneously with this operation, the mould-justifying wedge is released

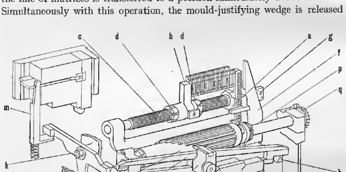

FIG. 394.—*Stringertype; line-justification gear.*

from its previously adjusted position and allowed to rise into contact with the lever k. In the meantime the fulcrum block n is advanced to the right until it meets the stop corresponding to the number of spaces in the line. The beam j is now permitted to fall into contact with the knife-edge h. The slide s is next elevated, and this permits firstly that the vice may rise to embrace the matrices, and secondly, through frictional engagement with the slide e, that the latter and with it the wedge f and the knife-edge h may be driven upwards to measure the line. The appropriate position of the mould-justifying wedge having been thus attained, it is locked in this position, and the various mechanisms concerned are returned to their normal or zero positions.

Thus the line-justifying space-matrices do not themselves determine the thickness of the spaces to be cast, but act through suitable mechanism to bring the mould-justifying wedge into the path of the mould body-blade at the moment when the line-justifying space-matrix is presented to the mould preparatory to casting.

The latter remarks do not refer to the normal or fixed spaces, whose set thickness is determined in the same way as the set thickness of the

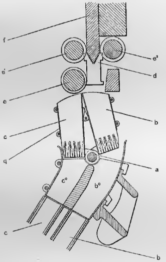

FIG. 395.—*Stringertype; gear for distributing matrices to magazines.* Cross-section.

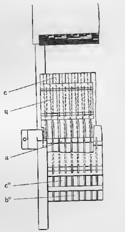

FIG. 396.—*Stringertype; gear for distributing matrices.* Front view.

character-type, namely by means of the notch in the edge of the matrix, the depth of which varies according to the thickness of type to be cast.

The method of distribution of the matrices into the two magazines is illustrated in figs. 395 and 396. Its chief objects are: increasing the capacity of the distributor-bar, and providing improved means for separating the matrices into groups and for delivering them to their respective magazines.

With these objects in view the distributor-bar is given an eight-tooth combination of matrix-sustaining teeth, instead of seven teeth as used in the Linotype, fig. 412, and provision is made for discharging matrices from the bar at every half revolution, or every $\frac{1}{8}$ inch, instead of at every revolution of the distributor-screws, or every $\frac{1}{4}$ inch, as usual; this enables a distributor-bar of given length to distribute twice the number of matrices which could be dealt with by the earlier arrangement.

The distribution of the different groups of matrices into their respective magazines is effected by means of an oscillating guide pivoted at *a*, fig. 395, and extending the whole width of the magazines; it is provided on either side with chutes *b* and *c* for receiving and guiding the matrices *d* to the appropriate channels *b′*, *c′*, of their respective magazines, the chutes on one side being staggered relatively to those on the other; this is shown more particularly in fig. 397.

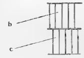

FIG. 397.—*Stringertype; gear for distributing matrices; magazine mouths.* Plan.

The oscillating guide is so correlated with the distributor-screws *e*, e^1, e^2 of the distributor as to make one complete stroke for each half-revolution of the distributor-screws and this brings each group of matrix-chutes *b*, *c* alternately into the correct position to receive the matrices from the distributor-bar *f* and to guide them into the respective magazines.

With a distributing apparatus for multiple-magazine machines operating as above described, it becomes unnecessary for the matrices belonging to one group to be distinguished from those of the other group otherwise than by the combination of the serrations or teeth engaging with the distributor-bar.

It should be noted that in the Stringertype the conditions of matrix circulation differ from those of the Linotype in an important particular. In the Linotype, as soon as the cast has been made the line of matrices is elevated to the distributor, and distribution commences but few seconds after the line is completed and sent forward. In the Stringertype, on the other hand, after the line has been set, each matrix must be cast from separately so that in an ordinary line of, say, sixty matrices, about twenty seconds must elapse before distribution begins; and whereas, in the Linotype, one magazine-channel of the most frequently used character is in general sufficient, it is necessary in the Stringertype to provide a larger number of matrices to enable uninterrupted composition to proceed while the casting is taking place; it is this fact which is mainly responsible for the augmentation of magazine capacity which it has been found necessary to make.

PART II.

MACHINES OF THE LINOTYPE CLASS; CASTING THEIR COMPLETE LINE AT A SINGLE OPERATION OF POURING.

بسم الله الرحمن الرحيم
قل لئنِ اجتمعتِ الأنس والجنّ على ان يأتوا بمثل هذا القران لا يأتون
بمثلهِ ولو كان بعضهم لبعض ظهيرا

The Koran, chapter XVII, intitled The Night Journey.

Composed and cast in Cairo on a Linotype machine in 18-point and 14-point arabic.

IN THE NAME OF THE MOST MERCIFUL GOD.

Say, Verily if men and genii were purposely assembled, that they might produce *a book* like this Korân, they could not produce *one* like unto it, although the one of them assisted the other. Sale's Translation.

Brevier modern.

The Linotype machine, figs. 398 to 413, plates LVIII to LXVII.—To the persevering genius of Ottmar Mergenthaler the world owes the Linotype machine and all its class, for to him belongs the credit of the original idea of a machine that should produce a bar or slug of type from a line of assembled and justified matrices. But the original idea of the Linotype had its origin in France, for the French patent, No. 285, applied for by "le Sieur Herhan" on the 23 Dec. 1797, with additions made "le 27 brumaire an VII" (17 Nov. 1798), was in the first instance for the composition in lines of matrices of soft metal struck from steel type which were not hardened, and in its later form for "la composition par matrices movibles." These matrices, made of copper, were set up in page form and stereotyped from direct. Herhan gives the composition of his stereotype-metal as: lead 80 per cent and antimony 20 per cent. In a French patent taken out at about the same time by Firmin Didot the composition of stereotype-metal is given as: lead 70 per cent, antimony 20 per cent, tin 9 per cent and copper 1 per cent. The tin and copper were to be melted first and the lead and antimony added subsequently.

Though the patent of Herhan may be viewed as the earliest forerunner in idea of the Linotype machine, the cost of the many individual matrices required and the impossibility of pulling proofs, and thus avoiding errors, prevented its practical adoption. It may be also mentioned that years before Mergenthaler made his matrices, the Caslon Type Foundry patented a method of casting imprints and logotypes, in which single-letter matrices were set and secured together for use on the casting machine. Mergenthaler was probably unaware of these early inventions, which contain principles embodied in the Linotype machine. Nevertheless, all the more credit is due to him because he had long been striving to produce transfer or impression machines and had been working on quite different lines; but when the new idea dawned upon him he cast aside ungrudgingly all his former achievements and started out for the fresh goal well knowing the troubles that would be his lot before he arrived at it. He has had many followers, imitators, and improvers; his class of machine,

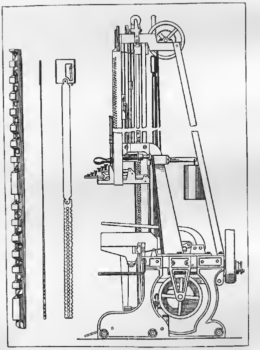

FIG. 398.—*Linotype; original machine of* 1884, *with enlarged views of the multiple-strike matrix-bars used.*

a machine that casts a slug or line of type from a line of previously assembled and justified matrices at a single operation of casting, is still the most important factor in newspaper printing throughout the world.

The Linotype, which was first produced on commercial lines by the Mergenthaler Linotype Company of New York, has been the subject of so much invention, it has played so important a part in the development and production of a great proportion of the newspapers of the day, and it has involved the sinking of so large a capital sum that it is really worthy of a volume to itself; several text-books relating to it have already been written. It cannot therefore be dealt with so briefly as the preceding machines, although many interesting features must be here omitted for want of space.

The evolution of the Linotype can perhaps be best traced by reference to the series of illustrations of complete machines, beginning with the

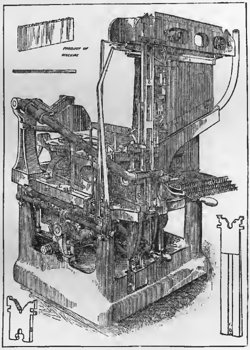

FIG. 400.—*Linotype; independent matrix machine of 1885 with blower; with views of slug, matrix, and wedge-space or space-band.*

earliest form, fig. 398, in which a characteristic feature is the multiple matrix formed as a long bar—shown enlarged in the figure—with a very great number of strikes, and having as its penultimate that beautiful piece of mechanism known as model 9, fig. 410, plate LXV, with its four matrix-magazines, its four distributors, and its great range of faces.

At the top of all modern machines is the distributor-bar, fig. 412, which is formed with seven wards interrupted on the following system: the top ward, which may be styled No. 1, is alternately tooth and space, the length of tooth corresponding to the pitch of the divisions in the magazine mouths

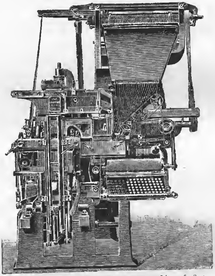

FIG. 402.—*Linotype; square base machine of 1890.*

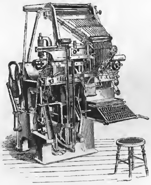

FIG. 404.—*Linotype; single magazine machine, American.*

immediately below. Ward No. 2 is alternately tooth and space, but the length is double the tooth length of No. 1; similarly No. 3 is alternately

PLATE LVIII.

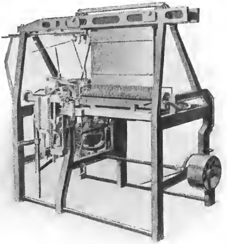

Fig. 399.—*Linotype; first individual-matrix machine.*

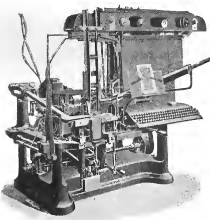

Fig. 401.—*Linotype; blower machine of* 1886; *introduced in* 1889 *into England.*

[*To face page* 424.

PLATE LIX.

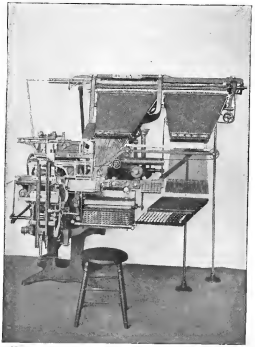

FIG. 403.—*Linotype; twin machine, with step line-justification*; 1894.

To face plate LX.]

FIG. 405.—*Lino*

PLATE LX.

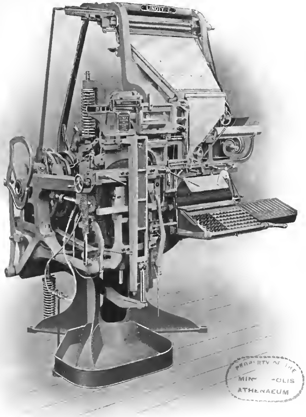

FIG. 405.—*Linotype; single magazine machine; English.*

[*To face plate LIX.*

PLATE LXI.

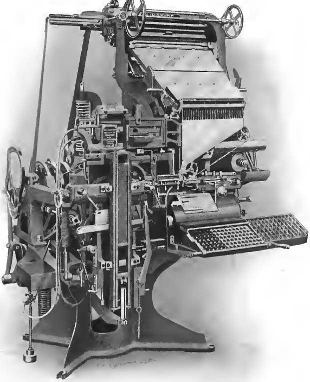

FIG. 406.—*Linotype; double magazine machine; English model 3.*

To face plate LXII.]

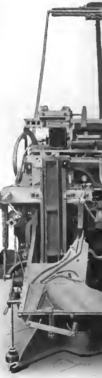

FIG 407.—*Li*

PLATE LXII.

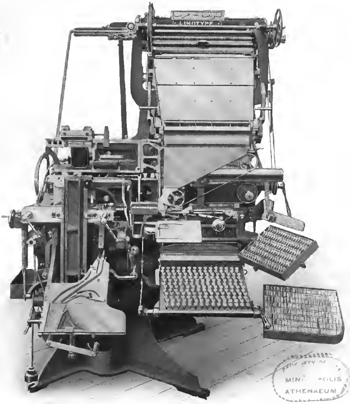

FIG. 407.—*Linotype; arabic machine, with 180 keys.*

[*To face plate LXI.*

PLATE LXIII.

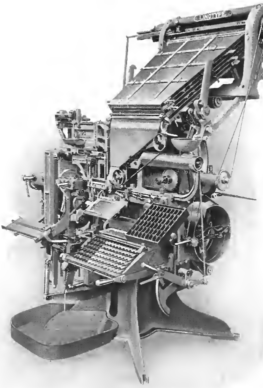

FIG. 408.—*Linotype; treble magazine machine; English model 4; front view.*

To face plate LXIV.]

FIG. 409.—*Linotyp*

PLATE LXIV.

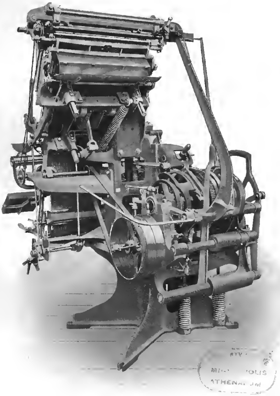

Fig. 409.—*Linotype; treble magazine machine; English model 4; back view.*

[*To face plate LXIII.*

PLATE LXV.

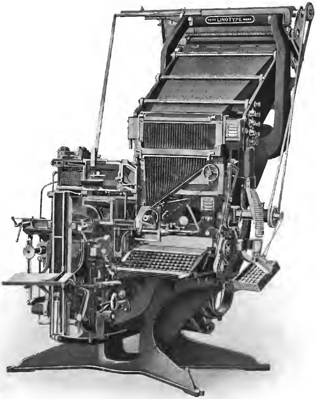

FIG. 410.—*Linotype; quadruple magazine machine; model 9; English and American.*

To face plate LXVI.]

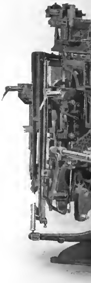

FIG. 411.—*L*

PLATE LXVI.

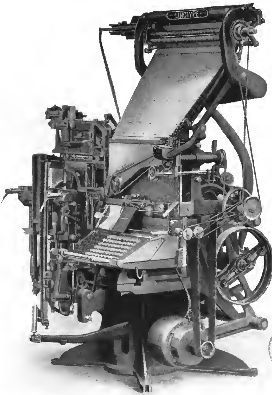

FIG. 411.—*Linotype; model 10; English and American.*

[*To face plate LXV.*

PLATE LXVII.

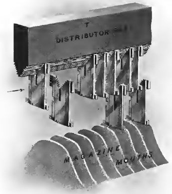

FIG. 413.—*Linotype; matrix distribution; perspective view.*

To face page 425.]

tooth and space for four times the tooth length of No. 1, and generally No. n is 2^{n-1} times the pitch of the magazine mouths. Each matrix is formed in the blank with seven teeth on each side of the top V-nick; one or more

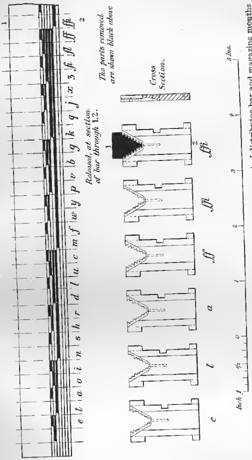

FIG. 412.—*Linotype; distributor-bar and matrices.* The arrangement of distributor-bar and magazine mouths with matrices in process of distribution is shown in fig. 413, plate LXVII.

pairs of corresponding teeth are removed, and that combination only is retained which corresponds to the wards removed from the rack at the point at which it is desired that the matrix should fall; fig. 413, plate LXVII. The arrangement on each side of the **V** is symmetrical. The matrices of the characters which are most used travel the shortest distance, return soonest to the magazine, and the keys releasing them are most conveniently placed together under the operator's left hand. The order of release, detail of the distributor-bar, and detail of some of the matrices are shown in fig. 412, and the

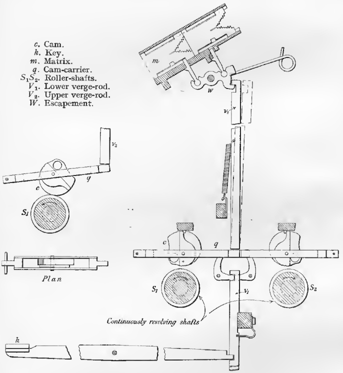

FIG. 414.—*Linotype; matrix-liberating gear.* Scale: half size.

keyboard in fig. 277, p. 294. The matrices in the magazine are retained by an escapement w, fig. 414, which is freed on the depression of the key k. The key does not effect this directly, but releases a cam-carrier q, which permits the cam c to be driven by one of two roller-shafts S_1, S_2 which are kept revolving one in front of and one behind the lower verge-rods v_1 which are raised by the depression of the keys. As long as the key remains depressed, the cam will roll on the roller and cause the upper verge-rod v_2 to reciprocate vertically and release a matrix successively at each stroke.

PLATE LXVIII.

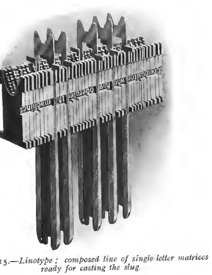

FIG. 415.—*Linotype; composed line of single letter matrices ready for casting the slug*

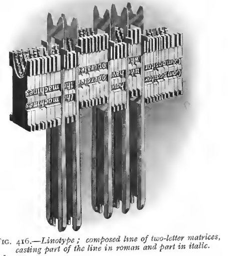

FIG. 416.—*Linotype; composed line of two-letter matrices, casting part of the line in roman and part in italic.*

To face page 427.]

A very light touch of the key is sufficient, the power-drive completing the release. The matrices, as they fall, travel in a curved path from the magazine, which slopes downwards and forwards, into the guide-box in which the left-hand grooves are nearly vertical, and the right-hand grooves rudimentary; these are supplemented by a continuously-running belt to assist the matrices to the star-wheel. The star-wheel, of fibre, pushes the matrices through a set of pawls. In falling past the star-wheel the matrix was apt to hit against the last in the line and to damage the sharp edge at the strike. To obviate this, one corner has been cut away, and this has greatly increased the life of the matrices. The completed line of matrices is shown in fig. 415, plate LXVIII. Many matrices are now made with two faces; when the second face is used, the lower side-tongues of the matrices travel in a groove at a higher level until the casting has been effected, fig. 416, plate LXVIII. The line is measured directly by the total length of the group of matrices. As in other composing machines the operator is warned by a bell, set about five ems before the end, when the line is nearly full; the length set must be short to allow for the spaces filling out the line. Between each word a distensible space-matrix, or space-band, is dropped; this has no teeth, consequently it is not elevated to the distributor-bar at the top of the machine, but goes direct to its own magazine. The space-band, fig. 201, p. 231, consists of two main opposing wedge-shaped pieces dovetailed together, yet sliding freely and fitting sufficiently well to avoid trouble from metal getting between the two parts. The line having been set up, the other parts of the machine come into operation when the operator depresses the handle which raises the composed line of matrices and starts the cycle of operations.

At the back of the machine is a cam-shaft carrying nine cams; this shaft is belt-driven through the intervention of an internal expanding clutch. The clutch is thrown out of gear in the event of any accident jamming parts of the machine; if too short a line to fill the measure should be composed the machine goes through all the operations except that the pump does not make its stroke and consequently no line is cast; if, on the other hand, the compositor should deliver too long a line of matrices a cut-out or safety stop comes into action and throws out the clutch. These and other safeguards render the machine practically fool-proof—a very necessary precaution—not only to avoid risk of damage by a learner, but because the expert operator, once he has composed a line and depressed the lever, immediately begins the composition of the next line, and does not watch the line which he has set through the successive operations of casting and trimming, nor does he follow the matrices in the elevator and distributor.

The following is the sequence of movements made by the Linotype: a line of matrices having been assembled, it is raised by means of a lever, and passes into the delivery carriage, which carries it into the first elevator. In the following description the figures in parentheses denote the cams actuating the lever or other member, counting from left to right along the cam-shaft at the back of the machine.

The first elevator descends (1); simultaneously the mould-wheel makes a quarter revolution (2), turning from the ejecting to the casting position: see fig. 419, plate LXIX; the matrices are now in front of the mould. The mould-wheel now comes forward (8) and engages the matrices, the alining lugs of the latter passing under the alining edge of the mould, but it does not make complete contact. The vice-closing lever rises (3), allowing a spring to seat, which in so doing turns a screw which sets the vice-block to the correct size of the line. The first line-justification lever rises (4), pushing up the spaces successively from right to left in an inclined position, fig. 417, plate LXIX. Meanwhile, the delivery carriage has returned to the position of rest (9). The first line-justification lever having descended (4), pressure is also now removed from the end of the line by the vice lever returning to the position of rest (3). The first elevator now slightly rises (1), causing the matrices to aline along the edge of the mould. The metal-pot, fig. 418, plate LXIX, now makes a temporary forward movement the object of which is to press the mould against the matrix line to ensure face alinement. The pot having dropped back, the vice lever again rises (3), allowing the spring-controlled vice-block to determine the correct length of line. Both the first (4) and second (3) line-justification levers now rise simultaneously, and push the space-bands up evenly. The pot again advances (7), and is tightly pressed against the back of the mould; the plunger descends (6), forcing the molten metal into the mould and matrices. The plunger having returned, the pressure on the bottom of the matrices caused by the first elevator is withdrawn, the line-justification and vice levers return to the position of rest, and the pot and mould-wheel retreat (8), leaving the slug in the mould. The mould-wheel now completes its revolution by making a three-quarter turn (2), fig. 419, plate LXIX, during which the back of the mould passes over a knife which trims off the superfluous metal, fig. 240, p. 265, including the retaining bars. The mould-wheel now advances (8) on to two steady-pins, the mould being in front of two parallel trimming-knives, through which the slug is forced by an ejector-blade (8), which pushes the slug from the mould, fig. 237, plate XIV, and thence through the knives into the galley at the front of the machine, fig. 419, plate LXIX, the ejector-lever being returned by (9). Meanwhile, the first elevator (1) has carried the line of matrices upwards to the intermediate channel, where it is met by the second elevator (5). The first matrix-pusher (9) now transfers the line of matrices from the first elevator to the second elevator. The pusher having temporarily receded, the elevators return to their position of rest. Meanwhile, the first matrix-pusher, acting in conjunction with the space-shifter (9), again advances and causes the space-bands to be gathered by the space-shifter, which returns them to their receptacle at the right-hand end of the intermediate channel. In the meantime, the line of matrices has been pushed

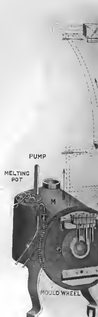

FIG.

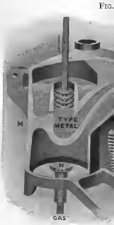

FIG. 418.—*Linotype;* … *and moul*

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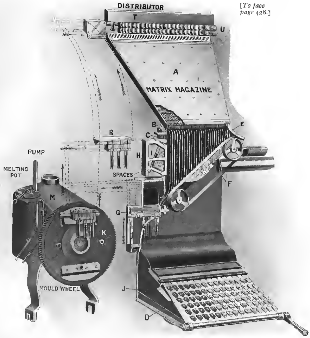
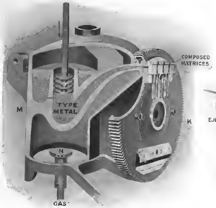


FIG. 417.—*Linotype; path of matrices.*



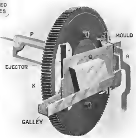


FIG. 418.—*Linotype; metal-pot, pump and mould.*

FIG. 419.—*Linotype; ejector, mould wheel and galley.*

PLATE LXX.

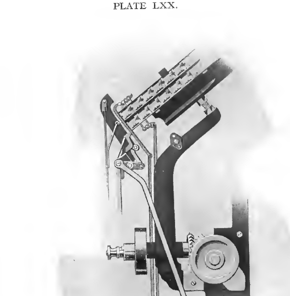


FIG. 421.—*Linotype; double magazine; arrangement of escapements and shift-key.*

To face page 429.]

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tributor-bar, fig. 412, p. 425,
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by the second matrix-pusher (2) from the second elevator into the lift-box, where the matrices are lifted, one at a time, so that each successive matrix is engaged by three distributor-screws, and passes on to the distributor-bar, fig. 412, p. 425, along which it travels, by means of the revolving screws engaging with the lugs. The matrices are suspended from the distributor-bar by their teeth, and when each arrives at that portion of the bar from which this particular combination of teeth has been removed, it falls between guides and passes back into the magazine. The path of the matrices through the machine is shown in fig. 417, plate LXIX.

The Linotype is driven usually by belting; the main-shaft carrying the clutch runs at about 72 revolutions per minute and the cam-shaft at about 6·5 revolutions per minute. About 0·3 horse-power is required to run the machine; the maximum torque is required when making the upstroke of the pump.

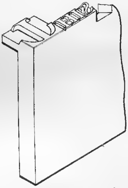


FIG. 420.—*Linotype; two-line letter.* Twice full size.

The mould and the body-trimming knives may be specially arranged so that when a suitable matrix is used the type can be kerned, or can beard, below the body-size, the kerned, or bearded, portion being entirely formed in the matrix. This is used to form the two-line letter used in newspapers at the commencement of advertisements. The beginning of the succeeding line must be set with two or more quads so as to provide the clearance for the kern, or the exact length may be obtained by using the two-line matrix reversed. A portion of a slug commencing with a two-line letter is shown in fig. 420.

The two-line and other large matrices are formed without nicks, and consequently are not elevated to the distributor-bar; they drop into a tray near the space-magazine. Matrices for accented and special sorts have a complete set of nicks and drop from the end of the distributor-bar to the pie-tray on the right of the machine.

In the model 4 English and model 9 machines the magazines may be arranged so as to take matrices for two-line letters, up to 36-point. In the case of the larger bodies the matrix carries only a single strike, the back of the character corresponding to the back of the lower character carried by a two-letter matrix; consequently such matrix is used in the raised position when composed, unless a mould of suitably large body is being used.

The rate of output of the Linotype machine is generally taken at a minimum of 6000 ens per hour, this representing the normal rate of an average compositor. Under good conditions, however, the compositor averages from 8000 to 10,000 ens. Under special conditions a very expert operator is capable of greatly exceeding this speed. It is recorded that in a competition lasting for two hours, held in 1900 in the United States, between thirty-six operators, the winner attained the remarkable speed of over 17,200 ens per hour, and the lowest speed attained by any competitor was over 12,000 ens per hour.

To avoid confusion between the various models of Linotype machines which are, generally speaking, numbered differently in England and in America, it should be noted that :—

The first independent-matrix commercial machine is identical with that known in England as the blower machine, fig. 400, p. 423.

Following the square-base machine, figs. 402 and 404, p. 424, in both countries came the star base, which has since remained standard.

The next decisive step in the change of pattern was the introduction of the light, quick-change magazine, the outstanding feature of which was that the change was effected from the front of the machine ; the machines embodying this feature are American model 5 and English model 2, both of which are single-magazine machines ; fig. 405, plate LX.

Then followed the provision of two superimposed magazines with two distributing mechanisms ; these features appear in American model 4 and in English model 3 ; fig. 406, plate LXI.

The next important step was the provision of an equipment of three magazines with a common distributing mechanism ; the machines so fitted are American model 8 and English model 4 ; figs. 408 and 409, plates LXIII and LXIV.

Following this came the four-magazine machines with four distributors, which are model 9 both in America and in England ; fig. 410, plate LXV.

A still later machine is known as model 10 in both countries. The differences between this and the standard models are that it holds one magazine at a time only, that the magazines are smaller with shorter channels, and that each holds fourteen instead of twenty matrices, but with two channels for e and an automatic change of channel at each line delivery ; fig. 411, plate LXVI.

The Linotype single-magazine machine, fig. 405, plate LX.—By a recent improvement the single-magazine Linotype can be arranged to take one of several interchangeable magazines, and may have two moulds fitted diametrically opposite each other in the mould-wheel. This enables the machine to be changed very quickly for face and to be operated on two different body-sizes without changing the mould.

The double-magazine Linotype is shown in fig. 406, plate LXI.—Double-magazine machines are now in general use. There are two magazines which are placed one above the other ; the lower magazine has its escapement below, as shown in fig. 421, plate LXX ; the upper magazine has its escapement above, with separate upper verge-rods. By means of a lever on the right of the keyboard either series of verge-rods can be thrown into gear, the lever performing a similar function to the shift-key on typewriters; thus any portion or portions of a line may be set in matrices from the upper magazine and the remainder from the lower magazine. Each magazine may contain two-letter matrices so that, with a keyboard of ninety keys, a total of 360 characters can be obtained. The return of the matrices to their respective magazines is effected by means of a central notch in the bottom of those matrices which belong to the upper magazine, fig. 181, p. 222. The matrices, after leaving the arm or second elevator, are received on a short rail, and those without notches engage with the lower distributor-bar, while the notched matrices straddle this short rail, travel between guides below the top ears, and drop sufficiently to clear below the lower distributor-bar; they then fall into an elevating device which transfers them to their own distributor-box above the other. The return of the matrix to its proper place in its own magazine is therefore perfectly automatic. The magazines can be thrown backwards and raised clear of the escapements at the front end by means of an arrangement of levers; in this position they can be changed very quickly.

The American or Mergenthaler Linotype machine has the same difference in the matrices, but the notched matrix in this case falls down a chute to its distributor-box and enters the lower magazine. The escapement of the upper magazine is below, and that of the lower magazine is above. Thus in the American machine the additional magazine has been added below, and in the English machine above, the original position. With the American arrangement the lower magazine can be changed while the machine is being operated with the upper magazine in use.

These machines, known as model 3 in England and model 4 in America, comprise a number of improvements for facilitating, in particular, access to the mould-wheel and to the trimming-knives.

In the Linotype machine adapted to use the arabic character, fig. 407, plate LXII, there are two distributor-bars, and a corresponding increase in the number of distributor-screws, of which there are four as in model 3 instead of three as in the machines with only a single distributing mechanism.

By special alterations in model 3 Linotype machine it has been made possible to carry out the composition of Arabic and other oriental languages. The keyboard has twelve rows of keys in place of the usual six rows, and matrices of a single-letter fount are distributed into the channels of the two magazines. The galley of the machine is of special construction, and so arranged that the completed slugs are delivered in column from left to right instead of in the usual order; the arrangement which effects this is shown in fig. 407, plate LXII. In this machine the distribution is carried out in a special manner: the matrices from the two magazines are automatically sorted and replaced in the magazine channels to which they belong by means of a duplicate distributor-bar; the mould can also be made of a special form for casting recessed slugs, and by this means slugs up to 36-point can be produced with only a small portion of the metal which would be required for the solid slug.

The recess mould when used for setting bodies not larger than 12 or 14-point may also be used to effect a considerable saving in metal.

Model 4 *Linotype machine* (English), like the other models, is capable of using the two-letter matrix, and can be made either as a simplex, duplex, or triplex machine; that is, it can be provided with one, two, or three magazines with their matrix equipment, the arrangement being such that the machine can be increased in capacity progressively from simplex to duplex or to triplex, as may be required, by the addition of the extra magazines; the same applies to American model 8.

The main feature of the design of this machine is the facilitation of quick-changing from one fount to another, the three magazines being retained in position, in the triplex machine, ready for operation at the will of the compositor who effects the change from one magazine to another by merely raising or depressing a hand-lever. The magazines are counterbalanced by means of a spring so that the operation of shifting them from one position to another can be effected with the minimum of effort. The change of the mould and the setting of the knives for effecting an alteration in type-body and measure can be made in the time required for the distribution of the matrices of the last line composed into their proper magazine. With this machine it is possible for the operator to make a complete change of face, body, and measure in a few seconds without leaving his seat.

The two upper magazines are of the light quick-change pattern, and can be easily removed by sliding forward on to the hooks, whence they can be lifted off by hand, and other similar light magazines substituted in their place if it is desired to make a further change of fount.

The range of these machines in body is from 5-point to 14-point, and the length of line ranges from 4 to 30 pica ems.

Among the improvements introduced into this model of machine are: an automatic knife-block for adjusting the trimming-knives by means of a hand-lever with an index-gauge; a quick-change driving pinion for enabling the mould-wheel to be turned to any desired position; a chute for conveying the metal chips from the back knife to a box at the base of the machine; and a quadder for the automatic quadding out of short lines without necessitating the use of the quad and space keys. In addition to the above an alteration has been made in the keyboard by carrying the space-key across the top of the board to give greater speed in composition; the keyboard-rollers have also been geared. Improvements have been made in the metal-pot which is fitted with three independent gas-jets at the front, centre, and rear respectively, and the gas-supply is fitted with a mercury governor, which allows the gas to be turned on fully without affecting the temperature for which the adjustment has been made. The galley, in front of the first elevator, has been improved so as to enable the compositor to see the slugs as they are delivered, and in addition to these modifications some minor improvements have been made in the assembling-slide and in the copy-holder.

All the upper magazines are standardized and interchangeable so that they can be placed upon or removed from the machine without adjustment.

For preventing matrices from falling into the lower magazine when the upper one is in use a plate is fitted covering the open space, so that any matrices fall into a tray instead of into the magazine below.

Model 9 four-magazine quick-change Linotype.—This machine, fig. 410, plate XLV, presents the latest improvements on previous models of the Linotype, and is equipped with four interchangeable superimposed magazines, any one of which can instantly be brought into operation, and all of which are controlled from the standard Linotype keyboard of ninety keys; as each matrix is of the two-letter pattern, it follows that it is possible to compose any of 720 different characters from the one keyboard, and in addition to this any character of infrequent use may be set into the matrix line by hand, and will, after casting, automatically return to the pie-box.

Any face can be set continuously or all the faces can be mixed in the same line of composition, so that an operator can set complete display advertising work involving several different styles and sizes of face and body and varying measures without leaving his seat. As in model 4 described above, the magazines are interchangeable and can be quickly removed and replaced by others, so that the range of styles and faces can be increased as desired, the only limitation being the total range of faces available for use on the Linotype. The mould-wheel carries four moulds. The universal ejector and universal knife-block which are fitted to this model are instantly adjustable for all bodies and measures.

A single assembling-belt transfers matrices from any of the various magazines to the assembling-elevator; by swinging the front entrance open the assembling-mechanism becomes accessible. In this model the magazines themselves remain stationary, instead of being movable, as in model 4. Each magazine is provided with a series of escapements for controlling the delivery of its matrices; the escapements of all four magazines are actuated by a single series of escapement-rods mounted in a frame, each rod having four notches in its edge. The escapement-rods are raised or lowered by shifting the hand-lever so that their upper ends are connected with the escapements of the particular magazine desired. The same movement of the handle couples these rods, through one of the series of notches, to the key-rods, and thus connects them with the usual keyboard mechanism. Both the magazine and the mould which are being used at the time are shown by indexes plainly visible to the operator. The cards of these

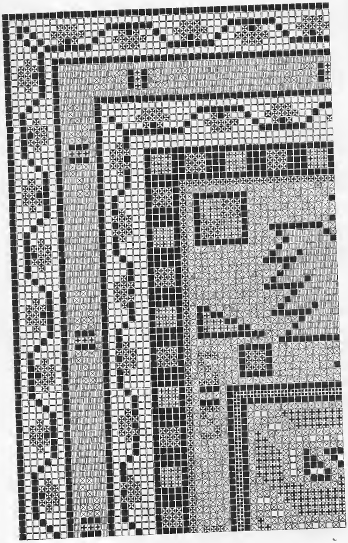


FIG. 423.—*Linotype; embroidery block.*

PLATE LXXI.

[To face page 435.]

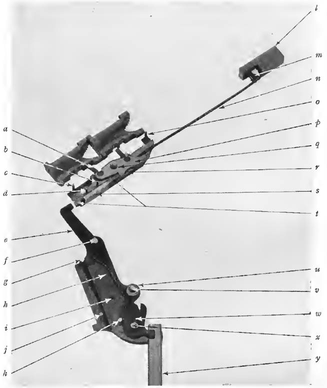


FIG. 422.—*Linotype; models 4 and 9; escapement mechanism.*

a. Escapement pawls.
b. Escapement plunger guide-wires.
c. Escapement division-fixing wires.
d. Escapement plunger guide-wires.
e. Escapement levers.
f. Escapement levers pivot-wire.
g. Wires fixing divisions between escapement levers.
h. Divisions between escapement levers.
i. Position of poker when machine is in operation.
j. Wires fixing divisions between escapement levers.
k. Escapement levers poker (in locked position).
l. Escapement-spring bar.
m. Escapement-spring locking-wire.
n. Escapement pawl-springs.
o. Escapement division-fixing wire.
p. Escapement pawl-links.
q. Escapement pawl-links pivot-wire.
r. Escapement divisions.
s. Escapement plunger stop-piece.
t. Escapement plungers.
u. Distance-washer for divisions between levers.
v. Escapement levers stop-wire.
w. Escapement tumblers worked by key-rods.
x. Escapement tumblers pivot-wire.
y. Key-rod.

indexes are changed by the compositor to correspond to the different magazines or moulds on the machine.

Any magazine can be removed by one man from the front of the machine without disturbing the other magazines, and it can be replaced by another containing a different fount of matrices, for each magazine is independently carried. The matrices are automatically locked in the channels, so that there is no danger of their falling out when the magazine is removed. The front entrance can be opened and closed without disturbing any adjustments, and the machine is ready for immediate use as soon as it is closed. The entire operation of changing the magazine can be performed by the operator in less than one minute. The four different kinds of matrices are selected and conveyed to their respective magazines by means of small bridges which engage with notches in the base of the matrix. Three different notches being required to differentiate between the different founts, it is of course necessary to alter the position of the respective bridge or selector to correspond to the fount to be distributed to any magazine which is changed.

The escapement for matrices in models 4 and 9 Linotype machines is not carried entirely on the framing of the machine as in the earlier models, but the escapement proper forms part of the magazine itself, while the escapement-operating gear is carried on the key-rod frames. The arrangement of the matrix-escapement and of the escapement-operating gear is shown in fig. 422, plate **LXXI**.

Figure 423 illustrates the flexibility of composing machines, a flexibility which is in some respects limited only by the matrices available. This particular example is from the Linotype, and, of course, cast in slug. Specimens of similar work from individual-type machines might perhaps, in the matter of their correction, afford greater facilities of alteration after setting, but, as above stated, the real limit in every instance is merely the variety and supply of matrices.

The Dougall Linotype, fig. 424.—This machine was a Canadian invention, and has been built and successfully operated. The authors are authoritatively informed that it was a very handy and practical machine. The machine differed but little from the Linotype in general appearance, but the line of matrices when assembled was rotated about a vertical axis before presentation in front of the mould occupying a position at right angles to that of composition. After the cast had been completed, the line of matrices was again rotated through a right angle to its original position, and then transferred to the distributing mechanism. The mould was not carried upon a mould-wheel proper, but upon a lever arm which had a reciprocating angular movement through 90° instead of making a complete rotation as in the case of the Linotype. Any advantages which this machine may have had depended upon its more compact form and greater simplicity rather than upon any organic difference from its great prototype.

The authors understand that this machine came under the control of the Linotype Company and was withdrawn from the market.

The Victorline, fig. 425, plate LXXII.—This machine closely resembled the Linotype two-letter single-magazine machine, but comprised some

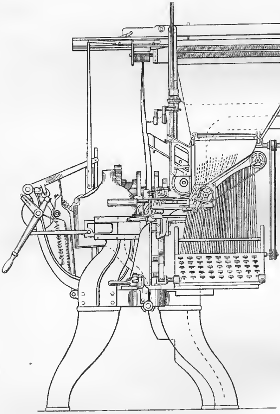


FIG. 424.—*Dougall Linotype.*

special features. To facilitate changing the magazine this was so arranged as to swing to one side and to be capable of being tilted. The keyboard comprised thirteen additional keys. Water-channels were provided for circulating water through the mould-wheel and round the mould-blocks. Several minor improvements were claimed in respect to the matrix-rail, the

PLATE LXXII.

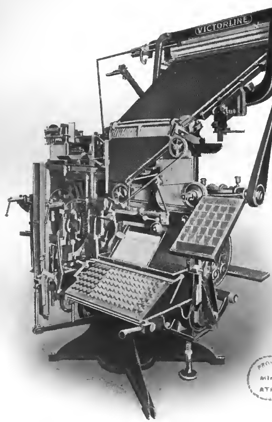


FIG. 425.—*Victorline; general view.*

[*To face page* 436.

PLATE LXXIII.

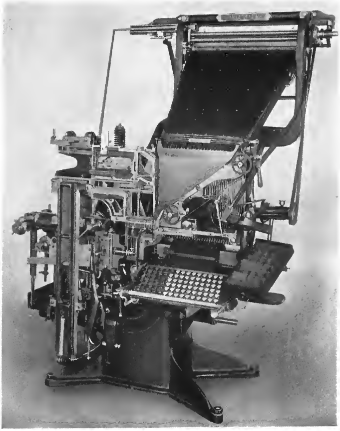
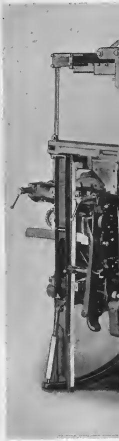


FIG. 426.—*Intertype ; general view.*

To face plate LXXIV.]



FIG

PLATE LXXIV.

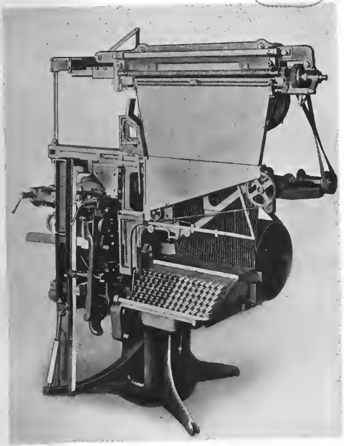


FIG. 427.—*Linograph; general view.*

[*To face plate LXXIII.*

PLATE LXXV.

1. Fount distinguisher.
2. Elevator-mechanism case.
3. Upper line-carrier-slide.
4. Matrix-carrier.
5. Matrix-cage.
6. Justifying-space magazine.
7. Hollow temporary space.
8. Elevator.
9. Side-trimming knives.
10. Tilting shelf.
11. Slug chute.
12. Galley.
13. Waste-box.
14. Left pillar.
15. Matrix-separator.
16. Matrix-distributing pins.
17. Matrix-distributor bell-cranks.
18. Pie-matrix gate.
19. Matrix-distributor and switches.
20. Matrix-magazine.
21. Matrix-gatherer.
22. Assembler star-wheel.
23. Keyboard.
24. Space lever.
25. Cancel-key.
26. Right pillar.
27. Control lever.

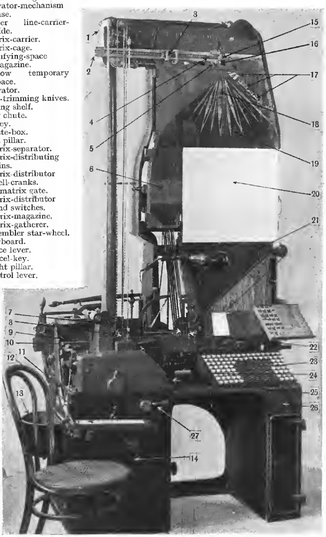
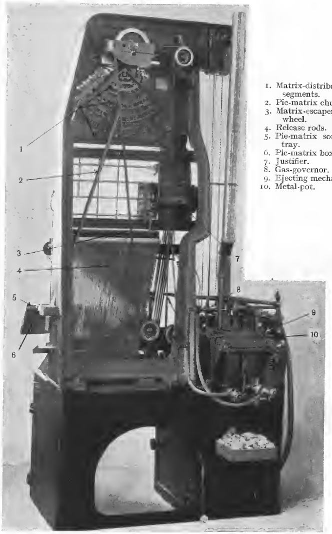


FIG. 428.—*Bellows or Electric compositor; front view.*

front view.



1. Matrix-distributor segments.
2. Pie-matrix chute.
3. Matrix-escapement wheel.
4. Release rods.
5. Pie-matrix sorts-tray.
6. Pie-matrix box.
7. Justifier.
8. Gas-governor.
9. Ejecting mechanism.
10. Metal-pot.

FIG. 429.—*Bellows or Electric compositor; back view.*

To face page 437.]

vice-jaw, the locking gear for the keyboard, and the release of the mould-wheel. The Victorline machine and plant were acquired by the Mergenthaler Setzmaschinen-Fabrik shortly after it made its appearance.

The Intertype, fig. 426, plate LXXIII.—Like the Victorline, this machine closely resembles the two-letter, single-magazine Linotype. The matrices, space-bands, and other supply parts are interchangeable with those of the Linotype, and the constructors have given special attention to speed of operating. It is claimed that the magazine can be changed by the operator in twenty seconds; that the act of removing the magazine locks the matrices at the front and back of the magazine and at the same time locks the keyboard and verge-rods. The knife-block and vice-jaws can be operated from the compositor's seat and the mould is universal and adjustable. It is also claimed that the transferring of the matrices at all points has been simplified and that the cut-outs prevent the casting of a tight or loose line, with the resulting splash. It appears to be virtually a copy of American model 5 Linotype.

The Linograph, fig. 427, plate LXXIV, is of American origin, and closely resembles the Linotype machine, from which, however, it differs in the arrangement of the magazine, which is vertical in the Linograph as in the early models of the Linotype instead of inclined, as in the Linotype in its present forms. The distribution is the same as in the Linotype, but the line is transferred directly from the elevator to the distributor-box, and the spacers are separated from the matrices in the distributor-box before the matrices are elevated to the distributor-bar. The magazine-channels are designed to hold twelve matrices, two channels being provided for the most frequently-used letters, the release being effected from each of the two alternative channels by means of the same finger-key.

The Bellows compositor, figs. 428 and 429, plates LXXV and LXXVI, is the invention of B. F. Bellows of Cleveland, Ohio, and is a slug-casting machine using electro-magnets with a mechanically calculated justification employing non-distensible space-matrices; distribution is effected by combinations of holes in the matrices which serve for their distribution to the magazine. The machine is now manufactured by the Electric Compositor Company of New York.

In its present form the Bellows compositor only uses electric power for the driving motor and for the signal light which indicates the line length; the machine, however, can be driven from any suitable source of power and the signal light replaced by the bell which is usual on other machines.

The operations of composing, line-justifying, and slug-casting are performed in the following manner:—

The control lever 27, fig. 428, is connected to the rheostat controlling the driving motor, and used for starting and stopping the machine. The base is formed with a space between its two pillars so that the operator can sit at the keyboard, as if it were that of a typewriter on a table. The keyboard 23, fig. 428, comprises 128 keys and a space-bar and lever; one of the keys is used for disposing of the line of matrices. The lay-out of the keyboard is similar to that of the Linotype, with the exception that the two top rows of keys are used for small capitals or titling letters. The key-buttons are fastened to straight levers which rest under the release rods, 4, fig. 429, which are in turn connected to a four-pointed star-wheel escapement mechanism, 3, fig. 429, in such a manner that the depression of a key-lever causes the star-wheel to make a quarter of a revolution and allows one matrix to be dropped from the magazine, 20, fig. 428. The matrix-release mechanism is not mechanically controlled as in the Linotype, but it is stated to be operated by a light touch.

As the matrices are released they drop into the gatherer, 21, fig. 428, where they are carried to the assembler star-wheel, 22, fig. 428, and formed into the line. The depression of the space-bar or lever, 24, fig. 428, permits a hollow temporary space, 7, fig. 428, to be dropped into the line. An assembled line of matrices and the slug cast for the matrices are shown in fig. 207, plate XI. Six temporary spaces are provided, and, should more than six spaces be required in the line, the space-bar or lever is automatically connected to the matrix-magazine and causes a normal space or en quad to be dropped into the line for each extra matrix. The range of the machine is such that it can compose any length from zero to five inches.

The operator continues the composition until the line has attained a sufficient length for justification, when a signal light, on the top of the keyboard, shows him that the line is nearly complete. When the line is ready for casting the compositor depresses the line-key (the centre key of the second row from the top of the keyboard), and the machine automatically proceeds with the line-justification permitting the operator to commence the composition of a new line almost immediately. The compositor has no calculation to make, but only has to watch for the signal light. The depression of the line-key puts in motion the mechanism for measuring the length of the line and transmits this measurement to the justifier, 7, fig. 429. By means of another star-wheel escapement, space or blank matrices of the proper number and size are selected and released from the space-magazine, 6, fig. 428. The space-matrices are carried to their respective places by rectangular tubes connected to the temporary spaces, 7, fig. 428; the temporary space-matrices are then withdrawn vertically from the line of matrices and returned to their normal place over the assembler star-wheel, leaving the justifying space-matrices in the line which is then carried horizontally to the left and into the elevator, 8, fig. 428, where it remains until after the cast, when it is delivered to the upper line carrier-slide, 3, fig. 428.

The horizontal water-cooled mould is then brought by a reciprocating movement into alinement with the matrices on one side and with the metal-pot, 10, fig. 429, on the other; both the line of the matrices and the metal-pot are locked against the mould, and the pump-plunger makes its stroke. After the cast has been made the metal-pot and the elevator are both withdrawn from the mould, which is moved past a knife, for trimming the bottom of the slug, to the ejecting mechanism, 9, fig. 429; the slug is here pushed out of the mould, through the side-trimming knives, 9, fig. 428, on to the tilting shelf, 10, fig. 428, which drives it down the slug-chute, 11, fig. 428, and on to the galley, 12, fig. 428, ready for the imposing-stone.

When the elevator has been released from the mould the chain causes it to ascend to the upper line-carrier slide, 3, fig. 428, where the carrier, 4, fig. 428, receives the line of matrices and takes them through the fount-distinguisher, 1, fig. 428, to the separator, 15, fig. 428, where the matrices are pushed one at a time into the matrix-cage, 5, fig. 428.

The matrix-cage presents the matrices singly against the distributing pins, 16, fig. 428, of which there are eight pairs. The illustration of the matrix, fig. 207, plate XI, shows that there are eight holes in each matrix, and that opposite to each hole there is a blank space. As the matrix is presented against the pins one pin of each pair enters the hole, and is moved forward by the other pin which is pushed backward by the blank part of the matrix; this gives a possible motion to eight bell-cranks, 17, fig. 428, and these in turn operate the segments, 1, fig. 429, connected to the various gates which act as switches to the channels of the distributor. The first or top hole in the matrix operates a segment controlling one gate, the second hole operates a segment controlling two gates, the third hole a segment controlling four gates, and so on, so that the eighth hole controls 128 gates, which are capable of being moved from side to side according to the position of the hole and the blank in the matrix; the number of combinations possible for one hole is 2, and for n holes is 2^n, hence in the present case the total possible number of combinations is 2^8 or 256; seven holes would actually be sufficient for the 128 keys provided.

The presentation of the matrix against the pins sets the gates so that there is a continuous channel open for the matrix; the matrix-cage, 5, fig. 428, now recedes from the pins a sufficient distance to allow the matrix to clear, and to pass down the channel to its proper place in either the space-magazine or the matrix-magazine, 6 or 20, fig. 428. The matrices are given an initial acceleration as they leave the cage, the speed of distribution being at the rate of 300 per minute. The completion of the distribution terminates the sequence of operations started by the operator's touch on the line-key. The distributor, 19, fig. 428, the justifying-space magazine, 6, fig. 428, and the matrix-gatherer, 21, fig. 428, each have hinged glass fronts; the matrix-magazine, 20, fig. 428, is made of aluminium alloy, and is designed on symmetrical lines.

Accessibility of detail has been made a feature of the design of the machine which has been divided into a number of units, each of which is really a small machine in itself, and these small machines are so connected as to synchronize with each other. These units also have each been made accessible to permit of adjustments or replacements being easily made and to reduce the cost of manufacture and assembly. Most of the moving parts, including the motor, the casting and the ejecting mechanism, are housed in the left pillar of the machine, 14, fig. 428; the elevator mechanism is enclosed in a case, 2, fig. 428, and the line-justifying mechanism is also enclosed in a case, 7, fig. 429. These casings are useful for protecting the parts from external injury and from dust or other foreign matter, besides serving to retain oil and grease where lubrication is required.

The casting mechanism contains some special features, amongst these being the end-clamp, which is a spring-actuated slide of the same width as the matrices and rather more than five inches in length; this clamp follows the matrices into the elevator just before the casting is effected. The principal advantage of this device is to quad out or make blank the last portion of a line; this portion being any length from zero to five inches. This usually obviates any possible trouble with long or short lines, and enables the machine to cast blank slugs without composing a line of quad or space matrices. The right-hand end of the slug, shown in fig. 207, plate XI, and the slug preceding the tabular matter in fig. 255, plate XIV, were automatically made blank by this device. The construction of the justifier is such that spaces of equal size are supplied in any line which does not require any modification of length after justification.

The mould is water-jacketed and universal; it produces slugs with smooth sides except for the holes shown in fig. 255, plate XIV; the slugs are cast without ribs to permit them to be used in conjunction with loose type; the pins remain in the slug until it is ejected and ensure uniform height-to-paper. When it is desired to cast repetitions of a line of matter, of a line of blanks, of borders, of dashes, or of kindred work, the mechanism can be controlled so that the repetition is effected without distribution.

The metal-pot is capable of containing about sixty pounds of type-metal, and is heated by Bunsen burners which are controlled by a gas-governor, 8, fig. 429. It is stated that the delivery of the metal from the pot and the peculiar method adopted for venting are such as to produce a very homogeneous and clean-cast slug.

The machine is stated to be capable of running for several weeks without filling the waste-box, 13, fig. 428, which catches all the trimmings. The side-trimming knives are controlled by a quick-change device so as to cover all sizes of slugs within the scope of the machine, and also to be capable of dealing with the overhung two-line letter which commences many short advertisements.

The matrix-magazine containing a full fount of matrices weighs about forty pounds, and can readily be changed by interlocking it and sliding it a few inches to the right; the right pillar of the machine, 26, fig. 428, can be used for the storage of three magazines. It is stated that a change of magazine can be effected in thirty seconds.

The standard matrices are made from the smallest size up to 14-point; they are of brass and measure one-half inch by fifteen-sixteenths of an inch. The depth of the strike is 0·060 inch from the face of the matrix; distinguisher cuts are made on the reference-letter side of the matrix for distinguishing the fount to which each belongs. Each fount of matrices, regardless of size or face, carries its own combination of distinguisher cuts, and the fount-distinguisher, 1, fig. 428, can be set so that only the particular fount for which it is set will pass it.

The magazine contains 127 characters, but as many extra sorts as may be desired may be run as pie-matrices. The pie-matrices carry the combination of holes for opening the pie-matrix gate, 18, fig. 428; this allows them to pass down the pie-matrix chute, 2, fig. 429, into the pie-matrix box, 6, fig. 429. The pie-matrices are distributed by hand into the pie-matrix sorts-tray, 5, fig. 429.

In the process of composition pie-matrices are inserted by hand either at the top of the matrix-gatherer belt or at the assembler.

The space-matrices resemble the character-matrices except for the absence of the character-strike in the face. It is claimed that the use of solid space-matrices gives a longer life to the character-matrices, because of the absence of sliding motion under pressure which occurs where space-bands are used. Moreover, a set of solid space-matrices can be supplied for about a fourth of the cost of space-bands, and they are subject to less depreciation.

The alinement of the composed line of matrices is effected by locking them against the top of the elevator by lifting them from the top of the dovetail; this portion of the matrix is only used for this purpose. All matrices are made to a standard alinement regardless of fount or of body-size. A line of H's ranged from 5½-point to 36-point is shown in fig. 207, plate XI; above 14-point the matrices are used in the advertising machine.

The speed of the machine is beyond that at which the compositor can work. The casting mechanism runs at 8¾ revolutions per minute on all sizes of slugs from 2 to 18-point, or an equivalent of more than 26,000 ens per hour of medium width 6-point on a slug 13 pica ems long. It is stated that actual runs have been made at the rate of 22,000 ens per hour for short periods, and that no trouble is experienced in getting long runs averaging between 14,000 and 16,000 ens per hour, which is above the amount expected from the average operator. A cancel-key, 25, fig. 428, enables the operator to dispose of a complete line, or part of a line, without its being cast.

The machine above described is neat and compact; it weighs about 1550 pounds; it rests on a rectangular pillar base and takes up about half the floor-space required for a Linotype machine. The power necessary to drive it is stated to be 0·25 horse-power.

In addition to the standard machine just described the Bellows compositor is also constructed as an advertising machine to be used for large type for advertising and title-line matter. The two machines are identical except that the matrices from 13 to 36-point, the distributor, the magazine, and the keyboard are designed for seventy-seven characters only in the advertising machine, and that the mould is constructed so as to give a cored or hollow slug from 18 to 36-point. The ordinary standard mould being used for smaller sizes, the matrices from the standard machine can be run on the advertising machine. A 36-point slug is shown in fig. 255, plate XIV. The cores enable the weight of the 36-point slug to be reduced to such an extent that it weighs a little less than the ordinary 14-point solid slug of the same length. The casting speed of the advertising machine is $8\frac{3}{4}$ revolutions per minute, or the same as that of the standard machine. The smooth sides of the slug are even more advantageous in the case of advertisement slugs, as they allow all kinds of loose type, blocks, or furniture to work against them.

The Monoline, fig. 430, plate LXXVII, invented by W. S. Scudder, in 1892, is of American origin, though manufactured in other countries, and is remarkable for its great simplicity as compared with the other slug-casting machines. Reduction in the number of parts has been carried out consistently in the design, with the result that a very compact, much lighter, and much less costly machine has been evolved.

The keyboard, fig. 283, comprises ninety-six keys and a space-key, which are arranged in eight rows of twelve, the arrangement being very similar to the standard keyboard of the Barlock typewriter or of other machines which have no shift-key. There are, apart from space-matrices, fig. 202, p. 231, for line-justification, eight different kinds of matrix, fig. 193, p. 227, each kind carrying twelve strikes. The characters of a group are, of course, chosen so that they come on the same set width, fig. 431.

According to the particular key depressed, a matrix is released from the magazine compartment for the kind of matrix containing that sort, and is received on a stop, set by the key, so that it is at the proper level to bring the required character in line when it passes into the assembler. The space-matrix, fig. 202, p. 231, consists of a long steel wedge sliding between two short steel wedges, and is operated in the same way as the Linotype space-band, fig. 201, p. 231. The long wedge has a projection on the back against which the justifier pushes, lifting the wedges until the line is filled, but the distribution of the matrices after the line has been cast is effected in a much simpler manner. The hooks at the top of the matrices are arranged in a series of nine different lengths corresponding to the eight kinds of type-matrices and to the space-matrix. The selection into the nine magazine compartments is effected by sliding the matrices on their lower ends so that the hooks engage on a series of distributor-rails, which are then lifted and bring all those of each kind of matrix, which have been used in the line, opposite to their respective channels in the magazine, into which each kind is pushed laterally, off the distributor-rails, by a pusher.

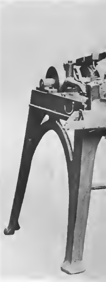


FIG.

PLATE LXXVII.

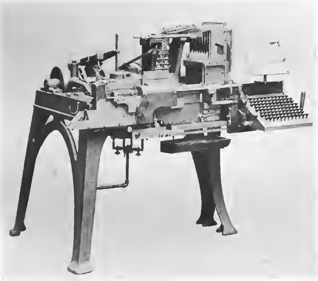


FIG. 430.—*Monoline; general view.*

[*To face page* 442.

The great gain in
however, at the expens
composing, line-justifyin
matrices which is subjec
from which the alinem
mentary guide-surfaces
quently wear of the alin
a number of strikes, mo
than are those with or

	1
bottom 1	7
2	6
3	en quad
4	5
5	8
6	0
7	1
8	2
9	3
10	4
11	9
top* 12	$

* Since, in composi
from the operator, it is

FIG. 431.—

damage, as an accide
renders the whole mul

The Monoline slugs

The Monoline machi
6 inches ; it weighs ab

The adoption in th
keys most used are pla
preferable to the me
described, in which the
of the characters or on

The great gain in simplicity in the Monoline machine is obtained, however, at the expense of accuracy in the product. In other matrix-composing, line-justifying and slug-casting machines that portion of the matrices which is subjected to wear on the guides is not the same as that from which the alinement is determined; this arrangement of supplementary guide-surfaces is not practicable in the Monoline and consequently wear of the alining surfaces is inevitable. Matrices with so large a number of strikes, moreover, are more difficult to produce commercially than are those with only two strikes, and they are also more liable to

	Kinds of matrices.							
	1	2	3	4	5	6	7	8
bottom 1	7	$\frac{7}{8}$	q	!	;	Z	@	&
2	6	$\frac{3}{4}$	b	)	‘	p	...	Y
3	en quad	$\frac{1}{2}$	g	?	thin space	L	em quad	U
4	5	$\frac{1}{4}$	a	e	i	T	m	R
5	8	y	o	t	,	O	H	w
6	0	fi	n	s	l	D	W	A
7	1	ff	h	r	f	F	M	G
8	2	x	d	c	.	B	—	E
9	3	fl	u	I	-	S	ffi	N
10	4	$\frac{1}{8}$	p	z	j	C	ffl	X
11	9	$\frac{3}{8}$	v	*	’	J	K	V
top* 12	$	$\frac{5}{8}$	k	(	:	Q	℔	£

* Since, in composing, the matrices are added to the right, with their faces from the operator, it is necessary that the strikes should be inverted.

FIG. 431.—*Monoline; arrangement of strikes on matrices.*

damage, as an accident to the feather-edge of any one of the strikes renders the whole multiple matrix useless.

The Monoline slugs are delivered into a galley in column.

The Monoline machine occupies a space of about 3 feet 6 inches by 4 feet 6 inches; it weighs about 800 pounds and requires about 0·17 horse-power.

The adoption in the Monoline of a rational keyboard in which the keys most used are placed close together is, in the opinion of the authors, preferable to the methods adopted in some of the other machines described, in which the arrangement of keys is dependent on the set widths of the characters or on some constructional peculiarity of the machine.

The Typograph, figs. 432 to 445, plates LXXVIII to LXXXIV.—This machine, invented by John R. Rogers, about 1888, was first constructed in America. It was bought up so far as that country was concerned by the Mergenthaler Linotype Company in order to acquire the rights of the wedge-space invented by J. W. Schuckers. The Typograph continued to be made in Canada and Germany, and was reintroduced into this country in 1908.

The space-disks, fig. 204, p. 232, are used in pairs one above the other, and are rotated equally so that the long stems of the letter-matrices are kept

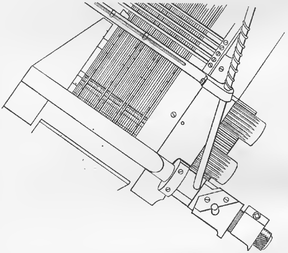


FIG. 437.—*Typograph; assembly-channel filled with single-letter matrices and vice-jaw closed ready for line-justification.*

parallel. Two steel bars of square section form the magazines for the space-disks; each of these bars is separate from, but forms the continuation of, the end of one of the square steel line-justifying shafts. In the normal position of these shafts, relatively to the bars, the space-disks can be made to slide freely from the one to the other in either direction. The hole through the centre of the main part of the space-disks is square, which enables this piece to be rotated relatively to the plate *b*, fig. 204, p. 232, the arm of which is held in a groove in a brass guide. The letter-matrices on each side of a pair of space-disks are thus wedged apart by the action of the helical surfaces; equal rotation of the two square shafts is effected by spur gears on the overhung ends of the shafts engaging with a rack which is spring-propelled on the line-justifying stroke.

PLATE LXXVIII.

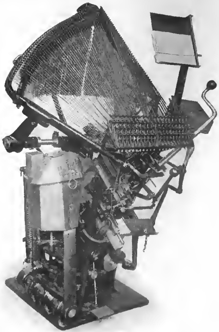


FIG. 432.—*Typograph; normal composing position of upper part; front view.*

[To face page 444.]

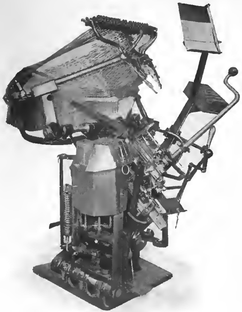


FIG. 433.—*Typograph; distributing position, upper part tilted back; front view.*

PLATE LXXIX.

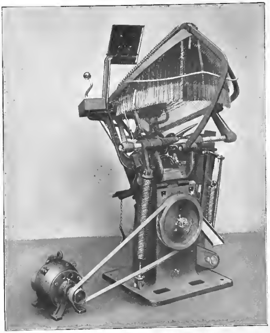


FIG. 434.—*Typograph; normal composing position of upper part; back view.*

To face page 445]

Figure 437 shows a line of single-letter matrices ready for line-justification, and fig. 438 shows the line after the shafts have been partially rotated to the requisite extent to make the space-disks fill out the line.

At the top of the machine, fig. 432, plate LXXVIII, is the keyboard, together with the escapements and magazine. The keyboard comprises eighty-four keys, the arrangement of which for the English language is shown in fig. 278, p. 294 ; since the matrices do not leave the wires it is possible to adapt the machine to any other language without either the necessity for specially designing the faces to any particular system of set widths or the need for modification of the magazine, escapements, etc. It is, in fact, as easy to

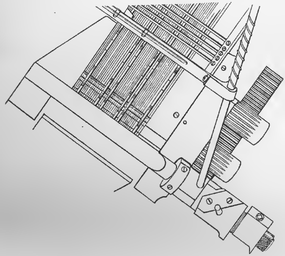


FIG. 438.—*Typograph ; line of single-letter matrices, line-justified ready for casting.*

adapt the machine to use other characters as it is so to adapt a typewriter. The escapement, fig. 439, is operated by a rod from the key ; it is of the shears variety, the pull on the rod raising the first blade and releasing the first matrix after the second matrix has been checked by the second blade of the shears. On the return of the key, the second matrix is allowed to come forward into the place occupied by the first matrix after the first blade has descended far enough to check its further movement. When the upper frame of the machine is tilted back the escapements, which are carried on a separate frame, are raised clear of the wires by a lever having an eccentric movement, so that the matrices can return freely to the ends of their respective wires. The escapement-frame comes back into position on commencing the return movement, so that the escapements are in place before the wires reassume a horizontal position.

The operation of tilting the upper portion of the machine back also ensures the return of the two sets of space-disks to their respective places on their magazine-bars, this being effected by a cam on the magazine-shaft operating a rack, which turns a pinion on a vertical shaft carrying two levers; these act respectively upon the two space-disk shafts on which the space-

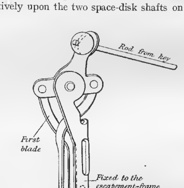


FIG. 439.—*Typograph; matrix escapement.* Scale: full size.

disks are threaded. These space-disks are released by a key-button just above the keyboard proper.

The operations of assembling and line-justifying are shown in the four figs. 440 to 443, plates LXXXI and LXXXII, the reference numbers in each of these being the same.

In fig. 440 the machine is shown at rest, neither the matrices, nor the space-disks being in the assembling-place which is open ready to receive them; the vice-jaw 1 is in the open position and the square shaft 2 is empty.

The part 3 is a removable stop-piece which can be changed when the mould is altered for varying the length of line. The two bars 4, 4 serve as a bearing to carry the matrices while being assembled, and to support them against the pressure of the metal-pot when the cast is being made. The alining bar 5 provides the bearing-surface for the feet of the matrix-bars to rest on during line-justification. The vice-jaw 1, connected to this bar, closes the assembling-place when the composition of the line has been completed, and keeps the line of matrices in position during the casting operation. There is an adjustable mark 6 above these parts, which shows the width of line to which the machine has been set to correspond to the mould in use. This mark warns the operator when he must finish the line and start the casting operation. The part 7 shown below the alining bar is called the gripper; it is mounted on the shaft carrying the mould-arm and bears against one of the notches in the matrix-bars pressing them up so that one of the back notches bears against the alining rib. This operation takes place at the same time that the space-disks revolve and spread the line, the final justification of the line being performed after alinement has been effected.

The operations described here relate to the two-letter matrix. The description of the single-letter matrix shows how the position and action of the alining bars must differ in the single-letter machine. In the two-letter machine the gripper moves up to aline the matrices; in the single-letter it moves down.

Figure 441 shows the assembling-block with a line of two-letter matrices composed, but free; the space-disks, nine of which are shown between the ten words composed, are barely visible as they occupy that position which presents the narrowest face towards the mould.

Figure 442 shows the vice-jaw in its erect position ready for closing in to the proper length of line indicated by the mark 6. This closing is effected automatically on moving the starting-handle. When the vice-jaw 1 has reached the position corresponding to the proper length of line the space-disks, which have up to this time remained stationary, rotate by the action of the rack on the two pinions. The space-disks can assume any width from two to nine points.

Figure 443 shows the arrangement of the matrices after line-justification has been completed. The increased width occupied by the space-disks, as compared with that shown in fig. 442, is easily seen. The gripper 7 holds the matrices in position for alinement. The mould is then brought up and held against the matrices pressing them against the back bars 4, 4. The metal-pot with its mouthpiece is then brought to face the tang-plate of the mould making the whole space to be filled with metal air-tight, except for the small air-ways ground into the face of the mould. The pump now operates and the slug is cast. After a slight pause, the pump and mould return to their original position and the line of matrices is then unlocked.

While the above operations are taking place the compositor is reading his copy, and as soon as the casting has been made the top of the machine or magazine tilts back automatically, thus distributing the line of matrices, after which operation it returns to its normal position; the compositor can then commence setting the next line. The upper portion of the machine is locked from the moment of moving the starting-handle until the casting has taken place.

After the matrices have been unlocked the tang-plate rises, cutting the tang clear from the slug; when the tang-plate has reached its upper position the slug-ejector comes into operation, partially ejecting the slug ready for the trimming-knives to operate. After the knives have completed their stroke the slug is ejected and travels down a chute to the galley; the tang is ejected from the tang-plate by the small ejector, and the various parts return to their positions of rest in readiness for the next casting operation.

The slugs being smooth on both sides, lines of single type can readily be composed and used alongside of them.

The time occupied in performing the cycle of casting, distributing and returning the magazine to its normal position is three seconds. Immediately the cycle is completed, the operator, who in the meantime has been reading his copy, proceeds with the next line, simultaneously with the operation of trimming and ejecting the slug. It is stated that in practice the time occupied by the casting and distributing operations is equal to that required by the operator for reading his copy, and consequently no time is actually lost. The copy-holder remains fixed in its place while the upper portion of the machine is tilted.

Where repetitions of a line are required, it is merely necessary to move a lever which throws the distributing mechanism out of action and leaves the line of matrices standing, and to move the starting-handle as soon as each slug has been turned out. The time occupied in the cycle of operations necessary for the repetition of a line of which the matrices are standing is the same as the period of three seconds required for dealing with a newly assembled line.

In its earlier form the Typograph dealt with one face only, but its range was soon after increased by the adoption of the two-letter matrix. Change of face from the one strike to the other is effected by a shift-key, similar to that of a typewriter. Change of the complete fount or founts involved removing the entire top of the machine, including the keyboard, by taking out four screws; a duplicate top complete with magazine and keyboard was then substituted for the one removed.

According to the latest improvements change of fount is now performed by the following method: racks, each of which forms a continuation of the matrix-guides, are provided for fitting on to the frame of the magazine, on its right and left sides respectively, from which they are readily detachable. Under normal working conditions

PLATE LXXX.

FIG. 435.—*Typograph; line of single-letter matrices composed and line-justified.*

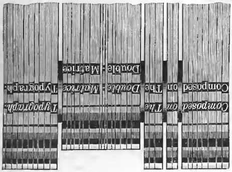


FIG. 436.—*Typograph; line of two-letter matrices composed and line-justified.*

[*To face page* 448.

PLATE LXXXI.

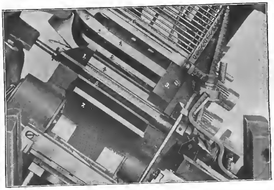


FIG. 440.—*Typograph; assembly channel empty.*

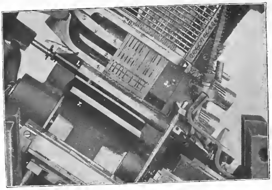


FIG. 441.—*Typograph; assembly channel filled with line of two-letter matrices.*

To face plate LXXXII.]

FIG. 442.—*Typogr*

FIG. 443.—*Typ*

PLATE LXXXII.

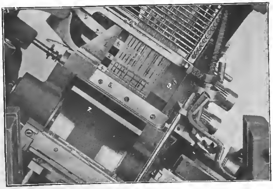


FIG. 442.—*Typograph; vice-jaw closed but line not yet line-justified.*

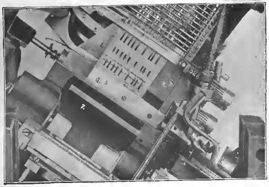


FIG. 443.—*Typograph; matrices line-justified ready for casting.*

[*To face plate LXXXI.*

PLATE LXXXIII.

[To face plate LXXXIV.]

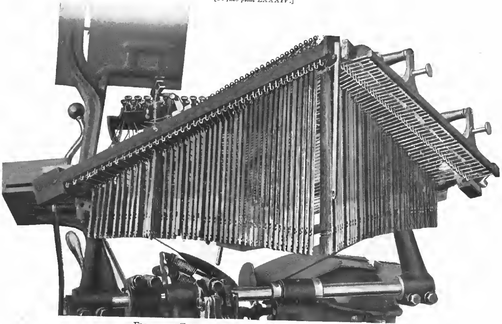


FIG. 444.—*Typograph; rack in position for changing fount.*

PLATE LXXXIV.

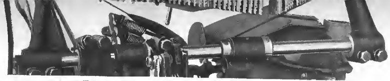


FIG. 444.—*Typograph; rack in position for changing fount.*

PLATE LXXXIV.

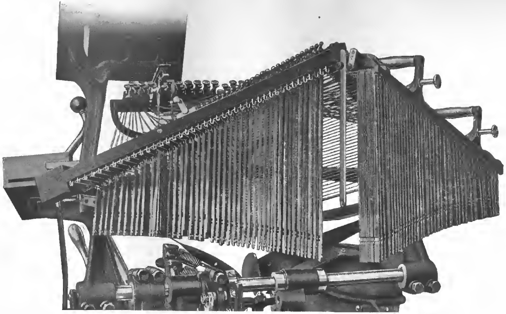


FIG. 445.—*Typograph; matrices transferred from magazine to the rack, ready for removal.*

To face plate LXXXIII.]

PLATE LXXXV.

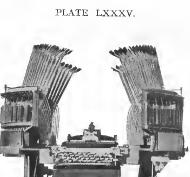


FIG. 446.—*Rowotype matrix-composing machine.*

To face page 449.]

these racks are absent an
return against a stop-rail e
magazine. The action of f
the stop-rail and gives the
matrices to pass off the gui
upwards in a plane at rig
plate **LXXXIII**. This ben
hook when the matrices sli
has been effected, with the r
LXXXIV, the rack carrying
duplicates the stop-rail, can
another fount can be sub
removed serves as a holder
again required.

When it is also requir
mould, which is retained in
end, is released by the withd
and one of another body-s
new mould into the socke
and secure it in place witho

No adjustment of the
necessary, but the knife-bl
sponding to the new body-s

A complete change of f
of any tools in less than th
throughout the operation.

The output of the Typogr
per hour, according to the s

The capacity of the meta
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The machine weighs abo
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for a machine and its ope
allowance suffices where a b

The power required to r

The Rowotype, fig. 44
machine in which there are
are different characters carr
all of the banks contain sev
being as many of each chara
The matrices are plain and
the matrix-bars. These b
the hinges being concentric
are two concentric arcs of
machine.

these racks are absent and when the magazine is tilted the matrices return against a stop-rail extending the whole width of each side of the magazine. The action of fitting the rack on to the magazine-frame raises the stop-rail and gives the matrices access to the rack; to enable the matrices to pass off the guide-wire the latter is bent downwards and then upwards in a plane at right angles to its length, as shown in fig. 444, plate LXXXIII. This bend passes through the opening in the matrix-hook when the matrices slide off on to the rack. When the transference has been effected, with the magazine in a horizontal position, fig. 445, plate LXXXIV, the rack carrying the matrices, secured by a locking-bar which duplicates the stop-rail, can be removed and a similar rack which carries another fount can be substituted for it. The rack which has been removed serves as a holder for the particular fount it carries until it is again required.

When it is also required to make a change in the body-size, the mould, which is retained in its socket by a spring-propelled bolt at each end, is released by the withdrawal of these bolts; it can then be removed and one of another body-size substituted for it by simply pressing the new mould into the socket. The bolts then close upon it automatically and secure it in place without further adjustment.

No adjustment of the knives when changing the size of the body is necessary, but the knife-block is instantly detached and another corresponding to the new body-size required is substituted for it.

A complete change of face and body can be effected without the use of any tools in less than three minutes; the keyboard remains untouched throughout the operation.

The output of the Typograph is stated to average from 6000 to 12,000 ens per hour, according to the skill of the compositor.

The capacity of the metal-pot is about 40 pounds of metal; it is heated by gas, the quantity required being about 11 cubic feet per hour.

The machine weighs about 9 hundredweight. It occupies a floor-space about 2 feet by 2 feet and stands about 5 feet high; the space required for a machine and its operator is about 6 feet by 6 feet, but a smaller allowance suffices where a battery of several machines is installed.

The power required to run the Typograph is about 0·25 horse-power.

The Rowotype, fig. 446, plate LXXXV, is a matrix-composing machine in which there are as many sets or banks of matrix-bars as there are different characters carried by the machine, at present eighty-four, and all of the banks contain several matrices bearing the same character, there being as many of each character as can be required for the setting of a line. The matrices are plain and are attached to the upper and inner ends of the matrix-bars. These bars are hinged at their lower or outer ends, the hinges being concentric with the central and assembling position. There are two concentric arcs of the matrix-bars, one arc on each side of the machine.

2 G

When the matrix-bars are released, they drop by gravity, turning about the hinges, and the matrices enter the composing-race at the centre of the machine. The matrix-bar escapements are electrically operated through covered wires formed into a cable and carried to eighty-five contact-points at the front of the machine.

In front of these eighty-five points is fixed a standard shift-key typewriter, and each key depression of the typewriter made when the operator fingers the keyboard causes the depression of a corresponding matrix or spacer. The operator can insert paper in the typewriter and obtain a typewritten copy as the composition proceeds. The typewriter can, moreover, be removed for use as a typewriter and readily replaced.

The line of matrices is assembled in a vertical position, and the slug is cast in the same position as the matrices stand, that is to say, reading from the bottom to the top of the line.

The justification is effected by means of pairs of space-wedges dropped between the matrices at the end of each word.

Cut-outs prevent the machine from starting if overset or underset. The machine locks and justifies the line of matrices at the place of assembly, consequently the time of transfer is not lost by the matrices, but, as in the case of the Typograph, it is necessary for the whole of the casting operation to be completed and the matrices returned to their initial position before the operator can proceed with the composition of a second line.

The Rowotype occupies between 5 and 6 square feet of floor-space.

Many other slug-casting machines have been proposed and some of these have been made experimentally; amongst those which have achieved a fair measure of success are: the *Linotype Junior* evolved from the Typograph, and the *Barotype* invented by H. F. Brown. The Barotype, according to J. S. Thompson, resembles the Monoline in its multiple-strike matrix, the Bellows or Electric Compositor in its use of hollow temporary space-matrices, and like these and the Typograph it produces a smooth-sided slug; as in the Linotype the matrices are provided with distributor-teeth.

The Grantype.—In considering the evolution of machines which perform the complete cycle of operations, it may have been noticed that a limitation was imposed on the speed and freedom of the operator by the necessity for casting characters consecutively in one mould as in the Monotype, Stringertype, etc., and that further invention was directed to multiplication of the mould, as in the Dyotype, for the purpose of overcoming this difficulty.

The same tendency was observed in those machines which perform casting alone in its various forms, from the early pivotal machine with its single mould, to the Foucher machine with duplex moulds, and ultimately to the Wicks machine with its hundred moulds. The total number of characters composed per minute by the fastest operators on the Linotype machine greatly exceeds the maximum number of type which a single mould is capable of producing within the same interval of time, and this fact has had its influence on the development of the class of machines which perform the operation of composing independently of that of casting, such as the Monotype.

In order to obtain the maximum speed of which the operator is capable, and at the same time effect the casting of a line of loose type, it is obvious that a multiple mould or its equivalent must be used if the automatic portion of the mechanism is to be capable of working so rapidly that, in no circumstances, will it cause delay to the operator. In other words, it must be as easy to operate as are the slug machines so widely in use at present, and must perform the operations of casting, removing, and distributing the matrices within the time period allowed in the slug machine.

The slug machine is capable of creating a very large and increasing percentage of the typographical surfaces required for the production of printing of an ephemeral and periodic nature, but in spite of all improvements that have been made in slug machines, their work has not, up to the present, proved entirely satisfactory for the whole range of printing, owing largely to the inherent disadvantages that must always accompany the use of a slug. The authors do not by this mean to imply that the use of a slug is of itself a disadvantage, for it may actually, as in the case of newspapers, be of the very greatest assistance in facilitating the handling of the composed matter. In fact, inventions have been made and patented for securing loose type after composition in the form of slugs; of this Hanigan's patent, referred to in the next chapter, is an example. This property is also recognized in the machines that form the type-bar class, also described in chapter XXX. In the best-known and most practical of these machines, the major portion of the slug consists of a metal bar of body thickness and of less than normal height-to-paper, into which the characters forming the typographical surface are successively fed while the groove in the block is sprung open to receive them, closing when the line is finished, and, usually, line-justified as well.

For very many purposes, however, the printer finds it necessary to have more freedom than is given by slug machines of any kind, and the advantages of a loose-type machine are always making themselves apparent to him, a fact which is strikingly brought out by the large and increasing application which the Monotype machine has found in the last few years.

A class of machine, however, in which the speed of the operator at the keyboard and the speed of the casting machine are different, and the perforated record of which can be read by few people even with difficulty and by most people not at all, has very grave disadvantages in the production of book-work, in which case the time elapsing from the commencement of a work till its final revision ready for the press is considerable. Not only is it necessary to arrive at the correct proportion of keyboards and casters to perform the work demanded by the particular conditions of each installation, or to have some machines of one class or of the other frequently standing idle, but also any amendment or correction wanted in the proofs must necessarily demand the use of machines of each kind consecutively. It is clear, therefore, that the requirements of the printer are more adequately met by a machine which, for want of a better word, may be spoken of as having greater flexibility. A one-man machine performing the complete cycle of operations of composing, line-justifying, and casting —at a single cast—a line of individual type composed into a galley, is, consequently, the highest ideal of the book-printer producing high-class work.

Briefly described, the chief differences between the Grantype and its parent, the Linotype, are as follows:—

1. The matrix is made to carry, as an integral part of itself, a portion of mould forming a division between the type cast against it and against the succeeding matrix.
2. The justification of the line which has to take account of a constant added thickness in the space-matrix, and a proportionate added thickness in the type or quad matrices, apparently complex in theory, and involving considerable investigation, is simple in practice. Several modifications of line-justifying mechanism have been elaborated according to the general form of the machine.
3. Owing to its peculiar form the matrix is required to be turned through 90° on its way to the mould and back again on its way to the magazine.
4. The pump is made with a combination of plungers coupled to a common cross-head so as to produce a sufficiently constant flow of metal over the entire width of the mould or comb.
5. Special forms of tang-break have been devised for enabling the complete tang to be sheared from the comb formed by it and the individual type as cast.
6. The mould, which is water-cooled, is arranged in such manner that its ends can be removed for the ejection of the completed line of type to the galley.
7. The form of break adopted and the method employed for removing the tang are such that it is possible to use hard metal as in founders' type.
8. The depth of strike is identical, both as to shoulder and as to counters, with the best products of the typefounders.
9. Like the Linotype, the speed of the machine is not limited by mechanical considerations, but only by the capability of the operator.

Except to the expert the machine would appear to be an ordinary Linotype machine.

CHAPTER XXX.

IMPRESSION MACHINES, TRANSFER MACHINES, TYPE-BAR MACHINES, PHOTOGRAPHIC AND UNCLASSIFIED MACHINES.

"First impressions are best." *English Proverbial Saying.*

12-point cheltenham old-style (American Type Founders Co.).

"Fair exchange is no robbery." *English Proverbial Saying.*

10-point cheltenham bold (American Type Founders Co.).

"A soft head is misplaced upon a strong body."
English Proverbial Saying.

10-point cheltenham wide (American Type Founders Co.).

"Look here, upon this picture, and on this."
Shakespeare.

8-point cheltenham bold expanded (American Type Founders Co.).

"'E were a man of no class," said Bill sententiously, spittiog through his incisors from the bunk; "we couldn't put him oowheres; leastwise me and my mates couldn't. Goa-Joe, our Portugee cook what came from Indier, said 'e were entered for no Caste at all, and I misdoubts that 'is words were true."
Sucupira Smith.

8-point cheltenham old-style (American Type Founders Co.).

Impression machines.—A great deal of time, not very profitably spent either by readers or authors, would be taken up if the subject of impression machines was discussed at any length, for, though the class of these machines is large, and they have engaged the attention of numerous inventors—the most notable among whom was Ottmar Mergenthaler, subsequently the inventor of the Linotype machine—this form of composing machine has never been a success. The difficulties are inherently almost insurmountable. The broad feature of these machines is the impression from male dies, of the letters desired, character by character, or the impression of a complete line at a time from male dies assembled in the desired position and order, in some more or less soft material, metallic or non-metallic, which impressions later serve as a mould from which to cast a slug or stereotype-plate with the required relief characters upon it. Methods and details may vary, but the principle remains the same. Some of these machines are exceedingly ingenious and costly, and have done good work in what may be termed the experimental stage, but the difficulty of justification and other practical drawbacks have, as far as the authors are aware, prevented any of them from becoming really commercial. The most interesting facts in connexion with these machines are that, as already mentioned, Ottmar Mergenthaler spent much time on them, and that J. W. Schuckers, while working on an impression machine in 1885, invented the double-wedge justifier, which, as J. S. Thompson well says, proved to be a very important invention in the art of printing. It was curious that Schuckers only just preceded Ottmar Mergenthaler in filing his application for the patent, and as it was decided that he was the prior inventor, the Mergenthaler Linotype Company was compelled to buy his rights in order to use this spacer in the Linotype machine. The price given is stated to have been $416,000, and is said to be the largest sum ever paid up to that time for a single patent. It is also interesting to note that John R. Rogers, inventor of the well-known Typograph, was in 1888 the inventor of the only impression machine ever put into practical use, this being the original Typograph, which was an impression machine. Like Ottmar Mergenthaler, this inventor also developed his machine on similar lines, namely, the casting of the slug from an assembled and line-justified line of matrices.

Another incident also worth mentioning in connexion with these machines, which have been so fruitful in causing the discovery of cognate and highly practical inventions, was that Charles Sears, while working on one in 1898, evolved a differential feed for the carriage of a typewriter.

Among a number of impression machines may be mentioned the Typomatrix, the St. John Typobar, Fowler's impression machine, and the Heath matrix-typograph. A reproduction of an illustration of one of these machines, namely, Fowler's impression machine, fig. 447, plate LXXXVI, is given to show what important and powerful machines some of these were, and to afford an idea of the large amount of time and money and effort that has been wasted to accomplish what has so far been found to be, if not practically impossible, at least a commercial impossibility in competition with the ordinary slug-casting machines. Further particulars of machines of this class are given in "The History of Composing Machines," by John S. Thompson, from which the illustration shown in fig. 447, plate LXXXVI, is reproduced.

According to the writer cited, a few of the Rogers impression Typograph machines are still in operation in the United States of America, but as far as the authors are themselves aware, none of these machines has had any real practical or commercial success; for, apart from the troubles arising from line-justification, the embarrassments due to distortion and the

FIG. 44

PLATE LXXXVI.

FIG. 447.—*Fowler's impression machine.*

[*To face page* 454.

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CALCULATING MACH

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CALCULATING MACHINES PRODUCING STEREOTYPE-MATRICES.

The most important impression machines ever made or proposed to be made are the calculating machines of Babbage and of Scheutz, in which the typographical operations are confined to the impression of figures for tabular work.

The tremendous labour involved in the calculation of tables of logarithms, of the trigonometrical functions of angles, of annuities and of astronomical tables such as those published in the "Nautical Almanac," as well as of other tables, is only a part of that necessary for the final production of the printed works of reference. Errors may occur in transcription from the computer's sheets on to the copy; they may be introduced by the compositor setting a wrong type through the preceding operation of distribution having been imperfectly performed; they may be subjected to error through the compositor misreading the copy or lifting the wrong sort, and again, even after the proof has been read, errors may be introduced by transposition of the figures or by mistake in correcting when the proof is being revised; in fact the work of checking tables, such as those of the "Nautical Almanac," is a most onerous and responsible matter, for there is practically no context to go by and the probability of an error passing uncorrected in a mass of figures is far greater than that of a mistake remaining in a literary work. Charles Babbage himself took the precaution to check his tables of seven-figure logarithms figure by figure with those of Vega, Callet, Briggs, Taylor and others, in all *nine* times, and yet, just before stereotyping no less than thirty-two errors were detected; after stereotyping eight more were found and corrected in the plates. The large tables of Prony, which were calculated in France by a staff of six mathematicians, six assistant mathematicians, who converted the formulæ to numbers, and from sixty to eighty computers, remain in seventeen folio volumes of manuscript still unpublished, though 100 pages were actually set up by Didot of Paris. The enormous amount of time occupied in the calculation and in checking the copy, and the even heavier work involved in checking the proofs, led Babbage to the invention of mechanism which would enable the whole of this purely mechanical work to be performed by machinery instead of by human agency.

Allusion has been made earlier in this work to calculating machines and to their evolution from the original adding machine invented by Pascal. The principle of the Babbage calculating machine may be briefly explained by means of the following simple examples :—

The squares of the natural numbers 1, 2, 3, 4, 5, . . . form the simple mathematical series 1, 4, 9, 16, 25, . . . If it is desired to calculate many terms of this series, it is found that if each term in it is subtracted from the term which succeeds it, the new series that is obtained is 3, 5, 7, 9, 11, . . . which may be termed the first differences. If these first differences are again subtracted from each other, the series obtained is 2, 2, 2, 2, 2 . . . which may be termed the second differences. If these differences are again subtracted in the same manner the third differences, 0, 0, 0, 0, . . . are obtained; the series is said to be of the order $\Delta^3 = 0$. These figures may be arranged as shown in table 46.

In the arrangement adopted in the table for the series under investigation, any square above 3 consists of the sum of the immediately preceding

TABLE 46.—*Squares of the natural numbers.*

Natural number N.	Square of number N^2.	First difference Δ^1.	Second difference Δ^2.
1	1	3	2
2	4	5	2
3	9	7	2
4	16	9	2
5	25	11	2
6	36	13	-
7	49	—	-

square and of the differences taken diagonally upwards across the table to the right. Thus: $25 + 9 + 2 = 36$.

In this simple example only two differences are required, but if a slightly more complex case is taken, that of the number of units in tetrahedral piles of shot, the series is obtained by the summation of the successive triangular layers of shot:—

The numbers contained in the piles form the series 1, 4, 10, 20, 35, 56, 84, . . . Treating this series by successive subtraction in the same manner as the squares of numbers, the first differences obtained are: 3, 6, 10, 15, 21, . . . ; treating these again by subtracting, the second differences are: 3, 4, 5, 6, . . . ; and treating these by subtraction for a third time the differences are: 1, 1, 1, . . . , after which the fourth differences are 0. This series is said to be of the order $\Delta^4 = 0$.

These figures may be arranged as shown in the following table:—

TABLE 47.—*Number of shot in piles.*

Number of layers of shot.	Number of shot in the pile.	First difference Δ^1	Second difference Δ^2	Third difference Δ^3
1	1	3	3	1
2	4	6	4	1
3	10	10	5	1
4	20	15	6	1
5	35	21	7	–
6	56	28	–	–
7	84	—	–	–

This table shows that for the series under investigation the number of shot in any pile above 20 consists of the sum of the immediately preceding pile and of the differences taken diagonally upwards across the table to the right. Thus: $35 + 15 + 5 + 1 = 56$.

Now most of the figures required for the tables used in calculations are obtained from the summation of the terms of a series, and it is possible, in practically all cases, to obtain a series which is convergent; a familiar example of a convergent series is

$$\epsilon = 1 + \frac{1}{1} + \frac{1}{1 \times 2} + \frac{1}{1 \times 2 \times 3} + \frac{1}{1 \times 2 \times 3 \times 4} + \ldots = 2{\cdot}718281828 \ldots$$

As the terms diminish rapidly in value a very limited number suffices for obtaining as many figures as are necessary for the degree of accuracy required in calculations of almost any kind based on measurements and statistics, and the six orders of differences adopted by Babbage would have been adequate to most practical requirements.

Translating the mathematical requirements shown by the tables of differences, the mechanism was so contrived that whatever might be the numbers placed respectively on the figure-wheels of each of the different columns, the following succession of operations took place when the handle was worked. Whatever number was shown on the column of first differences, would be added to the number on the table column. The same first difference remaining on its own column, the number shown on the column of second differences would be added to that first difference, and so on for other columns. The first half-turn of the handle

TABLE 48.—*Cubes of the natural numbers.*

	Numerator column.	Table column.	First difference column.	Second difference column.	Third difference column.
	–	1	–	–	–
	–	2	9	3	–
	5	5	1	6	6
After first two half-turns,	–	2	1	–	–
	–	1	2	4	–
	6	6	7	2	6
After second two half-turns.	–	3	1	–	–
	–	4	6	4	–
	7	3	9	8	6

performed the adding from wheel to wheel across the columns, while the second half-turn effected those carrying operations which may have been rendered necessary by the preceding additions or by the carrying operations themselves.

In the Babbage machine, a portion of which is shown in the illustration, fig. 448, plate LXXXVII, the reading wheels were arranged vertically over each other, so that the figures read downwards, the lowest wheel giving the units digit, the one above it the tens digit, and so on.

Thus in calculating the cubes of the natural numbers the figures 125 appear on the table column; 91 on the first difference column;

PLATE LXXXVII.

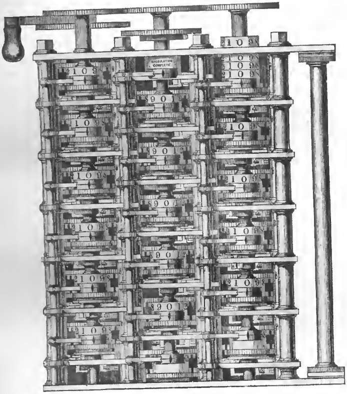

FIG. 448.—*Babbage difference engine.*

[*To face page* 458.

PLATE LXXXVIII.

[To face page 459.]

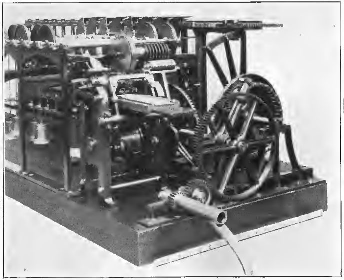

FIG. 449.—*Scheutz difference engine. Side view; with scale of inches.*

74	4·5366370
75	4·4925954
76	4·4453765
77	4·3947357
78	4·3404171
79	4·2821542
80	4·2196694
81	4·1526742
82	4·0808691
83	4·0039438
84	3·9215768
85	3·8334361
86	3·7391782
87	3·6384491
88	3·5308837
89	3·4161059
90	3·2937288
91	3·1633545
92	3·0245741
93	2·8769679
94	2·7201050
95	2·5535438
96	2·3768318
97	2·1895053
98	1·9910900
99	1·7811002
100	1·5590397
101	1·3244012

FIG. 451.—*Print from a stereotype cast from one of the original impression matrices, prepared on the Scheutz machine for Dr. Farr's "English Life Table."*

36 on the second difference column; and 6 on the third difference column. By making two half-turns of the handle, 91 is added to 125, giving 216 on the table column; 36 is added to 91, giving 127 on the first difference column; and 6 is added to 36, giving 42 on the second difference column. Another two half-turns of the handle give the figures in the columns respectively as 343 in the table column and 169, 48, and 6 respectively in the first, second and third difference columns. The arrangement of the figures before and after the first two half-turns of the handle and after the next two half-turns of the handle is shown in table 48.

In the portion of the machine assembled in 1833 and now at South Kensington the upper wheels of one column serve as the numerator or counter and give the natural number of the series shown above. A wheel below the units wheel on the central column serves for the third differences, which cannot exceed nine in this case; this arrangement was adopted for the sake of compactness, and to avoid the use of an extra column for this single difference wheel. Another but smaller portion of the machine is in University College, London.

It was intended to construct the machine for calculating six orders of differences each to twenty places of figures, so that the machine would have required six sets of wheels in its width and twenty in its height. In the work on "Babbage's Calculating Engines" by General Henry P. Babbage, the son of the inventor, it is shown that the construction of the difference engine was fraught with many difficulties. It was necessary to design many special machine-tools and other appliances for the production of the large number of identical parts required for the difference engine. Difficulties, moreover, occurred with Clement, the engineer, with regard to the ownership of these special tools and appliances, and further difficulties were encountered in the typographical portion of the machine.

When Clement stopped work on the Babbage difference engine, in 1833, amongst the workmen discharged was a young mechanic, who afterwards became world-famous as Sir Joseph Whitworth. It is to the interest and to the active part taken by him in the preparation of parts of the difference engine that we owe the very groundwork of all modern engineering—standardization—and the great advance made by Whitworth through the introduction of gauges of high degree of accuracy and machine-tools of such excellence as enabled others to approach his standards.

It has been mentioned that Charles Babbage invented another machine capable of a greater range of work than was within the capacity of the difference engine—a machine which he styled the analytical engine. So much investigation had been made of the possibilities of this engine, and of the claims of Babbage, supplemented by a series of elaborate drawings with a unique and simple system of notation devised by the inventor, that the question of the construction of the machine was investigated by a committee of the British Association appointed in 1878, consisting of

Prof. Cayley, Dr. Farr, J. W. L. Glaisher, Dr. Pole, Prof. Fuller, Prof. (now Sir) Alex. B. W. Kennedy, Prof. Clifford, and C. W. Merrifield, "To consider the advisability and to estimate the expense of constructing Mr. Babbage's Analytical Machine and of printing tables by its means."

From the conclusions arrived at by the committee it appears that the drawings for the analytical engine were not what would, even at that time, have been considered proper working drawings; the drawings did not give the limits as modern drawings would, and it was found that further invention might be necessary to bring the design to such a point that a more definite conclusion could be drawn as to the ability of the machine to perform the work for which it was intended; further, the committee was unable to give any estimate of the cost of the machine from the data laid before them; it made, however, certain recommendations as to the possibilities of a less elaborate machine, for the calculation of determinants and for the solution of simultaneous equations.

Probably the most admirable of the many ingenious inventions of Charles Babbage was the anticipating carriage which he devised for the analytical engine.

A large amount of work was done by General H. P. Babbage on that portion of the analytical engine which his father styled the "mill." This portion of the machine, which is the property of General Babbage, was exhibited at the Japanese-British Exhibition in 1910 and at the Coronation Exhibition in 1911; it is at present in the South Kensington Museum, where, by the kindness of the owner, one of the authors had an opportunity of inspecting it. This machine has been provisionally fitted with a printing device, of the ribbon-printing class, to enable the work done to be checked.

The other portion of the analytical engine in the South Kensington Museum has an impression device somewhat similar to that fitted to the Scheutz machine, but the authors are informed by General Babbage that it was proposed by the inventor to adopt a toggle action instead of a cam for obtaining the impression.

The analytical engine was arranged to print, in all, twenty-five figures in the width of the stereotype-matrix, and the number-wheels are engraved with a modern face of pica body.

The difference engines actually constructed and completed were those of Scheutz, a printer of Stockholm, Sweden, who was assisted by his son. The first Scheutz machine is stated to have been capable of calculating terms of five figures with three orders of differences of five figures each, and of printing its results. The second machine, which went to America, could calculate series with four orders of differences each of fifteen figures; it printed the results to eight figures, with automatic correction of the last figure—where necessary—for the omissions; for example 3·1415927 for 3·141592653. . . .

The Scheutz difference engine was completed at Stockholm with the assistance of the Swedish Government on a guarantee by the professors of the Academy of Stockholm. It is due to this assistance that the honour of producing the first complete machine for calculating mathematical tables by differences and printing the results was secured by Sweden. The Scheutz difference engine was exhibited at the great Exhibition of Paris and was then purchased for the Dudley Observatory at Albany, New York State, by John F. Rathbone, an enlightened and public-spirited citizen.

An exact copy of this machine was made by Bryan Donkin & Co., for the use of the British Government in the Department of the Registrar-General, Somerset House. The cost of this machine was £1200, and in the opinion of one of the authors who has examined it in detail, it must have cost more than this sum for net labour.

This machine is now in the South Kensington Museum, and by the courtesy of the director, F. G. Ogilvie, the authors are able to give the two illustrations shown in figs. 449 and 450, plates LXXXVIII and LXXXIX, as well as a portion of a stereotype, fig. 451, plate LXXXVIII, cast from a matrix actually impressed by this machine.

The Scheutz machine is slow in action compared to the Babbage difference engine, for the Babbage engine completed its cycle with two half-revolutions, forward and backward, of the operating handle, while the Scheutz machine requires thirty-eight revolutions of the handle to effect the complete cycle of calculation and impression.

A further difficulty with the Scheutz machine arises from the fact that many of the movements are gravity-controlled by small weights, and unless everything is working quite freely it is possible for the alining bar to be brought on to the tops of the teeth; the machine, when received at South Kensington Museum, bore evidence that this had occurred at some period in the past.

The reversing of the carrying carriages is effected in the Scheutz difference engine by a mangle motion on the large gears which show at the front of the machine, fig. 450, plate LXXXIX.

The impression device consists of a group of steel toothed-wheels, mounted on concentric sleeves, the other ends of these sleeves being fitted with gear-wheels engaging with the controlling racks. The toothed wheels are engraved on the tops of the teeth with the die-figures for impression; an alining bar of gun-metal is brought into engagement with a set of spaces between the teeth prior to the elevation by cam action of the stereotype-matrix bearing table. The stereotype-matrix is of card 0·05 inch in thickness, and the depth of strike is 0·026 inch. The depth of counter in the engraved figures of the wheels is 0·011 inch. The face impressed by the machine is long primer old-style.

The authors are informed by the Dudley Observatory, Albany, that the Scheutz machine there has been out of commission for over twenty-five years. An example of the work performed by it remains in the "Specimens of Tables, Calculated, Stereomoulded, and Printed by Machinery," 50+ xviii pp., Longmans, Brown, Green, Longmans and Roberts, London, 1857, a work dedicated to Charles Babbage by George and Edward Scheutz. This machine was fitted with number impression wheels for long primer modern figures; owing to this difference there can be no error made as to which machine produced tabular matter referred to either of them. Both of these machines gave an increased feed to the impression table, so as to produce the effect of leading, at every fifth line. The work of the Somerset House machine is represented by the "English Life Table; Tables of Lifetimes, Annuities, and Premiums with an Introduction by William Farr, M.D., F.R.S., D.C.L.," 605+clv pp., Longmans, Green, Longman, Roberts and Green, London, 1864. The stereotype here reproduced in fig. 451, plate LXXXVIII, is from a matrix prepared for this work.

Dr. Farr says of this (third) Scheutz machine: "The machine has been extensively tried, and it has upon the whole answered every expectation. But it is a delicate instrument and requires considerable skill in the manipulation. It approaches infallibility in certain respects, but it is not infallible, except in very skilful hands. The weakest part is the printing apparatus, and that admits of evident improvement."

Dr. Farr, in the appendix to the "English Life Table," refers to the Scheutz machine, and after mentioning the use of the machine writes: "This volume is the result, and thus—if I may use the expression—the soul of the machine is exhibited in a series of Tables which are submitted to the criticism of the consummate judges of this kind of work in England and in the World."

DIRECT AND INDIRECT TRANSFER METHODS.

Transfer machines.—Amongst the early attempts to produce a printing-surface mechanically, the idea of producing one by lithography rather than by the setting up of type and so producing a typographical printing-surface took hold of man's inventive imagination. Two main lines of inventive development seem to have been followed, the one being the production on a metal plate, by the touching of keys, of printing-characters for lithographic use; and the other by printing on a secondary machine from paper ribbon perforated on a primary machine on the Jacquard principle, with justification of the lines by some computation system, and the subsequent transference of the characters printed in lithographic ink to the metal plate from which the direct printing takes place. Where corrections are required, the paper is excised and patched.

Possibly with the offset press and the lithographic methods of printing now coming into general operation, there may be some small field for machines of this class, but this is very doubtful. As in the class of impression machines just discussed, an immense amount of ingenuity and brilliant invention has in the authors' opinion been expended to no purpose on transfer machines.

It is stated that it was while experimenting with a transfer machine that Ottmar Mergenthaler made his invention of the Linotype, but that

PLATE LXXXIX.

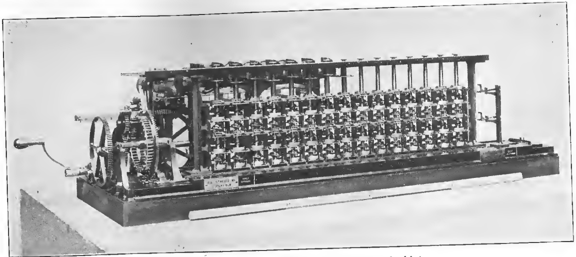

FIG. 450.—*Scheutz difference engine. Front view; with scale of feet.*

To face page 462.]

PLATE XC.

[To face page 463.]

Fig. 452.—*Lithotype transfer machine; keyboard machine.*

Fig. 453.—*Lithotype transfer machine; printing mechanism.*

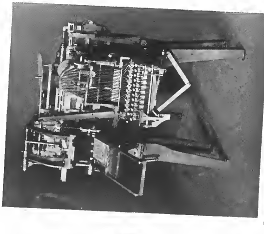

Fig. 454.—*Oddur type-bar machine; first model, using a matrix-dish and casting a grooved base upon a line of short type.*

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Pierre Flamm in the sixtie

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diligent inventor was probably also at work on both transfer machines and impression machines when his most important invention, the Linotype, assumed a practical shape. Transfer methods seem to have had a greater fascination for American inventors than for British, as is shown in the list given of American patents covering this method, which begins with that of Pierre Flamm in the sixties, his patent being granted in 1866.

One of the latest of these machines is the ***Lithotype***, figs. 452 and 453, plate XC, patented in 1903 by Walter S. Timmis of Brooklyn, New York, an exceedingly clever machine electrically controlled and provided with a keyboard of 100 keys. The line-justification is highly ingenious, and after the desired matter has been perforated and recorded in a first machine on a ribbon, this is passed through a second machine which, with equal ingenuity, at a very high speed, prints the copy on sheets of transfer paper. The sheets are made up into forme and a transfer taken on an aluminium plate lying on the bed of the transfer press. "When the transfer paper is removed from the aluminium plate, the ink characters are left on the surface of the aluminium. This sheet is 'rolled up' a few times, swabbed over with an acid solution, which fixes the design, and is then capable of producing an unlimited number of copies" in the printing-press. The mechanical electric typewriter, for so we can call it, has been operated at 10,000 ems (20,000 ens) per hour, or at twice the speed at which an average operator can manipulate a keyboard. Thus each transfer machine can handle the output of two perforator machines. Mistakes of the operator can be corrected in the usual manner with these machines and founts can be changed by simply slipping a new typewheel on the printer. The whole machine, as has been said, is exceedingly ingenious. For more detailed information concerning this apparatus and the subject of transfer machines generally, readers are referred to John S. Thompson's "History of Composing Machines," from which the two illustrations of the Lithotype are reproduced.

SHORT TYPE COMBINED WITH TYPE-BARS.

Type-bar machines.—Another class of machine which may be here noted —for the ultimate aim in its development is to form a slug—is that class known as type-bar machines. The characteristic feature of these machines is to produce a short type, practically only the face of the type, and sufficient base to give it the necessary strength and contain some form, such as a dovetail, notch, groove, furrow, or narrowing, capable of making an attachment with a bar, generally of steel, but in other cases of type-metal. This bar, by springing open or by a soldering or other process, such as swaging or casting on to the short types, is attached to the type-heads, which, before the attachment is effected, are in the later machines line-justified. The slug so formed is then passed into a galley to be used in the ordinary way. When a mechanical attachment of steel bars has been used, distribution is effected by returning the bars stripped from the type-heads to their magazine and consigning the type-heads themselves to the metal-pot

The use of short type was proposed by Mazzini in 1843, though in his case the type were intended to be secured from lifting by projections on the sides of the leads which were to engage with nicks on both sides of the type. In this arrangement the short type were jointly supported by two leads; in the modern arrangement the types and leads together form a slug capable of being handled independently.

The Calendoli type-bar machine was invented in 1893 by Father Calendoli, a Dominican monk, of Paris. In this early machine no method of line-justification was provided for the words as they were transferred to their prepared bases.

The Composite type-bar machine, invented by Lucien A. Brott, of Brooklyn, in 1895, one of the most interesting of these machines, was exceedingly well devised and compact, and had a proper system of line-justification, and though it had good chances of coming into commercial operation, the inherent drawbacks of the system probably prevented the realization of its constructor's anticipations.

The Unitype-bar machine, invented by Rolls P. Link, casts short type-heads with a dovetailed lower end which serves to retain them in the steel type-bars used to receive the characters. In this, as in the preceding case, the type-heads are arranged in position, and temporarily spaced by means of removable wedge-spaces; the channel in the steel type-bar which is in the form of a deep slot is then sprung open to permit of easy arrangement of the type-heads in line, during the processes of setting and line-justification. After the completion of each line the type-bar is permitted to close and grip the dovetailed ends of the type-heads, thus holding them in the position determined by the line-justifying mechanism; the bar is then delivered automatically to the galley.

The Oddur machine is a type-bar machine based on the inventions of Oddur V. Sigurdsson, an Icelander, who has invented and developed several machines in which he has attempted to produce single types very rapidly from direct keyboard manipulation. In his earliest machine he used long matrix-bars, each carrying a full fount, and worked in combination with a corresponding number of adjustable moulds, the whole being so arranged that any one of the units could be brought into operation independently of others and in succession to them. At a later stage the matrix-bars were mounted upon drums, rotatable and axially adjustable, and for his latest machine a matrix-disk, fig. 192, p. 226, with rotational and radial movement has been evolved.

One of the earlier machines is illustrated in fig. 454, plate XC. In the machine shown in figs. 455 and 456, plate XCI, which represent the present form adopted, a matrix-disk is mounted on a steel matrix-holder, which is immediately detachable from the shaft on which it is carried. This shaft is rotated by a frictionally-driven gear, and performs so much of a rotation as may be necessary to bring the next matrix required opposite to the mould opening, fig. 457; the depressing of a key advances a stop at the right

PLATE XCI.

PLATE XCI.

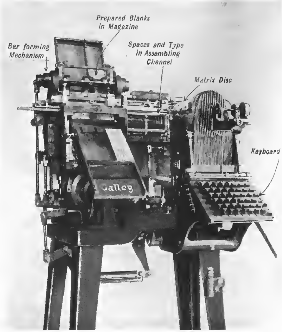


FIG. 455.—*Oddur type-bar machine, 1913 model; front view; casting short type and swaging a previously prepared base upon the line of short type.*

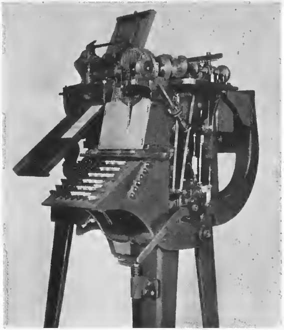


FIG. 456.—*Oddur type-bar machine, 1913 model; side view.*

[*To face page 464.*

circumferential position fo
withdraws the previously
disk when casting the
matrix-disk holder with
Hooke's joint to enable
axis so as to produce the
the concentric rings of ma
the front of the machine
shaft, and geared to it throu
shaft carries at the end nex
a stop-disk formed by c

FIG. 457.—*Oddur typ*

with the periphery cut b
divisions corresponding to
Each stop-disk has the resu
in length radially by an a
The stop-wheel slides axial
stop-screw that disk which
the particular matrix goes.
to enable any wear to be t
stop-disk is made D-shaped
replaced in the same relativ
to the matrix-disk holder,

circumferential position for arresting the movement of the matrix-disk and withdraws the previously advanced stop used for positioning the matrix-disk when casting the preceding character. The shaft connecting the matrix-disk holder with the matrix stop-wheel is fitted with a double Hooke's joint to enable the matrix-disk to slide at right angles to its axis so as to produce the radial change of position requisite for utilizing the concentric rings of matrix depressions. Carried on the upper table of the front of the machine is a second shaft, parallel with the matrix-disk shaft, and geared to it through the intervention of an idle wheel. This second shaft carries at the end next to the mould a stop-wheel capable of receiving a stop-disk formed by combining together two or more separate disks

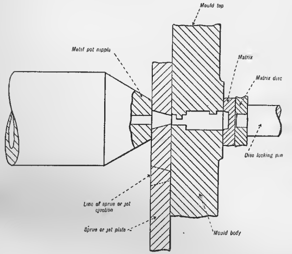


FIG. 457.—*Oddur type-bar machine.* Section at the casting-point. Scale: twice full size.

with the periphery cut by a narrow mill into the requisite number of divisions corresponding to each circle of depressions in the matrix-disk. Each stop-disk has the resulting teeth, or projections which are left, reduced in length radially by an amount corresponding to the opening required. The stop-wheel slides axially so as to bring into line with the body-slide stop-screw that disk which corresponds to the radius of the circle on which the particular matrix goes. The body-slide stop-screw is made adjustable to enable any wear to be taken up. The shaft which carries the matrix stop-disk is made **D**-shaped, so that the disks can be instantly removed and replaced in the same relative position to the gear-wheels. The same applies to the matrix-disk holder, so that a change of fount can be effected by removing the matrix-disk holder and the combined stop-wheel disks and replacing them with others of a different fount.

The operation of the machine is as follows :—

At each key-depression the matrix-disk makes a partial rotation, the matrix stop-wheel rotates through the same angle, lateral displacement of the matrix-wheel is made if required, and simultaneous axial movement of the stop-wheel takes place, the body-slide is brought back from its zero or closed-mould position as far as the mould stop-wheel permits, the pump

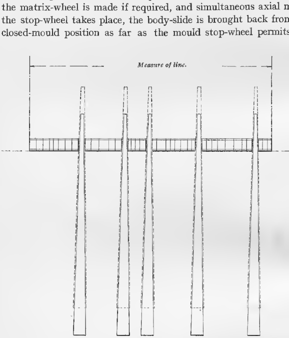


FIG. 458.—*Oddur type-bar machine ; line-justification.*

Scale : full size.

FIG. 459. — *The Oddur type-bar machine; space-band and type.*

makes its stroke and a short type is cast, fig. 457 ; the matrix-wheel is then drawn back, the mould stop-wheel remaining in the axial position it last occupied. The mould cover-slide, fig. 460, makes a downward stroke leaving its upper surface flush with the mould-cavity ; the sprue or jet-plate makes a downward stroke shearing off the tang or jet and assumes the position necessary for the ejection of the jet ; the mould body-slide then makes its ejecting stroke, pushing the type clear out of the mould into the type-race. At the end of a word the depression of the space-key causes a space-band, which is of the form of a plain tapered piece of steel of rectangular section, figs. 458 and 459, to come into place, and this is advanced by the type cast as the composition proceeds. When the line has been nearly completed, which is ascertained in the usual manner, the line is taken between gripping jaws and transferred to the swaging portion where the plain wedges are elevated, forcing the words apart and bringing the end characters of the end words into contact with the abutments and locking the line firmly between them.

The short type cast on the Oddur type-bar machines are shown with and without the jet or sprue, in figs. 461 and 462.

A grooved slug, fig. 463, previously cast in a separate machine, is then forced on to the line, and while in place in its proper relative position to the grooved slug, a corrugated steel swage is brought down into contact with the upper tongue of the slug covering the nick in the lower portion of the type ; it is then given an oscillating movement so that the metal of

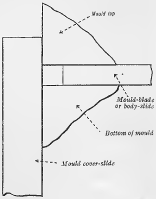
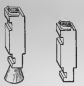


FIG. 460.—*The Oddur type-bar machine.* Front view of mould. Scale: twice full size.



FIGS. 461 AND 462.—*The Oddur type-bar machine; short type with and without jet or sprue.*

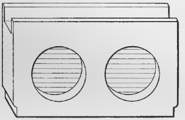
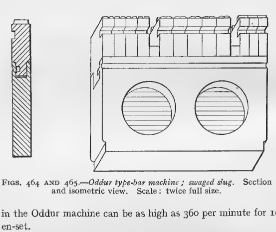


FIG. 463.—*The Oddur type-bar machine; grooved slug for short type.* Scale: twice full size.

the slug is swaged into the depressions in the type and the whole is formed into a continuous slug or type-bar which is shown in section and in isometric projection in figs. 464 and 465.

By the adoption of the corrugated oscillating steel swage a greater depression is caused between the words than where the slug-tongue is partially supported by the type ; this renders the locking of the words in their proper relative position more certain than if it were merely dependent on the friction produced between the individual type and that portion of the slug which is in contact with them.

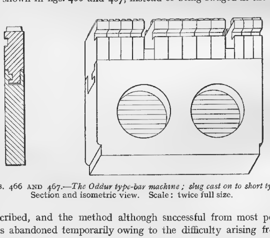
The size of the type is, of course, much shorter than that cast in other body-slide machines such as the Monotype, but the speed at which type can



FIGS. 464 AND 465.—*Oddur type-bar machine ; swaged slug.* Section and isometric view. Scale : twice full size.

be cast in the Oddur machine can be as high as 360 per minute for 10-point type of en-set.

In some of the inventor's earlier attempts the slug was cast on a short type, as shown in figs. 466 and 467, instead of being swaged in the manner



FIGS. 466 AND 467.—*The Oddur type-bar machine ; slug cast on to short type.* Section and isometric view. Scale : twice full size.

just described, and the method although successful from most points of view was abandoned temporarily owing to the difficulty arising from unequal contraction of the slug when cast. Further experiments have, however, satisfied the inventor that this difficulty can be easily overcome, and in his new model of machine, following that here illustrated, the cast slug will be used in preference to the swaged pattern.

The matrix-disk is obtained by electro-deposition in a manner somewhat similar to that already mentioned in the description of the Graphotype machine. Five of the type are arranged in a jig with proper packing-pieces so as to form a segment equal to one-eighteenth of the wheel; from this a mould or stereotype can be taken and from the whole assembled eighteen sections a disk is grown in nickel.

This disk need only be of small thickness as it is adequately supported in the steel matrix-holder, in fact, a thickness of only 0·08 inch to 0·12 inch is sufficient for the matrix-disk. Moreover, as the machine is independent of wedges, or of any scheme for influencing the set of any particular character, other than the production of the tooth on the mould body-slide stop-disk to the requisite length to suit the set of the character to be cast, it is not necessary that the type should be specially designed to suit the machine in any respect, and it is claimed that the disks can be made more cheaply and economically, from any existing fount of foundry type, than is possible for any other combined casting and composing machine. The inventor recognizes that the key of the whole question of matrix-composing machines rests with the production of matrices, and adopts a method for dealing with this problem different from that adopted by the large companies who have each and all been forced to adopt manufacturing methods of considerable complexity in order to enable them to produce matrices in sufficient quantity and variety to meet the demands made on them. It is claimed for this machine that matrix-disks can be produced for a few shillings and within a few days from receipt of the sample type.

The use of this machine as a sorts-caster has also been considered, and an extremely ingenious universally adjustable mould has been devised for enabling the machine to deal with type of all sizes from 5-point to 48-point inclusive.

Inventors are still busy on these machines, two of which have come under the authors' inspection while this volume was in course of preparation. Possibly a thoroughly practical and successful one may be devised, but it appears to them that the difficulties involved in the provision of the number of type-bars necessary to carry the type-heads produced by such machines would far outweigh any other advantages claimed for the method. Still more so is this apparent when it is considered that each different measure of line requires the use of bars of its own particular length, a serious matter where bars of steel are used, but one of little moment where cast slugs are used in conjunction with type-heads.

The Hanigan machine.—So strongly has the advantage of the slug in convenience of handling impressed itself on the minds of certain inventors, that proposals have been made for converting a line of loose type, after it has been cast and line-justified, into a form of slug by the use of a locking-strip. An instance of this may be noted in Hanigan's machine, the product of which is shown in fig. 468. This machine may be called a composite slug machine; for the individual type are cast their full height with a dovetail groove, and are then themselves turned into a type-bar.

In the method adopted by Hanigan there is no necessity for casting spaces of varying set width to meet the requirements of line-justification, because the spacing of the words can be effected directly by means of wedges, and, once the locking-strip has been inserted and hammered home, it is asserted that the type are securely held and further displacement of the characters laterally becomes practically impossible. Nevertheless, the

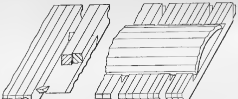


FIG. 468.—*The Hanigan machine: composite type-slug.*

inventor, in a later patent, as an extra precaution against possible lateral movement, has introduced means for depressing portions of the locking-strip edges between the words to act as positive keys; one of these is shown in the illustration of a composite slug which is drawn inverted on the left of fig. 468.

PHOTOGRAPHIC METHODS.

Photographic machines.—Many suggestions have been made for doing away with type altogether and reproducing letters and signs directly by photographic etching; a patent for this purpose was granted in 1898 in America to W. Friese-Greene. The letters were placed on strips and the whole fount arranged with the letters one above the other in the order of their width. As the keyboard of the machine was touched, corresponding letters were assembled, and the letters of the line being brought before a camera, it was automatically operated and photographed the letters on the plate. Letters of large size were proposed for use, to be reduced, in the process of photographing, to any dimensions desired. Photography suggests endless ideas for various methods and means of producing a line-justified printing-surface directly, but there are so many practical difficulties in the way of the adaptation of this very widely-spread and useful process that at present they seem to the authors to militate against its introduction into the printing-world as a serious rival of the older methods.

CHAPTER XXXI.

STEREOTYPING.

"Besides the errors incidental to the process of computation, there are further liabilities in the process of *transcribing* the final results of each calculation into the fair copy of the table designed for the printer. The next source of error lies with the compositor, in transferring this copy into type. But the liabilities to error do not stop even here; for it frequently happens, that after the press has been fully corrected, errors will be produced in the process of printing. A remarkable instance of this occurs in one of the six errors detected in so many different tables already mentioned. In one of these cases, the last five figures of two successive numbers of a logarithmic table were the following:—

35875
10436

Now, both of these are erroneous; the figure 8 in the first line should be 4, and the figure 4 in the second should be 8. It is evident that the types, as first composed, were correct; but in the course of printing the two types 4 and 8 being loose, adhered to the inking-balls, and were drawn out; the pressman in replacing them transposed them, putting the 8 *above* and the 4 *below*, instead of *vice versâ*. It would be a curious enquiry, were it possible, to obtain all the copies of the original edition of 'Vlacq's Logarithms,' published at Gouda in 1628, from which this error appears to have been copied in all the subsequent tables, to ascertain whether it extends through the entire edition. It would probably, nay almost certainly, be discovered that some of the copies of that edition are correct in this number, while others are incorrect; the former having been worked off before the transposition of the types."

The Edinburgh Review. Babbage's Calculating Engine (Dr. Dionysius Lardner).

6-point, old-style (Monotype).

"SPREAD INTO PLATES . . . THE WORK OF THE WORKMAN AND OF THE HANDS OF THE FOUNDER."

JEREMIAH.

Brevier egyptian.

STEREOTYPING may be defined as the art of reproducing, one or more times, as a single typographical surface, the composite surface of the type, or of the blocks, or of both these components combined, which, either alone or in combination, may constitute a forme. It is effected by taking an impression in intaglio of the forme, and using the mould thus obtained as a matrix from which the whole typographical surface is cast in relief so as to produce a fresh typographical surface identical with the original.

The process was originally proposed as an economic means for obtaining, for works, such as the Scriptures and the classics, of which successive editions are required and in which no change occurs, a permanent and practically convenient surface for the reproduction of the successive editions. The stereotype made at a single cast is much less costly than the original type in which the matter is composed; it enables the type to be released for fresh work once the proofs have been finally passed, and it ensures the absolute identity of one edition with another, so that a carefully corrected work may be reproduced in each successive edition equally perfect in all its detail. It has, moreover, the further advantage that the types need never be subjected to the heavy work of the printing-press, and that they can be returned to the case practically in the same condition as when new. Moreover, a work of great magnitude can be produced from a much smaller fount of type, for, as the reading and correcting are followed by the stereotyping process, distribution of the earlier pages can be effected and the type used again for composition. It is in the newspaper office that the introduction of stereotyping has proved to be a step of revolutionary character, for it has permitted the rapid multiplication of an original surface—itself unused in the actual press—and the simultaneous printing from replicas, instead of from the original, on a number of presses.

So great is the saving in capital formerly locked up in type, that stereotyping has now come into general use for all such works as remain practically constant in detail; it is also used for works of which a very large edition is to be printed, as it is cheaper to wear out the stereotype-plates than the type from which these plates are produced.

In many cases the stereotypes, or plates as they are called, are stored in readiness for a future demand, while in others the moulds from which the stereotypes are made may be preserved, and so give a still more economic method of future reproduction of the work. The advantage of stereotyping in the case of woodcuts and other costly blocks is obvious, as in the event of accident, damage, or excessive wear, a replacement can be effected at a trifling cost. Further advantages of the stereotype are the ease with which it can be handled, its immunity from becoming pied, and its freedom from blacks, monks and friars.

The stereotype mould or matrix is now generally made of one of two materials, plaster of Paris or paper; hence the various stereotyping processes may be divided broadly into two classes, according as the material used and its method of preparation approximate more closely to the one of these materials or to the other.

Of the two methods of stereotyping, the paper process is the simpler, and finds the larger number of applications because the material of which the mould is made enables it to be formed and handled more readily; several plates can be made from one mould, and the mould can be conveniently stored for use at some future date, or a replica of a stereotype taken from it.

The plaster process, on the other hand, an earlier invention, gives a deeper and sharper cast, and is for this reason preferred for the stereotyping of woodcuts; for the reproduction of blocks, however, it has now been superseded in most cases by electrotyping.

The flong or paper process requires the following sequence of operations: the preparation of the flong; the making of the mould; the pouring of the cast; the trimming of the plate, and its mounting on the backing.

Flong (from the French word *flan*) is a kind of *papier mâché*. It consists of a number of layers of paper of different qualities superposed and united by means of a special paste, usually composed of flour, starch, alum, and whitening. It is important that the paste should be quite free from lumps or impurities. The back of the flong may consist of a sheet of brown paper, to which is pasted a sheet of blotting-paper, usually followed by a second sheet of the same material and finished with two or more successive sheets of tissue-paper. It is important that no air bubbles should be formed between the sheets of paper, nor should the surfaces be in the slightest degree wrinkled; the whole mass must be carefully smoothed and, in some cases, a steel roller is used to incorporate more thoroughly the various layers of paper and paste. The flong is generally used in a damp or partially dried state, and, if it has not been quite freshly prepared, care must be taken to damp it to the proper degree before attempting to obtain an impression from the type. To obtain the impression, the forme is placed on the imposing-surface and the face of the type slightly oiled by means of a brush, and the flong is applied with the tissue-paper side next to the type. It is then covered over with a piece of damp linen, and the flong is beaten, by means of a stiff-haired, long-handled brush, well down into the type, care being taken, however, to beat lightly on those parts of the forme which are more open. The beating must be continued until the depth required for the cast has been obtained, a matter which can easily be judged by experience. The damp linen is then removed, and the large depressions in the back of the mould, formed by the whites, are filled in with softened pipe-clay or with pieces of old flong mould, pasteboard, or other suitable material cut approximately to the shape of each depression. The next operation consists in the application of a pasted wrapping, or backing sheet, lightly beaten on to the flong; the forme, with the flong in place, is then passed into a gas or steam heated press in which it is dried for some ten minutes, and after this it may be removed from the forme.

It is obvious that the flong process is not suitable for taking moulds of woodcuts, because the drying of the matrix tends to make the blocks split. The drying of the mould in place, on the forme of type, leads to a lengthening of the type due to the continued application of heat while the type is subjected to the pressure of the surrounding chase. This growing of the type in height-to-paper, renders it unfit, after the operations have been repeated several times, for use with new type; for this and other reasons, of which speed in the production of the finished mould is one of the most important, various dry-flong processes have been devised, to which reference is made later. It is to be noted that as far back as 1880 a process for preparing dry-flong was patented by F. Wicks, whose name appears elsewhere in this work as inventor of several typographical machines.

Plate-casting.—The casting is usually performed in a pivoted press and casting-box, fig. 469, into which the flong mould is placed when the press is in a horizontal position; this is then turned to the vertical, fig. 470, for the metal to be poured in so as to obtain the requisite head to ensure a sound cast. The metal used for making the stereotype-plate is of similar composition to type-metal, but contains less antimony and little, if any, tin; it must not be poured at too high a temperature, or it will damage the flong mould. After the plate has cooled sufficiently, the casting-press

FIG. 469.—*Casting-press for flat stereotype-plates: open.*

is turned down to the horizontal position, unscrewed, and the plate removed; it is then trimmed and machined to thickness ready for mounting on wood or other backing.

Plaster process.—The plaster process differs essentially from the paper process, for the plaster mould requires to be thoroughly baked in an oven to free it from moisture. The mould requires to be arranged in a particular manner in the casting-box, known as the dipping-pan, in which it can be immersed in a bath of metal and removed filled after the mould has acquired the temperature of the molten metal. As in the preparation of the forme for the paper process, it is necessary to oil the face of the type slightly with a soft brush, in order to facilitate the removal of the plaster cast intact.

The casting-frame must then be placed on the forme, which should be imposed with stereo-high furniture round all the sides, and plaster, of the consistency of cream, poured on the face of the type. The plaster must be carefully dabbed in so as to make intimate contact with the type without forming any air bubbles; while the plaster is liquid it is struck off level with the top of the casting-frame, and left for a few minutes to harden. As in most operations involving the use of plaster of Paris, the secret of efficiency lies in the speed at which the operation is carried out and the care

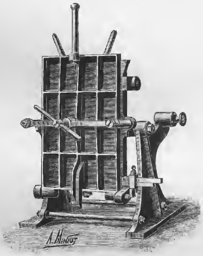


FIG. 470.—*Casting-press for flat stereotype-plates: closed, and turned to the vertical or casting position.*

which is expended in the proper mixing of the plaster. After some twenty minutes, when the plaster has set sufficiently hard, it may be lifted from the type by means of proper lifting tools; great care, however, is required in effecting this operation, because, even with the high quads used for stereotyping, the plaster can enter some distance in between adjacent type, and these parallel prisms above the quads must obviously be drawn out quite truly, or they will break. Evidence that the mould has been removed without damage is afforded by the absence of pieces of plaster remaining and adhering to the type. The mould must now be removed from the casting-frame by clearing away the superfluous plaster, turning the frame upside down and tapping it to assist the mould in falling out.

Notches must be cut into the face of the plaster rim of the mould to admit the molten metal to the face, after which the mould is baked. The baking operation performed in the oven is conducted at a temperature of about 380° F. and is continued for about one hour and three quarters, or until the effect of the baking is just enough to brown the plaster slightly.

The mould, when dry and hot, is placed face downwards on an iron plate called the floating-plate, which fits loosely in the dipping-pan. The mould, floating-plate and dipping-pan, must all be heated to nearly the same temperature as the molten metal before they are immersed. After the floating-plate and mould have been placed in position the dipping-pan is covered with a lid, either flat or slightly dome-shaped, but with the four corners removed to give free access for the metal to enter and for the gases to leave the interior. The lid is firmly clamped in place by means of loose clamps and a screw; the whole arrangement is then immersed for some ten minutes in the dipping-pot, which contains the molten stereotype-metal; the long time of immersion is necessary to allow for driving off all the gases contained in the plaster, and to ensure that the face of the stereotype shall be quite free from blow-holes. The next operation is that of cooling the dipping-pan; when this has been done the contents are turned out and the gates at the corners are broken away.

The specific gravity of stereotype-metal being greater than that of the floating-plate causes it to rise in contact with the mould until the back of the mould touches the lid of the dipping-pan; this permits of easy detachment, when cool, of that part of the stereotype-metal which occupies the space between the back of the mould and the lid of the dipping-pan. The trimming of the plate formed by the plaster process entails considerably more work than that required by the *papier-mâché* method of obtaining a stereotype, so that the former process is not only more lengthy, but also more expensive in every way; it is, however, preferred for certain work in which, as previously mentioned, the matter would not stand the temperature of the drying press or the severe mechanical conditions involved in the use of the dry-flong process.

A process somewhat analogous to the old plaster process is that which is used for obtaining stereotypes of process blocks by means of plaster-faced flong applied under heavy pressure.

Apart from flong, many attempts have been made to find other materials which would be capable of taking the impression of type within narrower limits of temperature than are required by the metal used for ordinary stereotype casts. In one of these processes the mould is made of a composition of yellow oxide of lead, or massicot as it is sometimes called, and glycerine; this composition hardens when subjected to slight heat under pressure in the press, and in some three or four minutes is sufficiently firm to bear removal from the forme. In another process, a celluloid sheet is placed in a press on the top of the matrix, and when heated by the admission of steam, is softened sufficiently to take a perfect impression of the matrix. It is claimed for the celluloid typographical surface that it has more elasticity and softness than type-metal and yet does not yield under fair working conditions; a plate of celluloid, moreover, can be curved easily to a cylindrical form. Further development, however, in these directions, has become less necessary since the stereotype process has been found to meet the exigencies of modern newspaper-work.

Although stereotyping has come into use very largely for book-work, it is in newspaper-work that it has found most scope, and it is in this connexion that the greatest amount of development of stereotype plate-making machinery has taken place. Very early in the last century it was realized that a single press was inadequate for news-printing, and that, for the economical production of large quantities of matter, several presses with several typographical printing-surfaces in simultaneous use, had become an economic necessity. Stereotyping was brought to a high degree of perfection by Tilloch and Foulis of Glasgow, who were ignorant of its previous invention by William Ged, a goldsmith of Edinburgh, but the process was not turned to practical account by them. It is said that the third Earl Stanhope derived his instruction in stereotyping from Tilloch and Foulis, and it is recorded that he produced stereotype-plates from plaster in 1802. At first the process found but little favour, the "Monthly Magazine" for April, 1807, stating that "stereotyping had not been adopted by the booksellers of London," and that "it does not appear that more than twenty or thirty works would warrant the expense of being cast in solid pages, consequently the loss would greatly counterbalance the advantages," etc.

It is stated, but the authors are not aware on what authority, or with what degree of accuracy, that the art of stereotyping was known and practised in the fifteenth century.

Johnson in his "Typographia," published in 1824, regards the advent of the stereotype and the steam press at "The Times" offices in 1813–1814 with horror, and says of others who simplified the early machines: ". . . these persons, although not printers, set up an office for *stereotype* and *printing by steam*, in opposition to . . . who had *steam* only; they also made machines for others: . . . thereby basely tearing down that beautiful fabric of our Art, which had caused so much labour and expense to rear. . . ."

The paper process for matrix-making was originated in France in 1829 by M. Genoud of Lyons, but it was not until 1848 that it was introduced into England by an Italian named Vanoni, although a patent, communicated from abroad, had been taken out for this process by Moses Poole in 1840. In the early part of the last century much thought was given by printers and engineers to the problems involved in stereotyping. "The Times," appreciating the value of such a process, entered into an agreement with Marc Isambard Brunel in 1819, an agreement, however, that was cancelled in 1821, for the use of certain improvements in stereotyping, and it is on record that even at this early date the production of the journal required the use of over 300,000 individual types. It was not, however, until 1859, when the Swiss, Dellagana, brought the full advantages of the method to the notice of "The Times," that, under the guidance of the manager of the printing house, the celebrated J. C. MacDonald—a kinsman of the father of one of the authors of this work—the first curved plate was cast. The difficulties met with at the outset were, however, very great, and it was not until 1863 that "The Times" used curved plates commercially. A period of nearly forty years elapsed before any further notable improvement in newspaper stereotyping took place.

At the beginning of this century the operations performed in the offices of a large daily newspaper, after the receipt of the last forme of corrected matter, comprised the making of the flong mould, including drying in a steam-heated press and the filling in of the whites; the transfer of the mould by hand to a semicylindrical casting-box and the making by hand of a cast, with a large riser attached, in this casting-box, fig. 471, plate XCII.

The plate was poured vertically and, after it had cooled sufficiently, it was removed from the press; the plate then was bored in a machine, which finished it on the inside, and the header was cut off; the edges were then trimmed by hand and the plate finished. The whole cycle of operations was performed in the short period of eleven minutes under average conditions, as timed by one of the authors, and in special cases this time was reduced to as little as nine minutes from the receipt of the last forme of corrected matter to the dispatch of the finished plate to the printing-press. A small amount of this work had still to be done by hand at the period named, although the heavy operations of removing the head and of boring were performed by machines. The plate, when finished and trimmed, appears as shown in fig. 472, plate XCII.

An improvement on the method of pouring by hand has now been introduced in some French newspaper offices; the metal is pumped into a mould carried upon trunnions and so arranged as to facilitate the handling operations. This combined metal-furnace and mould is shown in fig. 473, plate XCIII. The plate, after removal from the casting-box, as in the hand-casting process, requires to have the head cut off, and to be bored and trimmed at the edges.

An automatic boring machine has since been introduced in some of the French newspaper offices, in which the plate has merely to be placed on the machine at one end and is bored, trimmed, and delivered finished at the other end; fig. 474, plate XCIV.

An improvement on the vertical pouring arrangement, shown in fig. 473, plate XCIII, has also been introduced; in this a machine, actuated by hand through the medium of a lever and toggle-joint, closes a mould so arranged that the plate is poured from the edge instead of from the end. The movement of the lever, after the cast is cooled, throws the plate over into the position for trimming and removing from the machine, as shown in fig. 475, plate XCV. The machine is shown closed ready for casting the semicylindrical plate in fig. 476, plate XCV.

PLATE XCII.

FIG. 471.—*Semicylindrical plate, cast by hand, with head attached.*

FIG. 472.—*Semicylindrical plate, with head removed.*

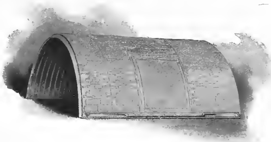


FIG. 479.—*Finished plate as removed from the Autoplate machine.*

[*To face page* 478.

PLATE XCIII.

[To face plate XCIV.]

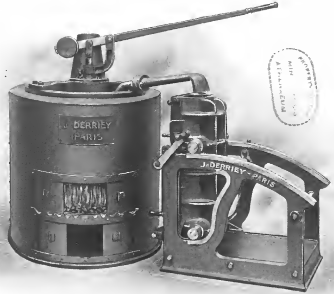


FIG. 473.—*Metal-furnace with pump filling semicylindrical-plate mould in vertical position.*

PLATE XCIV.

FIG. 473.—*Metal-furnace with pump filling semicylindrical-plate mould in vertical position.*

PLATE XCIV.

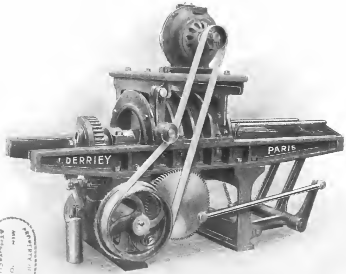


FIG. 474.—*Automatic boring machine for semicylindrical plates.*

[To face plate XCIII.

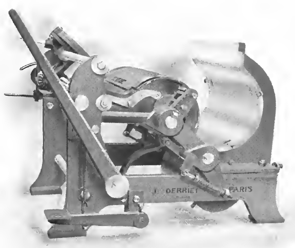


Fig. 475.—*Casting-press for semicylindrical plates; opened for trimming and removing the plate.*

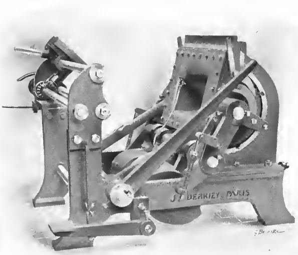


Fig. 476.—*Casting-press for semicylindrical plates; water-cooled with automatic closing and head-cutting gear.*

To face plate XCVI.]

PLATE XCVI.

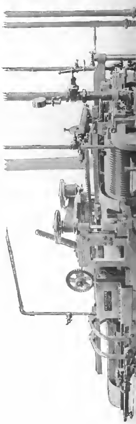


PLATE XCVI.

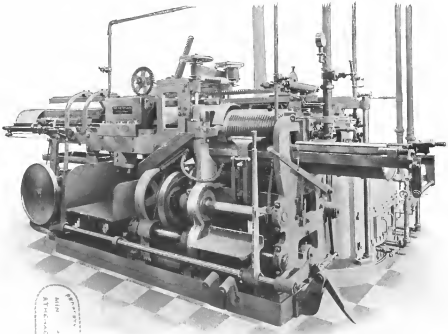


FIG. 477.—*Autoplate; front view.*

[*To face plate XCV.*

PLATE XCVII.
[To face page 479.]

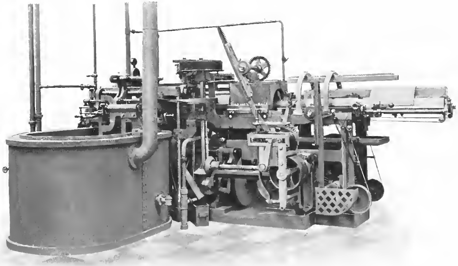


FIG. 478.—*Autoplate; back view.*

until 1859, when the Swiss, Dellagana, brought the full advantages of the method to the notice of "The Times," that, under the guidance of the manager of the printing house, the celebrated J. C. MacDonald—a kinsman of the father of one of the authors of this work—the first curved plate was cast. The difficulties met with at the outset were, however, very great, and it was not until 1863 that "The Times" used curved plates commercially. A period of nearly forty years elapsed before any further notable improvement in newspaper stereotyping took place.

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The plate was poured vertically and, after it had cooled sufficiently, it was removed from the press; the plate then was bored in a machine, which finished it on the inside, and the header was cut off; the edges were then trimmed by hand and the plate finished. The whole cycle of operations was performed in the short period of eleven minutes under average conditions, as timed by one of the authors, and in special cases this time was reduced to as little as nine minutes from the receipt of the last forme of corrected matter to the dispatch of the finished plate to the printing-press. A small amount of this work had still to be done by hand at the period named, although the heavy operations of removing the head and of boring were performed by machines. The plate, when finished and trimmed, appears as shown in fig. 472, plate XCII.

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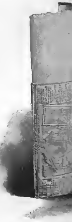

FIG. 471.—*Semicyli cast by hand, with*

FIG. 479 —

AUTOMATIC PLATE-CASTING AND FINISHING MACHINES.

The Autoplate is one of the more important adjuncts of the printing-office which should, strictly speaking, be regarded not as a means for producing a printing-surface, but as one for rapidly reproducing and multiplying a printing-surface, already produced by other methods, and thus meeting the requirements of the modern newspaper office. The Autoplate practically stands in the same relation to a mould or matrix prepared from a mass of composed type as an ordinary typecasting machine stands to an ordinary matrix; hence the flong mould taken from the type mass as a whole may be regarded as a single, but gigantic, matrix.

In this machine, figs. 477 and 478, plates XCVI and XCVII, the invention of Henry A. Wise Wood, of New York, the flong matrix is placed in a couple of clips, by which it is carried horizontally into the casting-box or semi-cylindrical mould of the machine. After the joint has been closed the mould is filled at the side of the machine, over the whole width of one end of the page, by the positive stroke of a pump-lever, the latter part of the movement of the lever compressing powerful springs. After a short pause the casting-box is lowered and simultaneously the flong mould is drawn away at the sides from the plate which has been cast, so that this is free of the mould and can be passed on through the machine without damaging the mould or matrix. The core-cylinder against which the plate has been cast then makes a half revolution, the opposite half serving as the core for the next successive cast. The cast which has been made is trimmed at the head and foot by saws placed in a diametral plane and encountered by the plate as it travels automatically from the casting-box to the boring-box. After leaving the casting-box it goes under the shaving-arch for boring, pauses for the boring to take place, and then passes routers, which finish the head and foot, and is finally delivered, at a rate of between three and four plates per minute after the first plate has been produced; the finished plate is shown in fig. 479, plate XCII. The total time for completing the first plate is usually about three-quarters of a minute from the time that the process is started.

The Autoplate is a large and very costly machine; an equipment of two Autoplates, which is a plant suitable for an ordinary newspaper, involves a capital outlay of £10,000. An examination of the saving effected by its agency is of interest. In the old method of stereotyping the damp *papier-mâché* flong, used to form the matrix, was beaten with brushes on to the forme of type and dried *in situ* in a steam-press, an operation which took some nine minutes. It was, when dry, removed from the type-surface and placed in a semicylindrical casting-mould, a core closed down upon it, and a plate cast from it. When sufficiently cool to handle, it was removed to a machine in which it was bored and the header cut off; the edges were then trimmed by hand, and the plate was finished.

FIG. 478.—*Autoplate; back view.*

The next step towards the reduction of time was the use of a mangle-press with blankets, as in the intaglio process, to receive the impression of the type; this reduced the time of preparing the mould to about four minutes. A still further improvement consisted in the introduction of the dry-flong process, in which specially prepared *papier mâché* was laid on the forme, then covered with blankets, a sheet of rubber placed on the top, the whole passed through a mangle-press, and the flong taken off immediately; the flong was then placed in a rotary matrix-dryer for about one minute and three-quarters, thus reducing the best time previously made by over 50 per cent.

The Autoplate economizes time still further, because the various operations connected with the formation of a plate are proceeding simultaneously on successive plates, so that forty or fifty plates, or even more if required, can be obtained from one mould in about fifteen minutes. This is rendered possible by a system of water-cooling in the mould-box and of internal water-spraying in the core-cylinder. The large number of presses used by some of the daily newspapers and the number of sheets of which each newspaper consists have in time of stress required the supply of an almost incredible number of plates. It is recorded that the proprietors of the "Daily Mail" on the occasion of the death of His Late Majesty, King Edward VII, recast all their plates with mourning borders, and achieved a total of 3344 plates in 24 hours; the "Evening News," consisting of far fewer sheets, on the occasion of receiving intelligence of the foundering of the *Titanic*, cast 1150 plates for one edition. Such performances would have been quite impossible by the methods of stereotyping in use but a few years ago.

The Autoplate Junior, figs. 480 and 481, plates XCVIII and XCIX, is a smaller and less costly machine in which the mould-box is vertical and the mould, while pump-fed, is not closed at the top, the charge of molten metal, raised by the pump, being simply poured in. After the pump stroke has been made, a timing mechanism is started which rings a gong, on the lapse of a period of thirteen seconds; the remainder of the automatic operations of the machine—cutting off the head and automatically ejecting—are then performed. The plate is then transferred by hand to the boring-box of the *Autoshaver*, fig. 482, plate C; the head is returned by hand to the metal-pot while the next charge is cooling. After the first cast, the Autoplate Junior produces casts at the rate of from two to three per minute. One Autoshaver deals with about six plates per minute, and is the complement of two of the Autoplate Junior machines. "The Times," the third office in this country to adopt these machines, is equipped on this basis.

The Multiplate, fig. 483, plate CI, is another machine of later introduction than the Autoplate; it practically combines a horizontal stereotype casting-box, an ordinary boring-box, a dressing-saddle, and a melting-furnace with a semi-automatic pump. In this machine the mould, or matrix, once it has been set in position, is firmly held in place, so that the trimming devices can reproduce plates to a great degree of exactitude; the matrix

PLATE XCVIII.

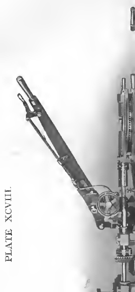

PLATE XCVIII

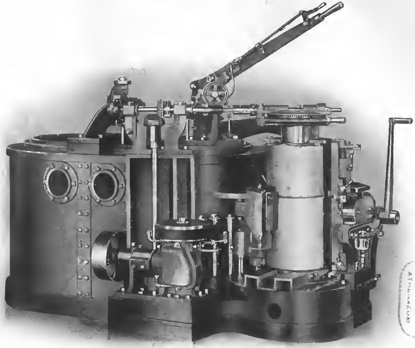

FIG. 480.—*Autoplate Junior; front view.*

[To face page 480.

PLATE XCIX.
[To face plate C.]

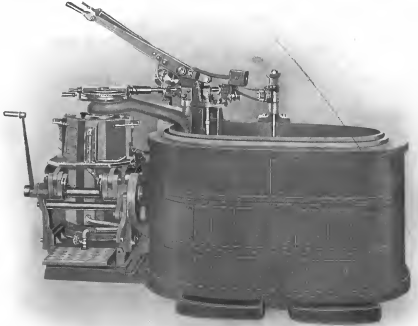

Fig. 481.—*Autoplate Junior; back view.*

FIG. 481.—*Autoplate Junior; back view.*

PLATE C.

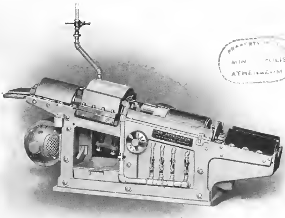

FIG. 482.—*Autoshaver.*

[*To face plate XCIX.*

PLATE CI.

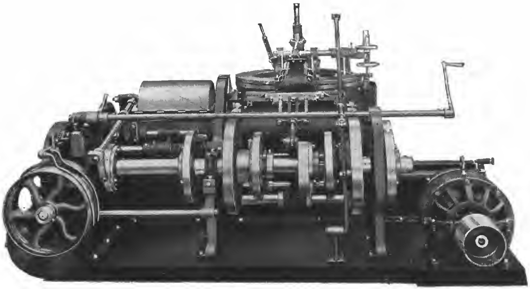

FIG. 483.—*Multiplate; at rest, after the first cast has been made.*

FIG. 483.—*Multiplate; at rest, after the first cast has been made.*

PLATE CII.

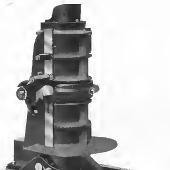

FIG. 484.—*Tubular-plate casting-box; closed.*

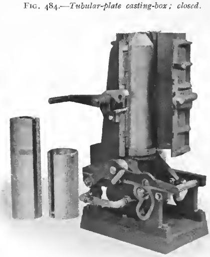

FIG. 485.—*Tubular-plate casting-box; open.*

To face page 481.]

is, moreover, exposed
it is possible for him t
cycle of operations—
this machine is as f
plate from the matrix
head, trimming the t
sides, delivering the f
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three times as long in
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difficulties has led to t
plate press, in which t
time, and which makes

is, moreover, exposed to the view of the operator after each cast, so that it is possible for him to verify that it has suffered no damage. The complete cycle of operations—stated to occupy about half a minute—performed by this machine is as follows: opening the casting-chamber, stripping the plate from the matrix, depositing the plate in the boring-box, cutting off the head, trimming the top and bottom edges, boring the plate, trimming the sides, delivering the finished plate, and pouring the succeeding one. These operations are effected by the agency of a system of cams and levers.

It is of interest to note that, while the cycle of casting, trimming, and delivering operations in an ordinary machine of the linotype class is effected in ten seconds, these stereotyping machines, dealing with many hundreds of times the weight of metal, accomplish their result in a period of time only three times as long in the case of the Multiplate, and in even less than that time in some of the previously mentioned larger machines. The Multiplate is installed in the office of one of the London daily morning papers.

It is almost impossible to describe the advances made in any one branch of the printing industry apart from those made in others, so much is progress in any one department dependent on the exigencies and requirements of another. Particularly is this the case with stereotyping and printing presses. To obtain duplicates of the typographical surface, so as to permit more than one platen press to work from the same matter, the plane stereotype-plate was necessary, and the very existence of the rotary press depended upon the successful production of curved plates.

TUBULAR PLATES.

The tubular-plate casting-box is shown in figs. 484 and 485, plate CII. In the ordinary cylinder-press the plates are semicylindrical; consequently each plate is idle, as far as printing is concerned, for one-half of each revolution, and therefore for one-half of the time the press is running. The requirements of certain daily newspapers, as regards circulation and number of pages, are such that they are intermediate between those successfully dealt with by the duplex flat-bed press and those met by the ordinary rotary press. Both the first cost and the expense of operating the latter are very great, while the output of the former is comparatively very small. Moreover, the only machines available recently for this class of daily paper required duplicate plates, and, when printing many-page editions, it was necessary to run them at a greatly reduced speed so as to enable the sheets to be collected. Much mechanical complication is involved, and other difficulties are introduced when papers with more than eight pages, and particularly those with ten, fourteen and eighteen pages, are required to be produced commercially. The consideration of these disadvantages and difficulties has led to the invention of the cylindrical or tubular stereotype-plate press, in which the plate is printing all the time instead of half the time, and which makes it possible to deliver the paper book-folded without the intervention of those collecting and associating devices which may be a cause of trouble in the larger presses. Not only is the output per plate per hour greater in the case of the tubular-plate machine than with the semicylindrical form, but the weight of plates used is less. Assuming that seven tubular plates do the same work as ten semicylindrical plates, then the actual weight of metal used in the former case is only one-half of that necessary in the latter.

The tubular plate is, strictly speaking, not a complete cylinder, but is so much of the curved surface as corresponds to the printed length of the page; that portion which would correspond to the top and bottom whites is absent to provide space for an ingenious arrangement of clips which hold the plate in position when it has been pushed home on the carrying cylinder of the machine. Still more ingenious is the arrangement of the framing of the machine which permits the tubular plate to be slid into place without dismantling the gears and the carrying cylinder; the framing which carries the bearing of the carrying cylinder is reduced on one side of the machine to a width narrow enough to pass through the longitudinal opening in the plate.

The conditions under which the tubular plate is used are not such as to require multiplication of the individual plate; hence the casting and finishing plant designed for its production approximates more closely to that used in the earlier method of stereotyping than it does to the arrangements adopted in the highly specialized Autoplate; in fact, it consists of a vertical casting-box containing a cylindrical core and having the two halves of the box hinged to each other; the core is capable of being pivoted, after the box is opened, to a nearly horizontal position for the removal of the tubular plate. The plate, with its head, is removed by hand, after it has cooled, to a combination plate-trimmer and tail-saw which bores and trims both ends of the plate.

CHAPTER XXXII.

TYPOGRAPHICAL ETCHING, RELIEF PROCESS BLOCKS AND ELECTROTYPING.

". . . skilful to work . . . also to grave any manner of graving, and to find out every device which shall be put to him, with thy cunning men and with the cunning men of my lord David thy father."—Extract from letter of Huram, King of Tyre, to Solomon, King of Israel.

II. Chronicles.

Long primer No. 18 clarendon.

THE process block with which papers and periodicals of the day are now generally illustrated is a complex entity. It has grown up into adolescence in little more than a generation, and it owes its existence and usefulness to a widely ramifying ancestry and to the inter-relationship of many branches of the arts and crafts. Its history, moreover, is wrapped up in the development of various other industries without which it could not have attained its present perfection.

In the second decade of last century two patents were taken out by Sir William Congreve for combining plates for the printing, in two or more colours, of the backs of bank-notes; these early colour-blocks consisted of a series of faces of metal, very perfectly fitted together mechanically to form the plane surface which was engraved, and so arranged that the one set of faces could be withdrawn from the other in a direction normal to the printing-surface, thus permitting separate inking of the two sets of faces. When the plates were again restored to their normal printing-position, the complete design was continuous, but partly inked in one colour and partly in another: this method is still used for some ornamental labels, those, for instance, on the bottles for "Stephens' Ink," which show both the mechanical perfection of workmanship of the portions of the two-colour block and at the same time afford an example of very skilled geometric-chuck engraving. In this early invention the difficulty of bringing the paper into true register as well as the other difficulty arising from difference of dampness and consequent variation in size were avoided by an extreme accuracy of fit between the different portions of the printing-surfaces.

Electrotyping as a method of reproducing a metal or other irregular surface came into existence about 1840, and in 1841 a patent was taken out by A. Parkes for growing matrices by electro-deposition. As a means for the reproduction of a typographical printing-surface, electrotyping is dealt with at the end of this chapter.

The first British patent for producing metallic plates with raised printing-surfaces is that of E. Palmer, and is dated 1841; this was followed in the succeeding year by a further patent for engraving through a wax-coated matrix-plate to form the printing-lines, or blacks in the positive electrotype taken from it. The process was termed by its inventor glyphography. The whites were built up in this process by adding wax by hand, assisted by various tools ingeniously constructed and heated. Figure 486 gives a section of the plate *a*, covered with a wax coating *b*, and shows the added wax *c* built up for the whites. The copper

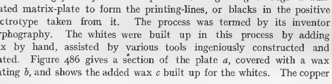


FIG. 486.—*Section of typographical etching-plate showing plate with wax built up for whites, and section of the electrotyped shell filled and mounted.*

electrotype is shown by *d*, and *e* represents the backing-up metal used for reinforcing the electrotype shell after its removal from the wax, the flow of which gives a natural and gradually decreasing slope to the metal supporting the black lines in the final result. After building up, the wax is black-leaded and metal is deposited on the surface so obtained; this deposit is then tinned on the back, backed up with lead, trimmed off on a lathe or shaping machine, and, when mounted on wood or metal to bring the printing-surface type-high, it becomes a finished typographical block. The method, much improved, is still in use to-day. One of the earliest works illustrated by Palmer's process is "The History and Antiquities of Brentford, Ealing and Chiswick," by T. Faulkner, 1845, and the word glyphography occurs at the foot of many of the illustrations contained in it.

Some four years later came the method of forming a relief engraving by using a plate covered with a ground, protecting the blacks with the medium used for the direct or transferred drawing, and etching down the whites to the desired extent.

About the end of the first decade of the nineteenth century possibilities in the nascent art of lithography attracted the attention of a retired French military officer, Joseph Nicéphore Niepce, who endeavoured to discover means for producing a lithographic printing-surface by the agency of light.

From 1814 to his death in 1833 Niepce worked continuously at the problem of producing a printing-plate from a transparent engraving, and in 1829 he invented a practical process of heliographic printing. His discovery that a bitumen coating applied to a metal plate undergoes change and ceases to be so readily soluble in certain oils where it has been acted upon by light, enabling an intaglio printing-surface to be etched, was the greatest step made towards photographic printing prior to the invention of photography itself by Daguerre after the death of his partner Niepce.

The most important advance, however, was that obtained by the combination of photographic methods with the processes already known and in use. W. H. Fox Talbot in his patent of 1852 describes the method of coating a metallic plate with a substance affected by exposure to light, exposing the plate photographically under a negative, and etching the parts on which the light has not acted. The sensitized surface is produced by a combination of potassium dichromate and gelatine, and gauze is used to obtain a grain. From this patent may be traced the evolution of the process block of to-day through all its numerous improvements.

Other methods rapidly followed the Talbot process, and in the succeeding year Applegath, to prevent forgery by photography, patented a method for printing in several colours, the possibilities of the photographic method of reproduction now having secured recognition.

About this period inventors began to realize that a process which gave an intaglio surface would conversely give a relief surface and *vice versa*, and patents were taken out for methods by which transfer prints on copper could be increased to the desired depth in the whites by repeated etching, and, though forestalled by other workers, the Comte de Fontainemoreau patented in 1854 a method of producing relief zinco plates by etching.

About this time various inventors sought concurrently for the solution of the problem of printing in several colours, and the method of using several separate chases printed consecutively is claimed in the patent of E. Boileau, in which both type-blocks and quads were used. A later patent of the same year covers the method in which wood-blocks are made of hardwood, cut plankways, with two systems of grooves sawn in at right angles to each other, so as to present a number of spots of equal size and equally spaced over the whole surface. All these spots except such as correspond to the required colour for each block, as shown by a design prepared on section paper ruled to correspond to the printing-block, are removed by suitable tools and the work of printing is divided over the same number of blocks as there are colours used. This method, practically without modification, is still used to-day for the printing of linoleum; the large wood-blocks in use for this purpose often exceed a square foot in area.

The simple zinc line process.—In the simplest form of this process, as originally used, a drawing is made in lithographic ink on a zinc plate. Powdered asphaltum or resin is dusted over the plate; some of this adheres to the ink, and the rest has to be carefully removed. The plate is then heated gently, and in this way an acid-proof coating is obtained which protects the lines which are to form the future printing-surface. The under surface of the plate then receives an acid-proof coating, and the whole plate is plunged into a bath of dilute acid. The unprotected interspaces on the upper surface of the plate then gradually dissolve. As soon as a certain small depth has been reached, this action must be stopped, or else there is risk of the protected lines being attacked laterally by the acid. The coating is next reinforced, either by a dusting method or else by applying a roller carrying some acid-resisting composition, and by then gently heating the plate. The result of this is that not only the lines, but also the adjoining top of the walls of the interspaces have a protective coating. The plate is then again plunged into acid, and this series of operations is repeated several times until the smaller interspaces are sufficiently deep to give whites in printing. Finally the larger interspaces are routed, or cut out, by means of hand-tools. At a later date, routing machines were used for this purpose. If the plate when completed is generally satisfactory, but has some small part of the printing-surface missing, it can be repaired by putting on a little solder and working this up by hand. The zinc plate is then mounted on a block made of mahogany, or other suitable hardwood, of such thickness that the correct height-to-paper is obtained. This block—as the completed article is termed—is then used for printing in the usual way. If a very large number of impressions are required, it is advisable to have several electrotypes made, and use these for the printing proper.

The transfer line process.—In a modification of the simple zinc line process, introduced very little later, the drawing was made in transfer-ink on lithographic paper, and transferred to the zinc plate, which was then treated in the way described above. Considerable skill is required to carry out this process properly, particularly in heating the zinc plate uniformly and to the exact extent necessary.

The photo zinc line process.—A plate of zinc is coated with a substance sensitive to light, such as asphaltum or bichromated gelatine. A reflected negative is taken, with the help of a prism or mirror, from the original which is to be reproduced. This negative must be quite clear and transparent in the lines, and dense and dark elsewhere; it must contain no half-tones. The negative is then placed on the prepared zinc plate and exposed to light; this renders insoluble those parts of the coating which are below the whites of the negatives, and the remainder of the coating can then be dissolved and washed off. The plate then undergoes treatment similar to that applied in the zinc line process. This process makes possible the reproduction of all drawings in black and white in which the lines are of sufficient width to produce a typographical surface, when reproduced on the scale required. It is admirably suited to the reproduction of pen and ink sketches, machine drawings, patterns, designs, and, in fact, all work resembling the typographical printing-surface in its general characteristics. Blocks of this kind were formerly known as process blocks or zincos, terms which are still often used for them, although their use has now become extended to half-tone blocks, which were only invented at a later period.

The gelatine process.—This process resembles that last described in using bichromated gelatine, but with the difference that while the parts acted on by light become insoluble the remaining gelatine can be made to swell by immersion in cold water. By taking a plaster mould from this and working on an impression from the mould with wax, as explained in the paragraph devoted to typographical etching, these parts can be built up and a shell obtained by electrotyping in the usual manner.

Typographical etching.—Dawson's process, invented by the brothers A. and H. T. Dawson and patented by them in 1872, is carried out by coating a plate of brass with a thin film of wax through which the etching is drawn with a needle used in a manner similar to that adopted in ordinary etching. Great care must be taken by the draughtsman to cut quite through the wax, or the resulting surface will not be type-high all over. The whites are built up on the wax coating with wax applied by means of several ingenious tools described in the patent. When built up the plate is black-leaded and an electrotype is taken from it in the usual manner.

Where printed matter is required in conjunction with a design, ordinary type can be pressed through the original film of wax. The process is used for preparing the illustrations for certain scientific works, and also for diagrams, maps, etc. The curve diagrams in the "Proceedings of the American Society of Mechanical Engineers" are prepared by this process, which is peculiarly suitable for work in which the use of lettering is often nearly equal in quantity to that of engraving. In England the diagrams of the "Proceedings of the Royal Society of Arts" are usually produced in this way; other examples of this process are to be found in many of the maps in the eleventh edition of the "Encyclopædia Britannica."

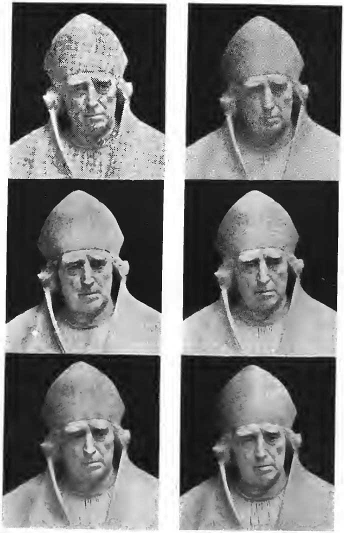
Half-tone blocks.—In this process, the picture is broken up into a series of dots, placed at regular distances from each other, the appearance of light or shade being produced by decreasing or increasing the size of the individual dots. These blocks are produced by processes based on that of Meisenbach, patented in 1882. This inventor at first used a glass screen ruled with parallel lines close together, which was inserted in the camera in front of the negative. In the original form of the process two exposures were given to each negative, the first with the screen placed in the camera with the lines running at 45° to the horizontal, and, after the first exposure had been given, the screen was withdrawn, turned through a right-angle and replaced, and the second exposure was then given. This double exposure had the result of breaking up the image on the negative into a series of dots. If a zinc plate was then prepared from the negative, in a way similar to that adopted in the photo-zinc line process, the size of the dots on this zinc plate varied with the darkness or lightness of the corresponding dots in the negative. Thus this process made it possible to reproduce a photograph or an object of any kind, not merely one in lines.

The difficulties, however, of accurately dividing the time of exposure, of moving the screen and replacing it in the camera, were obviously such as to handicap this invention very severely in its earlier form. It was soon found that the best effect was obtained when the screen or grid was not actually in contact with the negative, but a short distance away from it; this discovery led to the great improvement of making the grid of two plates of ruled glass with the lines filled in, the plates being cemented together face to face so as to obtain a true cross-grid available for use as a screen. But difficulties which were at first insuperable arose in ruling these glass screens in such a way that regularity of tint could be obtained, and the screens were necessarily very expensive; moreover one given screen could naturally only be used for one given size of grain. Other methods, many of them photographic, were hence devised for making suitable screens. Various woven materials, wire-work, etc., were tried with more or less success to obtain the necessary reticulations. One method which gave excellent results was the following: a series of fine parallel lines was engraved on a copper plate; the plate was then inked in and printed; a negative was then taken of the print, with alternate exposures of the lines in a horizontal and in a vertical position if a straight tint was desired. If a diagonal tint was required, the lines were placed in each position at 45° to the horizontal. A reticulated negative was thus obtained, which was subsequently used as a screen. One great advantage of this method was that it was possible, by varying the distance of the print when making the negative, to vary the size of the reticulations. The angle through which the print was turned when making the alternate exposures could also be varied. When this angle was 90°, as described above, a square tint was produced; but oblique tints could be produced equally well. Once a really good print, with regular and sharply-defined lines of the dimensions necessary, had been obtained, it was a comparatively simple, although somewhat uncertain matter to make excellent screens having reticulations of any size and pattern desired. The objection to these screens was, however, their comparatively short life. They rapidly deteriorated under the influence of the strong light which had to be used in those days. Otherwise good results were obtained, and some of the blocks which were made in this way about twenty-five to thirty years ago, were quite as good as any which have been made since.

The art of ruling glass screens has made great progress since, and it is to Max Levy of Philadelphia that is due the first production of ruled screens of the requisite degree of accuracy.

It is essential in performing the work of ruling that the machine should be kept at a perfectly even temperature, and free from all vibration from extraneous sources. The work is performed by coating a sheet of plate glass with asphalt and wax on which the lines are mechanically ruled with a diamond giving the required width of line. The lines are then etched in with hydrofluoric acid, the coating is cleaned off and the lines are filled in, after

PLATE CIII.
[*To face page* 489]



FIGS. 487 *to* 492.—*Study of a head by Prof. E. Lantéri.*

Examples of reproduction in half-tone using different screens. 487–50 per in.; 488–57 per in.; 489–100 per in.; 490–125 per in.; 491–150 per in.; 492–175 per in.

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487–50 per in.;
92–175 per in.

which the two grids are cemented together with the lines at right angles to each other. The pitch of the ruling varies according to the work to be done, and this is dependent on the surface of the paper to be used and the fineness of the ink.

The process blocks for illustrating the daily and evening papers, which are printed from ordinary stereotypes on the rotary press, are produced by means of a screen of 50 meshes per linear inch, fig. 487, plate CIII, or one even coarser. For better work printed on paper with a smoother surface, screens of 75 meshes per linear inch, fig. 488, or of 100 meshes per linear inch, fig. 489, are used; for high-class trade catalogues and text-books the blocks are obtained from screens of 125 meshes per linear inch, fig. 490, to 150 meshes per linear inch, fig. 491; a screen very generally used for such illustrations as appear in this work has 133 meshes per linear inch. In still-higher-class work, printed on art paper, screens are used having 175 meshes per linear inch, fig. 492; the work produced by these requires great care to ensure that the minute depressions do not become filled in with ink in printing and the effect spoilt; for text-books on and catalogues of works of art, which require much detail, a screen of 200 meshes per linear inch may be used; the difficulty of obtaining satisfactory work from this or from even finer screens does not lie in the production of the block itself but in the printing.

Occasionally for advertising purposes the printed impression of a half-tone is enlarged many times, with the result that the pitch of the dots may be increased to as much as one inch. Such advertisements will only appear to resemble the original print when they are seen from a sufficiently great distance; if an ordinary half-tone block is examined under a microscope, it is very difficult to identify which part of the picture it is that appears in the field.

With regard to the actual photography, that is to the optical side of the process as opposed to the mechanical, if the glass screen were placed so as to be actually in contact with the sensitized plate—and this would only be practicable if a dry plate were used—the resulting print would be a series of intersecting lines with interruptions; the tint would not be broken up into a series of dots in the manner desired. This effect is produced by diffraction; the clear spaces in the screen permit the passage of divergent pencils of light which spread over a larger area on the plate, and these make the sizes of the dots vary according to the intensity of the light received through any particular opening. The operator must determine the correct distance between the screen and the plate in order to take full advantage of this diffraction effect, so that in the result the dots on the negative join together in the high lights and the shadows are represented by small separate dots.

At first, all process blocks, both line and half-tone, were made of zinc. Subsequently other metals were also tried, particularly for half-tone blocks. Very good results are now obtained with copper.

Until 1892, most of the illustrations in newspapers and books were woodcuts. But the results obtained by means of the half-tone process were so superior not only as regards speed and price, but also as regards beauty and faithfulness of reproduction of the original, that in less than fifteen years the art of wood-engraving had died out almost completely. It is true that the Polytechnic and other art schools are making efforts to revive training in this art, which almost attained perfection in the hands of Albrecht Dürer and other great artists, but these attempts are bound to remain futile, except perhaps in the case of individual efforts of the highest artistic order.

Colour-printing blocks.—Before the advent of printing for books, colour-prints were made from blocks produced by wood-engravers, and this method is still in use in Japan.

The Japanese colour-prints made from wood-engravings require a large number of blocks for their printing, and the method is admirably illustrated by the examples in the fine collection of actual blocks and the prints from them which are exhibited in the Victoria and Albert Museum at South Kensington. The method of inking the blocks differs from European methods, inasmuch as the ink used is not of an oily nature but consists of a starchy medium, to which colour is added, the mixture being applied to the wood with a wide brush. The blocks are cut with the grain running plankways, so that the absorption is not so great as it would be in an ordinary European end-grain wood-block. Graduated tints are obtained in the inking by intentional irregularity in the amount of colour applied to the printing-areas covered by the brush.

Following the coloured print composed from a number of independent wood-blocks as used in Japan, came the completely coloured picture produced on an intaglio printed key in the manner devised by Baxter; this was followed by the use of a wood-block key and the building up of a picture tint by tint, a method used by Edmund Evans, the engraver-printer of Kate Greenaway's and Caldecott's illustrated children's books.

From this point it is very difficult to separate the history of typographical colour-printing from other methods of intaglio and surface printing, so interwoven is it with the progress made in intaglio colour-printing and in chromolithographic work. The three-colour process as printed from half-tone blocks has been made possible by its auxiliaries: photography, in its mechanical application dependent on the ruling of a screen to a very high degree of accuracy; paper, coated and finished to a surface both flatter and smoother than anything previously attempted; ink, ground to a corresponding degree of fineness; and finally, a degree of exactitude in the register of the printing machinery, far greater than could have been obtained without the corresponding improvement which had simultaneously taken place in machine-tool construction.

One of the first steps taken was the use of a half-tone key, and the French paper, "Le Figaro Illustré," produced coloured illustrations from a key made from an isochromatic plate, the colours being added from hand-drawn plates.

Meanwhile, colour-printing had made progress in other branches, for example intaglio colour-printing. Working, with a coloured picture by the artist before him, on an etched plate of the subject, the printer filled in each colour on this intaglio plate until he had obtained a result which in his opinion would produce a print resembling the original. This method was revived for a time, experimentally, by the Dawsons about 1886, and is still being worked at Montmartre in Paris by Delâtre, the son of the etching-printer of that name. At the present time this process is also being made use of by Emery Walker and others in London.

The collotype, with its resemblance in the ink-retaining quality of the reticulated surface of the hardened exposed portion of the plate to that of the stone in lithography, though but little known, has also taken its part in the development of colour-printing; many good examples of chromocollotype have been published by the Medici Society.

The use of three negatives exposed singly to red, yellow, and blue light by the interposition of suitable filters, and the subsequent printing of the results in the same colours on paper, is stated to have been suggested simultaneously by Ransonnet of Vienna and by Collan of London, in 1865. The idea, however, was premature, owing to the absence of photographic plates properly sensitive to each group of filtered rays of light, for the early red and yellow plates were nearly opaque to actinic rays. This difficulty was overcome when Vogel, of Berlin, discovered that the addition of eosine to collodion increased the range of colour to which the plate was sensitive; this was applied practically by Ducos Duhauron in 1868. It is stated that the negatives obtained were excellent for their colour-values, but that the inventor used the same colours for printing instead of the complementary colours, and consequently the printed results were found to be unsatisfactory. It is difficult to reconcile this statement with the masterly exposition of the subject given by the inventor in his French patent, No. 83,061, of 1868, at the conclusion of which he suggests the following test for the truth of his claim:—

"C'est en essayant de reproduire le spectre solaire par mes divers procédés qu'on reconnaitra s'il est réellement constitué par autant de couleurs simples qu'il y a de refrangibilités, ou s'il est formé par une trinité de trois spectres, rouge, jaune et bleu superposés et dont le maximum d'intensité correspond à des points différents."

It was not until the early nineties that the three-colour process was established on a commercial basis. Great difficulties had to be overcome in obtaining absolute register for all the three negatives; very powerful lighting was required to diminish the time of exposure; dark rooms had to be fitted with special lamps, deep red for plates sensitive to blue and yellow, and deep green for plates sensitive to red. Another difficulty that arose was due to the production of a *moiré* effect in the print if the screen position was not changed, and it was found necessary to use a screen capable of being revolved so that while the lines of dots were at right angles to each other on each plate, those of each of the three plates were inclined at an angle of 30° to those of each of the other two. Fixed screens are now used instead; the one is usually arranged with its lines inclined at an angle of 45° to the edge of the plate for the blue, and another screen having lines inclined at an angle of 15° to the edge of the plate is used, the one way round for yellow and the other way round for red.

The colour-screens have been the subject of much research and invention; coloured films, coloured glasses and dye-containing cells have all been tried in turn, but it has been found that in every case optical flatness is an essential feature mechanically, and that the quality of the filter must pass a spectroscopic test. An orange-red filter has to be used for the rays sensitizing the plate which is to print blue, a green-blue filter for the plate which is to print red, and a blue-violet filter for the plate which is to print yellow. Thus good work depends upon many variables, and these are largely dependent on the judgment and experience of the operator:—

For the proper illumination of the subject;

For the selection of the proper light-filter;

For the correct setting of the screens for angle and for distance from the plate;

For the choice of the appropriate sensitized plate;

For the correct time of exposure;

For the development of the three negatives so that they will give plates from which, in combination and by the use of inks of the proper colour, a true ultimate result will be obtained.

The half-tone plates made from these three negatives by the photo-etcher must be trimmed, squared up, and mounted type-high. In making the trials the procedure is to print first from the yellow; next, to take a trial proof from the red; then to take a combined proof of yellow and red; following this a proof print of the blue plate, and finally a combined print of the yellow, red, and blue plates. In the actual printing it is usual for the yellow block to be printed first and the paper allowed to dry; the red is printed next, and also allowed to dry before the blue or last printing is done. The continuous spectrum, which has been chosen as an example of the three-colour process, is given in figs. 493 to 497, plate CIV. In this the yellow, printed first, is shown in fig. 493; the red is shown alone in fig. 494, and the combined yellow and red in fig. 495. The blue is shown alone in fig. 496, and the complete spectrum resulting from the superposed printing of the three blocks is given in fig. 497.

In the four-colour process there is the addition of black or a broken black; the fourth colour is usually printed between the yellow and red, but occasionally it is printed first, though less frequently it is printed after the red or even after the blue. The yellow being the first colour to be

FIGS. 493 *to* 497.—Co

PLATE CIV.

[*To face page* 492.]

FIG. 493.—*Yellow alone.*

FIG. 494.—*Red alone.*

FIG.—495.—*Yellow and red.*

FIG. 496.—*Blue alone.*

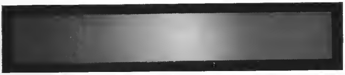


FIG. 497.—*Yellow, red, and blue.*

FIGS. 493 *to* 497.—*Continuous spectrum reproduced by the three-colour process.*

PLATE CV.

[*To face page* 493.]

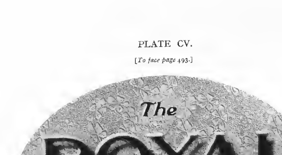


FIG. 498.—*Example of Litho-block.*

received by the paper is absorbed to a greater extent, and here comes into account the question of skill and experience in mixing the inks to the right tone to correct such absorption and give the desired result.

Whereas in ordinary language the words *tone*, *tint*, *hue*, and *shade* are used almost indiscriminately, for the niceties of colour-printing work it is necessary to use these as having different meanings, which are generally accepted as follows :—

Tone signifies intensity of colour ;

Tints refer to admixtures of colour with white ;

Hues relate to admixtures of colours with other colours ;

Shades indicate admixtures of colours with black.

In describing the effect which the various colours produce in the plate, it is commonly stated that :—

Yellow gives light and life to the subject ;

Red gives colour and warmth ;

Blue gives shadow and depth and completes the form and outlines of the picture.

The success of colour-printing is largely dependent on the improvements that have taken place in the preparation of inks and in their application ; in the parallelism and flatness of surface of the paper ; and in the printing-press itself, both in its power of impression and in its accuracy of register.

Attempts have been made to print in three colours simultaneously, that is without any intermediate period for drying the ink. Where attempts have been made to do this on the cylinder-press it has been found that the difficulty of obtaining sufficiently accurate register of curved plates is extremely great. In France three or four colours have been printed at one operation by means of a flat-bed press, introduced in 1902 by Lambert. This process, however, involves the difficulty of adding an impression to one not quite dry, though it avoids the still greater difficulty of change occurring in the paper with consequent impossibility of obtaining accurate register.

The fact that the process block is produced from any suitable photographic negative permits it to be used to reproduce effects which could otherwise only be obtained by lithography ; in fact, it is possible to obtain at a single printing an effect which would require two operations lithographically. An example of this is afforded by the process called the *Litho-block*, which is actually a process block obtained from two or more superposed images on the photographic plate, the lettering being printed through the illustration or background of the block, usually an advertisement. An example of this process is given in fig. 498, plate CV.

Other results can be obtained by suitable combinations of process blocks. An extreme example is that process in which two stereoscopic plates are taken. Separate blocks are prepared from these plates and then printed in red and green colours, superimposed on the same sheet of paper. The combined impressions produce a blurred effect when looked at in the ordinary way, but, when viewed through glasses, red and green respectively for the two eyes, the pictures actually seen by each eye become combined into a single stereoscopic image which is comparable in effect to that obtained by the two adjacent photographs of the familiar stereoscope.

In the issue of "The Inland Printer" for November, 1913, a very remarkable example of combined photographic and colour printing portraiture is shown. Three colour-record negatives were taken simultaneously and instantaneously of the sitter, a wonderful feat of photography, by means of the special camera and flashlight apparatus of the Polychromide Company of America. From these three colour-record negatives the Van Dyke Gravure Company of New York engraved photogravures on copper cylinders and printed off the seventeen thousand copies required for the edition of "The Inland Printer," from whose pages the preceding few lines have been summarized. This combination of instantaneous photography in colours and rotary photogravure in colours seems to be a consummation beyond which it would appear impossible for pictures in printing-ink to go. To what has been said above, the authors can only add their unstinted admiration of the beauty of achievement and workmanship in the specimen shown in the admirable trade-journal to which reference has just been made.

ELECTROTYPING.

This modern form of reproducing a typographical surface must have but very brief notice here, for although it gives very satisfactory results it can never compete commercially, for ordinary letterpress work, with the older process of stereotyping and its later developments. For the reproduction of process blocks, engravings, and surfaces other than typographical, it is very largely used. This process is still more largely employed in other branches of the arts: these, however, call for no comment in this work.

The process of electrotyping really consists in the separation of metals from their solution by electrolysis and their deposition in a solid form on a suitable mould. In practice the art of electrotyping requires very close and constant attention to minute details: the purity of the materials, the cleanliness of the vessels used and the perfection of the electric connexions being matters of the greatest importance, while the distance between anode and cathode, the temperature of the depositing bath, the composition of the electrolyte and the voltage of the current supplied are all variables, each of which must be confined between narrow limits.

It is not a process that can be carried on commercially and profitably on a small scale; it does not call for further description in this work, for it has formed the subject-matter of many scientific memoirs and has a considerable literature of its own.

CHAPTER XXXIII.

THE LANGUAGE OF CHINA AND ITS TYPOGRAPHICAL EXPRESSION.

雲 浮 如 我 於 貴 且 富 而 義 不

11 point Chinese No. 4.

"**Riches and honour acquired by ways that are not right are to me as a floating cloud.**"

Analects of Confucius.

Brevier abbey text (Stephenson, Blake & Co.).

In dealing with Chinese, a man of any other race in the world has to divest himself of all preconceived notions and of every idea that has become familiar to him in connexion with speech, aural or written, and approach the subject from a standpoint not only novel, but as difficult of attainment as it is novel.

There is ample reason for this statement, for the Chinese language in its recorded state does not express itself through the ear as do other languages, but through the eye in pictorial ideographs, all of which, it is stated, can be traced back to some visualized fact. Hence it has no alphabet, no syllabary, practically but little real grammar, only an enormous range of characters or conventionalized pictures extending from over 100,000 in exaggerated estimates to 15,000 in conservative estimates. It is obvious, therefore, that its adaptation in this state for modern machine-composition is entirely out of the question, for it would be quite beyond the range of practical possibility to cut punches and strike and apply such a number of matrices to any known form of machine. Imagination boggles at a Linotype keyboard a quarter of a mile in length, or a Monotype grid weighing over a quarter of a ton. Indeed, to bring the whole language within the scope of operation of an ordinary hand-compositor working at case, would draw one very near the late Mark Twain's description of Chinese compositors at work, a matter already alluded to elsewhere in this book. In practice the ideographs in general use are restricted to some 6000 or 8000 characters, but even such numbers are unwieldy.

FIG. 499.—*Archaic Chinese writing, in form 2,700 years old.*

Disregarding certain archaic types, the Chinese recognize six orthodox styles of writing. First of these is that commonly called the "seal character," which is said to date from 827 B.C.

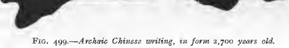


FIG. 500.—*Chuan shu or seal character.*

Following this comes the "clerkly style" used in public offices, dating probably from 213 B.C.

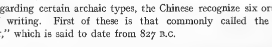


FIG. 501.—*Li shu or clerkly style.*

Then we have the "pattern style," from which all modern forms have originated, probably dating from the beginning of the Christian era.

宋草行楷隸篆

FIG. 502.—*Ch'iai shu or pattern style.*

Next there is the "running hand," the pencil, or brush, being carried from stroke to stroke; this dates from about A.D. 200.

宋草行楷隸篆

FIG. 503.—*Hsing shu or running hand.*

Then come the "grass characters," dating from about the same period. This is a very abbreviated running hand, full of difficulties even to an educated native; it is still commonly in use, particularly in Japan and Korea.

宋草行楷隸篆

FIG. 504.—*Ts'ao tzŭ or grass character.*

The sixth and last hand is that of the Sung dynasty, whose name it still bears.

宋草行楷隸篆

FIG. 505.—*Sung t'i or Sung dynasty style.*

This is the printed style, and, since it came into use, the *Sung t'i* has undergone no material alterations. It constitutes a medium of daily and common communication between the individuals of a large proportion of the human race, and is well called a "marvellous script" by Sir Walter Hillier, one of the leading Chinese scholars of the world, and the gifted writer of the interesting volume, "The Chinese language and how to learn it," from which these illustrations are by permission reproduced; an authority to whom the authors of this work are personally indebted for much of the information here given and for the admirable memorandum which follows.

Classic Chinese writing is indeed a wonderful and beautiful form of conveying ideas, but apart from the fact that the whole of the rest of the world recognizes meanings through the ear and not through the eye, the difficulties of its acquisition are immense. Not only is there the portentous difficulty of memorizing an enormous number of ideographs, but each ideograph changes its meaning or expresses an entirely new idea according to the position in which it stands relatively to other ideographs. Merely to mention some of the technical difficulties of reproducing the classic Chinese characters by modern methods of preparing a typographical surface would take up several pages of this book, and, owing to these difficulties, the use of the language as a rapidly printed and easily understood means of expression not only throughout the Chinese Empire, but for foreigners, becomes an impossibility.

Many attempts have been made to write Chinese phonetically by means of latin characters, and these have to a certain extent come into use. All such foreign systems, however, have grave disadvantages, firstly, from the fact that the alphabet itself is foreign, and therefore objectionable, and secondly, from the tonal qualities of Chinese, necessitating, in addition to the ordinary letters of an alphabet, the use of a number of arbitrary marks, signs and accents. Further objection to the latin character arises from the different dialects spoken in China, which may practically be termed different languages using the same pictorial sign to express the same word-meaning, but having a totally different pronunciation; for instance, the ideograph 金 metal, is in Peking pronounced *chin*, in Nanking it is pronounced *kin*, and elsewhere through China it is variously pronounced *tsin*, *kem*, *cing*, and *ciang*, and possibly may have many other pronunciations. The example given is in any case sufficient to show how impossible it is to produce a universal, correct, and efficient system of writing Chinese by means of a latin alphabet.

Within the last few years, however, a new Chinese alphabet, or more strictly speaking, syllabary, has been invented by the Chinese themselves and has come into a certain vogue and into semi-official use; for instance, in matters connected with military affairs. By using this syllabary all variations can be represented, and many of the disabilities mentioned are incidentally removed. This syllabic form of writing, itself, however, presented almost insuperable difficulties to machine-composition or type-writing; but the difficulty has been overcome by an invention of the authors, which applies not only to the syllabary in question, but with slight modifications to any similar attempt at the phonetic expression of a language.

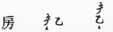
The new method of writing Chinese phonetically, which is, as already stated, a Chinese invention, includes: dividing the so-called mandarin pronunciation of each ideograph into two portions; expressing each of these portions by a character of fixed phonetic value; and adding it to a symbol or mark which expresses the tone-value to be given to the whole composite character.

It is impossible to do without an example in a subject of such complexity as that with which this invention deals. Here, therefore, is given the ideographic character for *fang* 房 and after it, the same word as at present written in the new Chinese syllabic alphabet  [*f*(*u*)*ang*]. Unless special matrices are made for the whole composite character—and not only for the whole composite character as here represented, but also for the same composite character in all its eight different variations of tone and elision—the new composite character, or syllabic word, is as impossible of production on the composing machine as would be the original pictorial ideograph itself unless it also had a special matrix made for each variety. In the one case the difficulties would arise from the large number of permutations and combinations of a limited number of characters and signs, and in the other, from the vast number of totally different ideographic matrices that would be required. Moreover, even though the syllabic character were divided into its several component parts in the attempt to get over one complex difficulty, it would still be impossible to set it, in its present position, on any form of composing machine using separate matrices, for this would necessitate producing at the same time and in the same mould at least two separate and interdependent slugs, or characters. Similar difficulties would also arise in the attempt to adapt the script to the typewriter under the same mechanical conditions of circumstance and situation.

The invention of the authors consists in the mechanical and technical processes involved in altering the position of the two components and the tonal mark in such a manner that while retaining perfect naturalness and legibility to Chinese eyes, the composite phonographic character is rendered capable of being written with a typewriter or composing machine. This, speaking broadly, is done by placing one character after the other, followed by the tonal mark, or otherwise arranging it on the principle here indicated, so as to allow of its being brought within the range of machine-composition.

Should elision be required, a diamond may be composed between the two characters forming the word.

The following example displays the three methods of writing the same ideograph; firstly, the ideograph itself, which has already been given; secondly, the syllabic form of expressing it, which is just coming into use; and thirdly, the syllabic form of its expression as adapted for the typewriter or composing machine:—



the tonal mark is shown in both examples of the syllabic form.

Another example illustrates the use of the elision mark :—

金 *chin*, metal 

signifying the elimination of the initial letter of the second syllable.

Though apparently a simple innovation, the subject has baffled some of the ablest workers in the world, and it is one that affects the commerce, government, and intelligent and simple reproduction of ideas in typewriting and printing among nearly four hundred million human beings. Whatever the ultimate system adopted, there is urgent need of the adoption of some system, by which, for the purposes of everyday life at any rate, the inhabitants of China shall no longer be handicapped in the ever accelerating race between the nations.

In the field of the written, as opposed to the printed character, it is not impossible that a system of Chinese writing invented by Dr. T. F. Lam of the Middle Temple, Assistant Professor of Chinese at King's College, London, may some day usefully be worked in conjunction with the existing new Chinese script which has been under discussion. It is really a system of shorthand, with its own advantages. Its mechanical reproduction falls into the same category as the reproduction of ordinary shorthand. It is in no sense a rival to the printed character, but stands in the same light to it as European shorthand does to the ordinary latin character.

The brief foregoing reference made by the authors to a new Chinese script which is coming into use in that country, and their solution of the problem of adapting it to the consecutive operations of work performed on the typewriter and in connexion with any class of keyboard-operated composing machinery, are better explained in Sir Walter Hillier's own words in the memorandum which follows.

If it is true that time is money, in this respect at least, there is urgent need of reform, for the time of the Chinese people is being grievously wasted when the time taken for the transcription of their own beautiful classic script is compared with that taken by the plainer and less expressive, but more severely practical writing of the western nations, their present and future great trade rivals, with whose systems of transcription, printing, and reproduction, the new Chinese script can now compete on equal terms.

The authors lay claim to no knowledge whatever of the Chinese language, while the writer of the following memorandum has an intimate personal knowledge of the language of China, of its peoples and of their needs.

MEMORANDUM

BY

SIR WALTER HILLIER, K.C.M.G., C.B.

ON AN ALPHABETICAL SYSTEM FOR WRITING CHINESE, THE APPLICATION OF THIS SYSTEM TO THE TYPEWRITER, AND TO THE LINOTYPE OR OTHER TYPECASTING AND COMPOSING MACHINES, AND ITS ADAPTATION TO THE BRAILLE SYSTEM FOR THE BLIND.

THE Chinese written language is expressed by some 13,000 to 14,000 characters or ideographs composed of from one to six lines, dots or strokes arranged in various combinations, the most complicated of these characters containing as many as twenty-seven of such lines, strokes or dots.

It is obvious that these various combinations cannot, for many reasons, be thus reproduced on a typewriter or by a typecasting and composing machine. The only way in which they can be printed is by means of separate dies or type for each character, and although the process of selecting and arranging Chinese type is considerably simplified by the fact that every character in the Chinese language is capable of being assigned to one or other of 214 radicals or root indices, the process of selecting and arranging these characters from the root indices under which they are placed in the cases of type cannot but be slow.

Many attempts have been made to express the Chinese language by the use of roman letters, but romanization of Chinese sounds cannot be universally applicable for several reasons. First, no common system of romanization exists, nor can any system be found which would be understood, appreciated, or accepted universally by either foreigners or Chinese. The Chinese will not accept a common system because of the diversity of dialects and of modifications of each dialect that exist even in places that are not far distant from each other. The foreigner, moreover, will not accept a common system of romanization for a similar reason, and for the further reason that foreigners of different nationalities insist upon the romanization of Chinese sounds as they consider these ought to be reproduced by their own systems of spelling, while even foreigners of the same nationality have never yet been entirely in agreement as to how certain Chinese sounds should be spelt phonetically.

It is only in recent years that a script has been invented by Mr. Wang Chao, an eminent native Chinese scholar, which appears to overcome all these objections. The basis of this system is the adoption of a certain number of simple symbols representing the initials and finals of all the sounds in the Chinese language which in combination, and in some instances singly, adequately reproduce every Chinese sound that exists.

Before proceeding to discuss these symbols, which consist of twelve vowel sounds and fifty consonantal sounds, it should be explained, for the benefit of those who do not know anything of the Chinese language, that this language is restricted in the matter of sounds, of which there are in the Mandarin or Court dialect about 400. It follows, therefore, that many words must have the same sound. In Chinese writing this deficiency can be ignored, as each ideograph speaks for itself, but in speaking, or in reproducing spoken words in any but ideographic form, it is evident that unless some means were devised by which words of the same sound could be distinguished much confusion would result.

There is, however, a system by which these sounds are subdivided. In the first place, a considerable multiplication is effected by the duplication of many sounds having certain initial consonants by the interposition of an aspirate between the initial consonant and the vowel, as *pa, p'a, tan, t'an,* and so on. But the number is still more appreciably increased by the pronunciation of the same sounds in different tones or inflections of the voice. In the Mandarin or Court dialect there are, for conversational purposes, four of these tones which the foreigner, who is obliged to learn and remember them, commonly indicates by the figures 1, 2, 3, 4. The Chinese does not learn these tones; he picks them up intuitively as he learns to speak, and it is impossible for him to make a mistake in the intonation of a word. When he learns to read, he is told the sound of a character with its intonation, and he does not forget the intonation any more than he forgets the sound of the character. When, however, he is confronted with a system of writing his own language such as is here proposed, tones and tone marks have necessarily to be considered, and the Chinese, equally with the foreigner, must consider Chinese sounds as expressed by 1, 2, 3, 4, or, as indicated in the system about to be explained, by and .

TONAL MARKS

1st Tone
2nd Tone
3rd Tone
4th Tone

ELISION MARK

COMMA

FULL STOP

PROPER NAMES

FIG. 506.—*Tonal marks and points.*

Herein lies the difficulty to the Chinese mind. The Chinese reader has practically to regard his language in a new light, and must force himself to think in terms of 1, 2, 3, 4 which he has never thought of before in connexion with the words he uses, and that will not be an easy task. If he can be persuaded to do so, the system will be a successful one. If he cannot, it is doomed to failure so far as the Chinese literary class is concerned, though it can be taught without difficulty to those who have not the education necessary to read the present form of Chinese ideograph.

As it is probable that not more than a third of the Chinese race can read the Classic script, the new system will still prove of immense advantage to many millions of people. It can be learnt in a few weeks, and books and newspapers can be printed in it with infinitely greater rapidity and at much less cost than in the old script. In the embossed form it can be read easily by the sightless, while it has successfully been adapted, as will be shown, to the braille system of embossed writing for the blind.

In the tables which are placed below—in the first instance arranged with the vowel sounds brought together and preceding the consonantal sounds, and in the second instance arranged as far as possible alphabetically for the convenience of foreigners—are shown the twelve vowels and fifty consonantal sounds by which all sounds may be represented. The sounds which they represent are indicated for Chinese readers by ideographs in the old style ; for foreigners, by a system of spelling which has been adopted by practically all English students of the official dialect, but is in no sense an arbitrary system. Any one can modify it to suit his taste. The German may adopt his system of spelling, the Frenchman can apply his idea of what the romanization should be. The Chinese will not apply any system of romanization to the symbols, each of which stands for a sound which, with three exceptions (the terminals *êng*, *eh* and *ei*), can be represented by a Chinese character. They are therefore applicable to every dialect. As the northern Chinese pronounces the character which represents the sound of the symbol, so will he pronounce the symbol ; the southern Chinese will read the symbol as its indicating character is pronounced in the south. Thus, singly or in combination, each man will read the sounds that the symbols represent in the way he is accustomed to pronounce them.

It is probable that in some dialects bearing very small resemblance to the official dialect the system will be found faulty in certain combinations, but it is also probable that by certain modifications it can be adapted to those dialects. In any case it is to the official dialect, which prevails, with certain local distinctions, over the greater part of the Chinese Empire, that the system is intended to apply, and it is believed that it will do so more effectively than any system of romanization that has been or can be invented. The objection has been raised that the written, as opposed to the spoken language, cannot be intelligibly produced in this script. This may be true of the higher classical style, but it is contended that it can be applied successfully to what is known as the "easy written style" as represented by what may be called "newspaper" Chinese, or the "easy *wên li*" of the translated Scriptures.

The practical advantage of this system lies in the fact that it is the only one at present known (excepting of course the romanized system) which can be applied to the typewriter or composing machine with

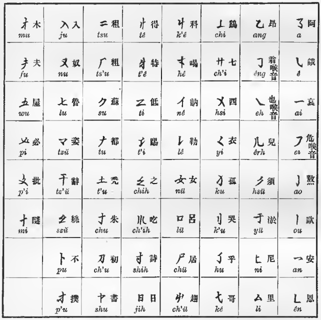


FIG. 507.—*Chinese syllabic symbols; vowel sounds preceding consonantal sounds.*

advantages in the matter of speed, simplicity and economy that are so obvious as to require no explanation.

The system, of course, has certain defects, some of which may possibly be remedied by experience, but it is claimed that it constitutes the nearest approach that has yet been made to the reduction of Chinese writing to a simple and intelligible form which, though it is not suggested that it should supersede the historic script of China, will supplement that script and be an incalculable boon to the millions of Chinese who can neither read nor write so complicated a character. The number of symbols might be reduced, but no attempt has been made to alter the form or reduce the number of these symbols as arranged by the Chinese scholar to whose ingenuity the system owes its origin, as it is already in limited use in northern China, where at least one magazine in the script was published, at any rate before the revolution, and where it was taught in various schools. But, in order to render the system applicable to the typewriter or linotype machine, it has been necessary to make one important change. In the existing Chinese system the symbols are placed side by side, reading from left to

土 禿 *t'u*	厶 絲 *szŭ*	丨 歐 *ou*	匕 魯 *lu*	日 日 *jih*	ㄴ 恩 *ên*	爪 吃 *ch'ih*	了 阿 *a*
マ 姿 *tzŭ*	忄 得 *tê*	乂 必 *pi*	口 呂 *lu*	入 入 *ju*	丁 翁喉音 *êng*	寸 朱 *chu*	一 哀 *ai*
干 辭 *tz'ŭ*	孑 特 *t'ê*	文 批 *p'i*	十 謎 *mi*	七 哥 *kê*	儿 兒 *êrh*	刀 初 *ch'u*	乛 安 *an*
五 屋 *wu*	乙 低 *ti*	卜 不 *pu*	才 木 *mu*	丩 科 *k'ê*	扌 夫 *fu*	尸 居 *chü*	乙 昂 *ang*
く 衣 *yi*	扌 踢 *t'i*	才 撲 *p'u*	亻 訥 *nê*	丁 孤 *ku*	木 喝 *hê*	屮 趨 *ch'ü*	亅 敖 *ao*
于 淤 *yü*	二 租 *tsu*	寸 詩 *shih*	匕 尼 *ni*	刂 哭 *k'u*	乂 西 *hsi*	乀 餓 *ê*	丄 鷄 *chi*
	厂 粗 *ts'u*	中 書 *shu*	又 奴 *nu*	丨 勒 *lê*	夕 須 *hsü*	乀 也喉音 *eh*	廾 七 *ch'i*
	十 都 *tu*	ク 蘇 *su*	女 女 *nü*	厶 里 *li*	亅 乎 *hu*	㇇ 危喉音 *ei*	之 之 *chih*

FIG. 508.—*Chinese syllabic symbols, arranged alphabetically.*

right, as 厶亅 廾丁 夕乛 亅乙. It is not possible to compose these symbols side by side on the typewriter or linotype machine, but if, instead of placing them side by side, they are placed one over the other, the process becomes a simple one. For typewriting or printing purposes the symbols must be placed on their side as below:—

The tonal mark under each combination indicates the tones. When reading the finished line all that is necessary is to turn the paper half round to the right when the writing will be read downwards and from right to left as is the rule in all Chinese writing. It should be stated that the credit of this invention belongs to J. C. Grant and L. A. Legros, formerly of the firm of Grant, Legros & Co., Ltd., the well-known engineers who have specialized in all matters connected with the production of the printing surface. In the existing system, numerals may be represented by single symbols preceded by an indicating mark, or they may be represented by the shorthand numerals at present in use in China with one or two slight modifications.

NUMERALS.

〡 *i*^{1}, one	〨 *pa*^{1}, eight
〢 *êrh*^{4}, two	〩 *chiu*^{3}, nine
〣 *san*^{1}, three	什 *shih*^{2}, ten
〤 *ssŭ*^{4}, four	伯 *pai*^{3}, hundred
〥 *wu*^{3}, five	仟 *ch'ien*^{1}, thousand
〦 *liu*^{4}, six	万 *wan*^{4}, ten thousand
〧 *ch'i*^{1}, seven	〇 *ling*^{2}, cypher

FIG. 509 —*Chinese numerals.*

Tables of the symbols, known to the Chinese as ***kuan hua tzŭ mu***, with a character showing the sound they are intended to represent, arranged under vowel and consonantal sounds, and also alphabetically, are given above, figs. 507 and 508, together with a phonetic rendering of the sound in what is known as the Wade system of spelling. Tone marks, points and proper name sign are given in fig. 506, and fig. 509 gives the numerals.

Words of one syllable, such as *li*, *ti*, *pu*, *p'u*, etc., are obviously represented by the symbols indicating these sounds. Compound words requiring two symbols, such as *li-ang*, *tu-an*, *pi-eh*, are equally easy to represent, as

li *tu* *pi*
ang *an* *eh*

The formation of certain other compound words requires explanation. Take the sound *ti-en*. There is no symbol in the table to represent the sound *en*, the nearest approach to *en* being *an*. But *an* is quite good enough, because in certain combinations the sound *an* does not exist in the Chinese language. There is, for instance, no such word as *ti-an*. Therefore, when a Chinese reads the compound *ti-an*, he knows it must represent *ti-en*. *Chi-en* is a common word. There is no such sound as *chi-an*. Therefore, when a Chinese reads the combination *chi-an*, he knows it must be *chi-en*. Other combinations will present difficulties unless certain principles are understood. Take the sound *ma*. This can only be represented by the symbols *mu* and *a*, but the combination will present no difficulty to the mind of a Chinese because there is no such sound as *mu-a* in the language. Moreover, by the system of representing the sounds of Chinese characters employed in Chinese dictionaries, he will have learnt that the final of the first sound must be eliminated—sometimes also the initial of the second sound. When a Chinese, therefore, sees the symbols *mu-a* in combination he will instinctively drop the *u* and read them as *ma*. Take, again, the sound *chin*. There is a symbol for *chi* in the table, but there is no final *n* or *in*. The nearest we can get to *chin* is *chi-an*, but we have already seen that *chi-an* must be read *chi-en*. To get *chin*, therefore, we have to get rid of the *a* in *an*. This is the way it is done: when the initial sound of the second symbol has to be suppressed an indicator is employed. This indicator is a diamond-shaped mark placed between the first and the second symbol *chi*◆(*a*)*n*. Where no indicator is used and it is evident that something has to be cut out because the combination does not express a Chinese sound, always cut out the final of the first symbol. Another word that may puzzle the uninitiated is *chiu*. There is no symbol for *u* in the table, the nearest approach to it being *ou*. We must therefore represent *chi-u* by *chi-ou*. But there is no such sound as *chiou*, so the Chinese must read it *chi-u*. Of course all these little difficulties could be got over by the multiplication of symbols, but it is not necessary to simplify matters for the Chinese, because when he finds that the combination before his eyes does not represent a recognized sound he at once accepts the nearest approach to a recognized sound. A very little practice will enable the foreign reader to do the same. The Chinese do not use capital letters. They indicate these in the case of proper names by a line at the side of the characters indicating proper names. In the present script proper names are indicated by a bracket placed above and below the symbols. Commas are indicated by the comma sign > and full stops by the sign of the full stop ∘.

Of the four hundred millions usually taken to represent in round figures the population of China, it is possible that there are as many as one million blind, whose condition, in the absence of any vehicle of education, is one of dependence on their friends and of uselessness to the State. The relief to their affliction and the stimulus to their intelligence and usefulness to be gained by any system which would place it in their power to read and write is too obvious to require to be enlarged upon. So far as is known, nothing has been done by the Government of China or by any Chinese institution to teach the blind to read. Missionaries in various parts of China have taken this duty upon themselves, and there are two systems at present in use for enabling the Chinese blind to read. One, known as the Murray system, is taught to a limited number of blind in Peking, who are educated in a small school for the blind supported by contributions from abroad. This system, when once acquired, is effective enough, but as the readers have to commit

學務要言

嘗聞求才之道首在興學立強之本貴
乎教育考諸環球各國無不因學校而
興起然國民不興必立學以教之使皆
有善良之德忠愛之心自養之技能必
需之知識方為富強之本是以我國君
臣極力設法造就人才以求教育普及
果能實力奉行誠與國計民生兩有裨
益書云民為邦本本固邦寧此之謂也

FIG. 510.—*Extract from "Sacred Edict," printed in alternate lines of classic Chinese ideographs and syllabic script.*

408 sounds to memory, and to remember these sounds as represented by figures from 1 to 408, a considerable amount of study and practice is necessary before any blind person can read with ease. The second system is the romanized system translated into braille. This suffers from limitations which have already been pointed out. A third system—the application of braille to the symbols of the Chinese alphabet, or *kuan hua tzŭ mu*, as it is called by the Chinese—has been worked out by Mr. E. G. Hillier, C.M.G., Manager of the Hongkong and Shanghai Bank in Peking, has been thoroughly tested by him, and has been proved to be by far the most efficient system in existence. The following notes are an epitome of a pamphlet on Chinese braille written by Mr. Hillier.

The basis of the braille system, now applied to all European languages and used in all schools for the education of the blind in Western countries, is the group of six dots representing the highest throw of a die. These dots are, for convenience of reference, numbered 1 to 6.

1	2
3	4
5	6

The various combinations, ranging from a single dot to the entire group of six, which can be made of these, will be found to be sixty-three in number, and they furnish sixty-three distinct signs which can be either used alphabetically or as representing syllables and words.

The system known as the *kuan hua tzŭ mu*, which reduces the Chinese language to what is practically an alphabetical basis, consists of fifty radicals and twelve phonetics (elsewhere described as consonantal and vowel sounds) which, used singly or in combination with the addition of a tone sign, furnish correctly every sound of the official Chinese language. The present scheme of Chinese braille consists, briefly, in the application to each of these sixty-two radicals or phonetics of a corresponding braille sign. In bringing it into practical shape it has been found necessary to discard as unsuitable, for reasons suggested by experience, six of the sixty-three signs furnished by the braille system, reducing the total number of Chinese braille signs to fifty-seven. These signs are exhibited in fig. 511 in order of series, with their corresponding Chinese sounds.

It will be noticed that the signs of the fourth series represent both radicals and phonetics; but as the phonetic, except when used singly, always follows a radical, confusion is impossible. The second sign of a group of two (excluding the tone sign) must always be a phonetic. Where a phonetic is used singly it is distinguishable from the radical of the same sign by prefixing the single phonetic sign. Similarly the comma and stop cannot be confused with the first and second tone signs because the latter always precede a group while the former necessarily follow it. The tone sign takes precedence of everything except the proper-name sign. The single phonetic sign, when used, immediately precedes the phonetic. The

Note.—The Chinese sounds are all in the 1st tone.

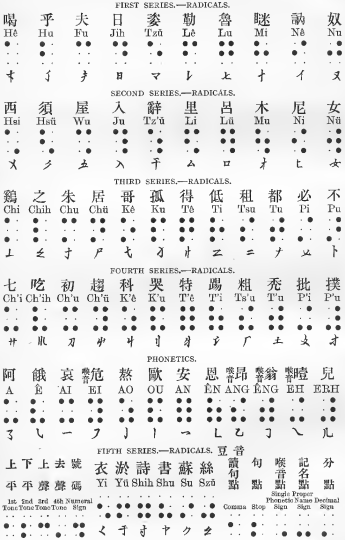


FIG. 511.—*The application of the Chinese syllabary to the braille system.*

proper-name sign precedes the tone sign. In practice, it will be found possible to dispense with the tone sign in the case of words which frequently recur, and where ambiguity is not likely to result, as, for instance, the classical possessive *chih* or its colloquial equivalent *ti*. The ten signs of the first series are used as numerals, representing respectively 1, 2, 3, 4, 5, 6, 7, 8, 9, 0. When so used, each group or series of figures is immediately

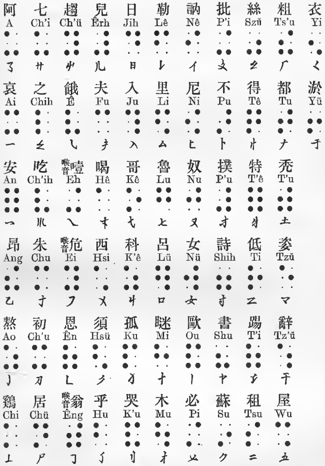


FIG. 512.—*Chinese braille syllabary arranged alphabetically (continued on next page).*

FIG. 512.—*Chinese braille syllabary arranged alphabetically (concluded from last page).*

preceded by the numeral sign. Where the figures exceed four in number each group of four (a Chinese *wan* or myriad) is marked off by a comma sign. The decimal point is represented by dot 5, the same as the fourth tone sign. With moderate practice this Chinese braille can be written as fast as ordinary Chinese round hand, and with little more consumption, if any, of paper space.

Note.—For the information of those who are not familiar with the *kuan hua tzŭ mu*, or Chinese phonetic system, earlier referred to, the following examples will illustrate the practical application of the method. The two syllables in each case are slurred, so as to produce the effect of a monosyllable.

Liang (tael)-	radical	*li*,	phonetic	*ang*,	in combination	*li-ang*.
T'ien (day)-	..	*t'i*,	..	*an*,	..	*t'i-an*.
Ch'êng (city)-	..	*ch'ih*,	..	*êng*,	..	*ch'ih-êng*.
Ma (horse)-	..	*mu*,	..	*a*,	..	*mu-a*.
Yüeh (moon)-	..	*yü*,	..	*eh*,	..	*yü-eh*.

Where a sound is furnished by a single radical or phonetic, these are used accordingly. Employed either singly, or in combination, with the addition of a tone sign, the radicals and phonetics given in the table will be found to cover the entire gamut of the Chinese Mandarin dialect, and to reproduce its various sounds with an accuracy unattainable by any system of romanization.

An example of Chinese braille with the corresponding Chinese ideographs is shown in fig. 513.

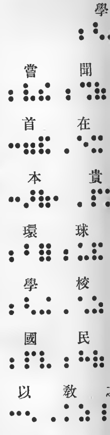


FIG. 513.—*Example of*
from "

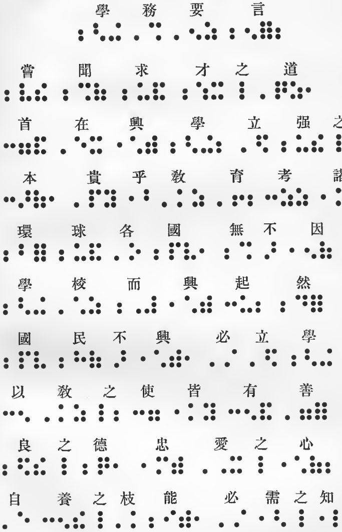


FIG. 513.—*Example of Chinese braille with Chinese ideographic equivalents; extract from "Sacred Edict"; (continued on the next page).*

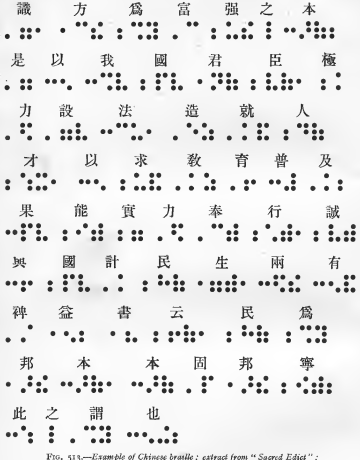


FIG. 513.—*Example of Chinese braille; extract from "Sacred Edict"; (concluded from the previous page).*

CHAPTER XXXIV.

HIEROGLYPHIC, COGNATE, SYLLABIC, AND OTHER SCRIPTS.

". . . men pourtrayed upon the wall, the images of the Chaldeans pourtrayed with vermilion."

Ezekiel.
Long primer gothic No. 1.

"And they made the plate of the holy crown of pure gold, and wrote upon it a writing, like to the engravings of a signet, . . ."

Exodus.
10-point winchell.

". . . David wrote a letter to Joab, and sent it by the hand of Uriah."

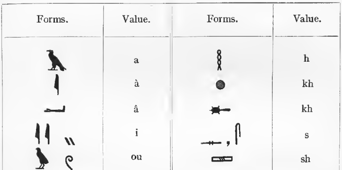
II. Samuel.
12-point columbus (Haddon).

"OH THAT MY WORDS WERE NOW WRITTEN! OH THAT THEY WERE PRINTED IN A BOOK!"

JOB.
Brevier inclined gothic No. 1.

ONE of the most interesting developments in connexion with the modern typographical printing-surface is the increasing use of hieroglyphics, or more strictly speaking, of ideographs; for hieroglyphics, as the term is more generally understood, are not pure ideographs, but ideographic symbols that have in the course of time had certain phonetic values attached to them. Originally, however, they were purely ideographic, and it is a curious fact that the enormous development of locomotion due to the internal-combustion petrol engine has brought men of different tongues into such contact that a demand has sprung up for a language, mute in itself, but which is a conveyer of meanings through the eye, and may be interpreted by every man into his own aural language in his own particular sound values. This fact has been strikingly exemplified in chapter VI, where the great saving, not only in printing to the printer but in time and trouble to everybody, effected by the use of this medium of intercourse is illustrated.

In the present chapter, however, hieroglyphics in their secondary application are considered, and certain points in the technology of their production and use are discussed. The authors here tender their fullest acknowledgments in the matter to an article by Albert Geiss, which



Forms.	Value.	Forms.	Value.
	a		h
	à		kh
	â		kh
	i		s
	ou		sh
	b		q
	p		k
	f		g
	m		t
	n		d
	r, l		z
	h		

FIG. 515.—*Hieroglyphic alphabet: simple sound-symbols.*

appeared in the November number of the "Bulletin Officiel de l'Union Syndicale des Maîtres Imprimeurs de France," of 1910, and also to N. J. Werner, whose paraphrase of the foregoing article appeared in "The Inland Printer" of January, 1913.

The history of the decipherment of hieroglyphics is too well known to need discussion here; the key to its interpretation was given by the Rosetta stone, a *stela* of black basalt now in the British Museum. It dates from the year 193 B.C., and is trilingual, being written in hieroglyphic, demotic, and greek characters, fig. 514, plate CVI.

PLATE CVI.

To face page 516.]

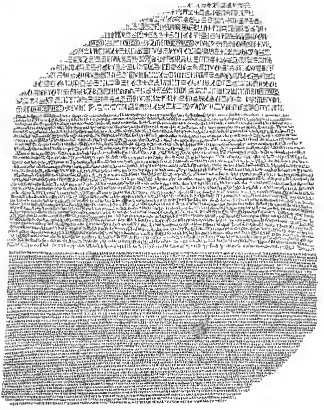


FIG. 514.—*Rosetta stone.*

F

The first clue to the deci
characters contained in the
from this comparatively slig
hieroglyphic alphabet were
phonetic values. With com
no discussion, the alphab
accepted; the particular s
those of the venerable autho
sufficient.

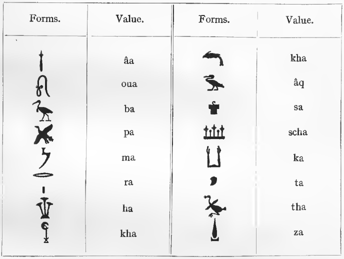
Forms.	Valu
	âa oua ba pa ma ra ha kha

FIG. 516.—*Hierogl*

Had the letters given in
would have been no easy m
addition to those shown, one
made out, which, though occ
the phonetic equivalents of
represented in the original al
complex sound-symbols whic
inscriptions.

In addition to these alph
that certain signs, called
a series of letters or signs r

The first clue to the decipherment of the writing was drawn from the characters contained in the cartouches surrounding royal names, and from this comparatively slight indication the various components of the hieroglyphic alphabet were gradually worked out, together with their phonetic values. With comparatively small differences which here require no discussion, the alphabet or list of sound-symbols is generally accepted; the particular sound-equivalents here followed—French—are those of the venerable authority, Maspero, the mention of whose name is sufficient.



Forms.	Value.	Forms.	Value.
	âa		kha
	oua		âq
	ba		sa
	pa		scha
	ma		ka
	ra		ta
	ha		tha
	kha		za

FIG. 516.—*Hieroglyphic alphabet: complex sound-symbols.*

Had the letters given in fig. 515 been all that were worked out, it would have been no easy matter to decipher a hieroglyphic text, but, in addition to those shown, one hundred and twenty-five other signs were also made out, which, though occasionally differing in form, were none the less the phonetic equivalents of two or more of the sounds hieroglyphically represented in the original alphabet. Figure 516 shows a few of the more complex sound-symbols which are of frequent occurrence in hieroglyphic inscriptions.

In addition to these alphabetical signs, Egyptologists have discovered that certain signs, called determinatives, are always found after a series of letters or signs representing a word belonging to the category to which the sign itself belongs. Thus the name of a man is always followed by the sign opposite the word men in the list below; the name of a woman by the sign opposite the word women in this list, and so on. Reference to the following list of a few of the commoner determinatives will make the use and meaning of these signs perfectly clear.

Forms.	Determinative of	Forms	Determinative of
	Men, masc. pronouns		Houses, buildings, abodes
	Women, fem. pronouns		Peoples of the desert, to travel
	People, persons, human race, classes		Meat
	Divinities, kings		Fire
	Ancient gods		Time
	Goddesses		Dust, sand
	Animals		Liquids
	Birds, flying insects		Marching (action), locomotion
	Plants, flowers		Sight (action), to know
	Trees		All which appertains to the mouth (actions)
	Earth		Little, wretched, mean, wicked
	Water, level		Abstract (sense, things), writings
	Desert, steppes, foreign countries		Violence, force
	Cities, villages		

FIG. 517.—*Determinatives.*

The foregoing information is sufficient to give an idea of the mechanism of Egyptian writing. Its more detailed discussion is beyond the scope of this treatise, as well as beyond the knowledge of the authors.

The first hieroglyphic reproductions were autographic, and it was

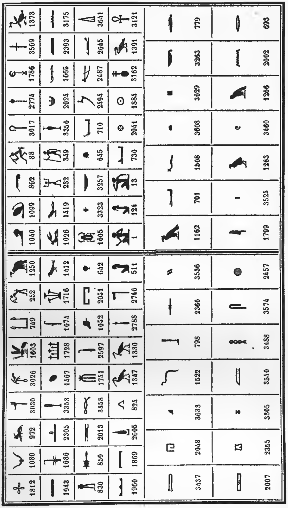


FIG. 518.—*Hieroglyphic case: first portion.*

not until 1842 that the *Imprimerie royale de France* commenced cutting the punches for their hieroglyphic founts, the first fount not being entirely completed until 1852. The complete founts to-day comprise 3972

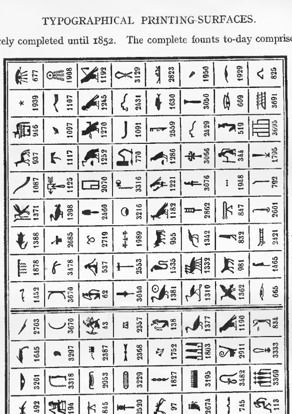


Fig. 519.—*Hieroglyphic case: second portion.*

signs, the majority of which are on two type-bodies, together with a certain number on a third type-body. This series of signs is distributed in sixty cases, in addition to the ordinary case, which is made up of four sections, shown in figs. 518 and 519, and the space-case, which is made up of two sections, shown in fig. 520.

The cases shown in the illustrations are used in the printing-office of the *Institut français du Caire.* They differ a little from those in use at Paris, but the principle of their construction and the classification of the signs are very similar in both places.

In connexion with such a matter as hieroglyphics, constant additions are being made to the founts, owing to the fact that new characters frequently appear when fresh manuscripts or inscriptions are deciphered. About one thousand fresh punches have been prepared for the production of characters not given in these cases, most of which have been cut by Hénaffe of Paris following the fine designs and careful instructions of the actual director of the *Institut français du Caire,* M. Chassinat,

1½-16	1-13	1½-13	3-13	2-13	2-14	1-14	1½-14	4-14	4-16
1-16	3¼-7	1¼-7	1-7	2-7	2-9	1-9	3-9	1½-9	2-16
5-10	1-10	1½-10	4-10	2-10	2-5	1-5	1½-5	2½-5	5-5
10-10	1-3	1½-3	3-3	2-3	2-4	1-4	3-4	1½-4	4-4
6-6	1-6	1½-6	3-6	2-6	2-8	1-8	4-8	1½-8	8-8
12-12	6-12	3-12	1¼-12	2-12	2-18	1½-18	3-18	18-18	8-18
Cadrats 12	Cadrats 12	1-12	4-12			4-18	1-18	Cadrats 18	9-18

FIG. 520.—*Hieroglyphic case: spaces.*

who has treated the subject most artistically. Private typefounders are not likely to rival the official and semi-official production of hieroglyphic type, which is practically a national matter for Egypt, where the Cairo Institute can always draw upon the resources of the *Imprimerie royale de France.*

The setting of hieroglyphic types, difficult as it may appear at first sight, is relatively easy to those who are familiar with the work.

The real difficulties that had to be overcome were in the rational arrangement and classification of the type. Its composition became comparatively easy once that was done.

Before going further into the details of composition, a facsimile, fig. 521, is given, which shows in its upper half a portion of the manuscript of a text, and below its equivalent set up in hieroglyphic type.

This shows that the highly skilled writer of the manuscript portion of the figure—M. G. Legrain, Director of Works in the *Service des Antiquités de l'Égypte*—has taken the trouble to commence each line of the text with

Original manuscript.

FIG. 521.—*Specimen of hieroglyphic manuscript and printed text; slightly reduced from the original.*

the same sign as that which begins the line of printed matter. It need hardly be said that manuscripts usually handed to the printer do not present this peculiarity, the groups being written and the lines filled out as the size of the paper permits. In the instance given the division of the lines is regulated by the measure and justification adopted in the particular quarto work for which the figure was originally prepared.

It will be noticed how the signs are grouped in the manuscript portion. The Egyptian scribes, and, even more than the scribes themselves, the stone-cutters, were wont to place their signs in squared groups.

For reproduction in movable type, these groups have to be analyzed and combined with the appropriate spaces, in order to reproduce as nearly as possible the appearance of hieroglyphic writing having this characteristic peculiarity. To attain this end, it was necessary to have the signs cast of more than one body-size. The *Imprimerie royale de France* has adopted three bodies of the sizes shown in fig. 522 :—

First body, 18 typographical points (*corps* 18).
Second body, 12 typographical points (*corps* 12).
Third body, 8 typographical points (*corps* 8).

FIG. 522.—*Three standard body-sizes of hieroglyphic type.*

It should be understood that these dimensions are those of full-sized signs, and that the types themselves are cast on the square or em set of each body, as shown in fig. 522.

Signs which have one dimension small are generally cast on set widths or on bodies which conform to their shape and to a definite fraction of the respective standard body, as shown in fig. 523.

On first body is 18 points body and 6 points set.
On second body is 12 points body and 4 points set.
On third body is 8 points body and 2 points set.

FIG. 523.—*Widths of hieroglyphic type conforming to shape of character.*

Certain signs only, of which the effect, if placed on the first or largest body, would be ungraceful, or which, when used by the Egyptians, are always placed above or below, or joined with others in the same group, have been engraved, and cast on intermediate bodies of ten points (*corps* 10), six points (*corps* 6), etc., according to their form ; care is taken that the face is supported by a shank sufficiently large to facilitate composition and to give a good distribution of blank spaces within the groups.

To secure the easy justification of all these elements, a variety of spaces and quads have been provided, graduated in such a manner that the compositor can space the groups evenly ; see fig. 520, showing the space-case. Thus in setting the group shown in fig. 524, the compositor first places the in his stick—he knows that this is on 4-point body ; on 6-point body ; on 6-point body, the three making up a total of 16 points.

As the group must occupy a space 18 points square, the compositor can place between the three signs two 1-point spaces of the 18-point body, which would fill up the space. It is evident, however, that the common rules for spacing whites must also be respected in hieroglyphic composition.

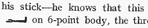


FIG. 524.—*Hieroglyphic-character group and its components.*

Hence in this instance, instead of two spaces of 1-point thickness, the compositor places a 2-point space between and as the white space carried by in its upper part is enough to permit of its being set close to the .

This group is now correct as to its height, but the width also has to be filled. The is cast upon a 6-point em quad ; it therefore lacks 12 points of filling the entire width—18 points ; as the sign must be placed in the middle of the group, this space of 12 points must be divided between the two sides of the , and this is done by using two 6-point em quads. All the groups are made up and spaced according to this principle. Each group is temporarily separated from its neighbours by a 2-point space ; when the width of the line is reached, whatever spacing is required to fill it is added between the groups. There is no extra spacing between the words. Sometimes the lines of the original, especially of the inscriptions on stone, are indicated typographically by numbering them with figures, placed above a short vertical line, ordinarily less than 10 points long when the 18-point body is being set, thus : $\overset{1}{|}\ \overset{10}{|}$

Once these principles have been accepted, it is a simple matter to understand how the recognition by compositors of the hieroglyphic signs is facilitated, and how the signs most in use are placed at their disposal to the best advantage. To begin with, the types are classified in families, of which there are twenty-eight, made up as follows :—

1. Men.
2. Gods.
3. Women.
4. Goddesses.
5. Parts of the human body.
6. Mammals.
7. Parts of the bodies of mammals.

8. Birds.
9. Parts of the bodies of birds.
10. Saurians, batrachians, amphibians.
11. Reptiles.
12. Insects.
13. Fishes.
14. Vegetables.
15. Heavens, stars, earth, water.
16. Plans, buildings, parts of buildings.
17. Profane and sacred furniture.
18. Measures, balances, various tools.
19. Equipments for fishing, hunting, and war.
20. Vessels, sacred barges, rigging.
21. Head-dress, clothing, articles of adornment and toilet.
22. Banner staves, sceptres, symbolic emblems.
23. Music, writing, games.
24. Loaves.
25. Shallow baskets, panniers, vases.
26. Cords, couplings, knots, packages.
27. Geometric figures.
28. Objects of nondescript form and use.

This done, the signs which correspond to the letters of the alphabet are placed in two sections of the first portion of the ordinary case, fig. 519. Above these, and in the same portion of the case, are placed the determinatives and the other signs most commonly used. The second portion contains the hieroglyphics which are next in order of frequency. The same arrangement is also employed for those signs which are cast on the second body. The compositor's frame has three divisions; on the central division and before him is placed the space-case, fig. 520, and above it the case for the signs of the third and smallest body; at the right of these are placed the two portions for the signs of the first and largest body, figs. 518 and 519, and at the left the two portions for those signs which are on the second body. The complete equipment, therefore, of the compositor consists of six cases or portions of cases.

The other types are distributed amongst other cases, whose number varies according to the number of different characters in use, and it is to these supplementary cases that the compositor goes for the less frequently used odd sorts.

The difficulties which the compositor might be expected to meet with both in knowing where to look for and in recognizing any particular sign are got over in a practical, if not scientific, manner by the compositors adopting a nomenclature of their own which meets their requirements quite satisfactorily. The terms they use have nothing scientific about them, but have the advantage of being easily expressed and understood, and really vary but little from the scientific classification given above. In general, the names used are descriptive of the forms of the written characters. Thus the compositor always calls man, and old man, and whatever may be the shape of a sign of this sort, he holds it to belong to the category of man. represents woman, and a woman in childbirth, and so on. With regard to the various portions of the human body, there is no difficulty in distinguishing them; for instance, the arm, ; the mouth, ; the leg, ; the head, ; the heart, ; the sacred eye, ; the hand, ; the phallus, .

It is the same with regard to animals and the other categories whose shapes readily recall to mind the creature, the plant, or the object depicted by the copy. Thus is one which is instantly recognized. Among the signs best known to the compositors, but certain of whose shapes are less like reality, are the eagle; the chicken; the owl; the ibis; the duck; the wagtail, to which the compositor does not trouble to give their phonetic values such as **a**, **ou**, or **m**, and so on. It is the same with the serpent; the Nile; the cord; the house; the uræus, or serpent-symbol of sovereignty; the lotus leaf; the field of papyrus; the tree; the town; the sun; the libation vase; the palette of the scribe; the scarab or beetle; the bee; the shallow basket; the war chariot; and the sacred barge.

Some other rules have also been elaborated. It is taken, for example, that three | , properly termed unities, are the mark of the plural. These signs may be placed either horizontally | | | , or vertically, according as they happen to come after a sign of horizontal or vertical shape. These three unities must never be separated from the last sign of the word whose number they indicate, as they are a qualifying part of it. This rule applies also to determinatives; the mark of the plural or of a determinative must come next to the word to which either is related, and no division must occur between the mark of the plural or the determinative and the word it qualifies.

Equipped with no more than this rudimentary knowledge, a compositor is able to set up hieroglyphic matter quite correctly. Taking the copy, which as a rule is to be set in the first or largest body, in one hand, a sheet of paper before him, and a pencil in the other hand, the compositor scans the pages, carefully examining them line by line, having under his eyes his catalogue of hieroglyphic signs.

He identifies by their shapes and numbers, for all the signs are numbered, any of the signs which his memory tells him are not to be found in the ordinary cases; and he writes down their numbers on the sheet of paper in the order in which they appear in the manuscript.

When he has picked out some forty or fifty of these signs, he takes a wooden stick and proceeds to collect them on it so as to have them at hand when required and to avoid further search when he proceeds with the actual composition. If, for example, the first line of the matter in fig. 521 is taken, the first thing to be determined is the direction in which this copy is to be read and composed. Usually hieroglyphics are read from left to right, like European writing; but they are always read in the direction facing the pictorial symbols. In the specimen shown in fig. 521, the arm character of the first group at the left is turned towards the left, and the man , who alone forms the fifth group, is also turned in the same direction; the copy, therefore, reads from left to right.

Certain texts, notably inscriptions, are engraved or written in the reverse direction. They are, however, rarely composed in this manner, and it is only in the case of inscriptions having the hieroglyphics arranged in vertical columns that these sometimes face one another. For isolated phrases the precaution is taken of indicating by an arrow ←, or →, the direction in which the original inscription is engraved or written.

Returning to the analysis of the first line, it has to be noted that all the components of the first group are to be found in the ordinary case; the same thing occurs with regard to the second group For the third group , which is absent from the case, the compositor is compelled to search in the catalogue, where he finds it under head-dress, clothing, articles of adornment and toilet, bearing the number 2941. The compositor has to continue these mental and physical gymnastics till he has completed the setting of the whole manuscript. After he has passed the fourth, fifth, and sixth groups, shown in fig. 521, he comes across the character . This interrupts his work, as the sign does not exist, and will require to be specially engraved for the work in hand; the compositor therefore leaves a blank space for its reception when ready. On the distribution of the matter, this new character will be placed amongst "various tools" in family 18, as its form approaches most closely to that particular category. Continuing after , we easily recognize as coming from among the fishes, and , which belongs to family 15 of heavens, stars, earth, and water. Next comes from family 27, where it is found among geometric figures, and finally , who, with his smart head-dress, his crooked staff and his whip, is identified, after considerable search among men in family 1, as No. 367 of the "Catalogue" of the printing-office of the *Institut français du Caire;* and so on, line by line, the composition is carried out to the end of the copy.

Those signs which are not to be found in the ordinary case, having been sought out and assembled on the wooden stick, as already explained, the compositor can proceed with the composition at his cases where the work is then quite easy. There is another matter, however, to be noted. In the fourth line of the manuscript shown in fig. 521 there appear four signs or groups of signs surrounded by a cartouche or frame

As was said in the beginning of this chapter, the cartouche indicates the name of a royal personage. To render this typographically, the end is first taken; this is found in the second portion of the case; the signs are next taken of the second body, of 12 points (*corps* 12), and after the group is set, comes the other end or closing portion of the cartouche ; when the line is filled out and justified, the portion , which makes up a 12-point body, is framed by the addition at the top and at the bottom, of two rules, each 3 points (*corps* 3) in thickness, with a 1-point face, shouldered on one side, and having ends which fit exactly to the points of the brackets and .

The elementary principles of hieroglyphic composition have been given in the preceding description. It is impossible in the space at the disposal of the authors to treat of the rules which cover the intercalation of inscriptions or of isolated hieroglyphic words in the midst of roman text. An arrangement which places the roman under the centre of the hieroglyphics is the most usual form adopted in this class of composition. With regard to the spacing between lines of matter entirely hieroglyphic, no special directions apply; the run of the work, and the exigencies of making it up into pages, as well as good taste, decide this question.

In Egypt the hieroglyphic or priestly engraved writing, which, as has been said, at first was purely pictorial but later developed into pictures representing different sounds, was soon found to be cumbrous; priestly scribes, therefore, when using papyrus, first began to modify, and then to abbreviate, the pictorial characters until at length they developed the form of writing known as hieratic or priestly. This form of writing is shown in fig. 567, but this modification itself was in its turn found too cumbersome, and the later scribes modified it into a purely conventional

PLATE CVII.

FIG. 526.—*Clay cylinder of Sennacherib, recording the siege of Jerusalem*, 700 B.C.

To face page 529.]

system of signs from which most of the permanent characteristics of the true hieroglyphic and even hieratic characters were removed. This script was called demotic, or the writing of the common people, fig. 568, p. 548. Figure 514, plate CVI, showing the Rosetta stone, also gives an example of this form of writing.

Sumerian, the ancient language, which was followed by the Babylonian and Assyrian languages, began by representing objects by signs and giving the sound value of the object so represented to the sign. In the course of time, what were originally pictorial ideographs developed into syllabic sounds, without any reference whatever to the object originally represented; thus, as stated in a lecture to compositors by Vincent Pitman, the sound

FIG. 525.—*Comparison of cuneiform writing, showing development from early ideograph to simple syllabic character.*

of the sign 𒀭 was *an*; now 𒀭 represented heaven, and the word for heaven was *an*. At a later time these sounds, which were really words, were used both in the pre-Semitic Sumerian as well as in the Semitic Babylonian and Assyrian language as syllables only, without any reference whatsoever to the objects which they originally represented. Thus the sign 𒀀 in the ancient language was a picture for water, the name of which was *a*; but in the Assyrian word 𒀀𒁀 *a-bu*, father, the sign 𒀀 is used merely as a syllable without any reference to its original picture-form or meaning. Figure 525 shows six of the characters and their development from ideographs into mere components of a syllabic system or alphabet. An example of a clay cylinder with cuneiform inscription is given in fig. 526, plate CVII.

There are various other syllabic, and possibly alphabetic, scripts which at present generally come outside the scope of the printing-surface save as complete process blocks, such, for instance, as the Hittite, an example of which is given in fig. 527, plate CVIII, but for which, owing to recent discoveries and increasing interest, type is now being made, fig. 528; others, to go very far away indeed from oriental lands, are the curious inscriptions from Central America, at present undeciphered, or at least with their decipherment lying within the region of guess-work. Some day, possibly, punches will have to be cut and matrices struck and type

FIG. 528.—*Hittite inscriptions.*

cast for these and similar scripts, but at present, strictly speaking, they are outside the true scope of this treatise.

In fig. 529, plate CVIII, is shown a beautiful example of the as yet untranslated script of a people who worked out an early civilization in Central America. Whence they came, who they were, and what became of them, are mysteries that at present, as far as the authors know, have not yet been solved. Possibly some happy coincidence may enable a second Champollion to start successfully a clue to their decipherment and all the wonder and the interest that awaits our learning. To-day intelligent man can but look and long for communion with this antique intelligence of his race.

The authors' attention has lately been called to a curious form of writing referred to by P. Amaury Talbot, of the Nigerian Political Service, which is found in use among the negroes of Southern Nigeria.

According to the writer of "The Times" review of his volume, "A very interesting part of Mr. Talbot's book is the account of the *Sbididi*, a secret system of writing used in connection with the Egbo mysteries. The characters are conventionalized ideographs, bearing a general resemblance to the script of the Easter Island tablets, though Bishop Jannsen and M. de Harlez, proceeding on Mr. Talbot's plan of employing a native pundit, did not succeed in making much sense of the Polynesian tablets they studied.

"The *Sbididi* script, though vague and inexact as a means of preserving human thought, seems to be a genuine script evolved unaided by negroes."

From reference to P. A. Talbot's book, "The Shadow of the Bush," recently published, the authors have learned that the first idea that there was a native African script, originated in 1905, when twenty signs of a secret primitive writing were discovered by T. D. Maxwell, District Commissioner of Calabar; and that later on, twenty-four signs in all were published in the Government Civil List of July of the same year. A

FIG 527.—*Ston*

FIG. 529.—

PLATE CVIII.

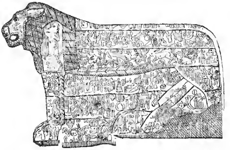


FIG 527.—*Stone lion with Hittite inscription from Marash.*

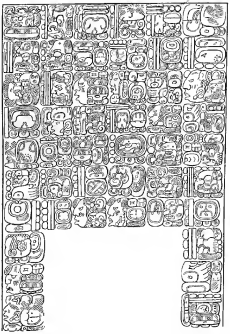
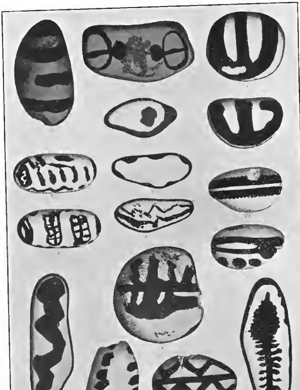


FIG. 529.—*Maya inscription from Piedras Negras.*

[*To face page* 530.

PLATE CIX.

[To face page 531.

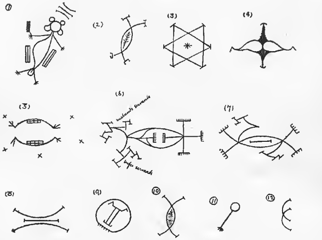


From "l'Anthropologie."] [Photo. Macbeth, London.

FIG. 531.—*Inscribed neolithic pebbles.*

paper on this writing, by the Rev. J. K. MacGregor, was published in the "Anthropological Journal" for 1909, and reference has also been made to it by Dr. Mansfeld, who figures certain of the signs in "Urwald-Dokumente."

According to Talbot, the native Ibos declare that this method of writing was acquired long ago from the monkeys which used to gather



"(1) Husband and wife love each other ardently. They like to put their arms round one another (shown by extended hands). They are rich, have three pillows and a table on each side. The wife holds a comb.
(2) Wedded pair belonging to Egbo Society. Shown by the Egbo feather.
(3) Very great love between husband and wife. The central 'star' denotes a warm and loving heart.
(4) A husband cooks two calabashes of food to give to his wife.
(5) Man and wife with river between them. The latter is denoted by two 'canoes.' The crosses show that messages are always being sent from one to another.
(6) Another sign for ardent love between husband and wife. They have many servants.
(7) Man and wife lying with their 'piccan' between them. The consorts lie with their heads in different directions.
(8) Quarrel between husband and wife. They turn their backs on one another and place a pillow between.
(9) A woman wants to marry a man, but her people object.
(10) A man wishes to leave his wife because she has craw-craw.
(11) The wife tries to hold back her husband by his loin-cloth. At the bottom of which her hand is seen.
(12) Woman who wishes to be rid of her husband."

FIG. 530.—*Sbididi or Nsibidi script.*

round their camp-fires, a legend which in any case tends to prove that it is of considerable antiquity. The script is certainly not derived from any external or foreign source, and, though to a large extent pictographic, it has in the course of years become highly conventionalized.

The Ekoi explanation of the name Nsibidi, or more properly, Nchibbidy, is that it is derived from the verb *nchibbi*, to turn, from which has been deduced the further meaning of agility of mind, and hence, therefore, that of cunning or double meaning.

Messages are sent in Nsibidi script, cut or painted on split palm stems.

The facsimile of a page from the appendix referring to this matter in Talbot's highly interesting volume is given in fig. 530.

Perhaps the most suggestive, as well as the earliest known attempt at the permanent record of sound, and therefore idea, are the marked pebbles discovered by Ed. Piett at Mas d'Azil on the left bank of the Arize in the Department of Ariége, France.

These stones are coloured with peroxide of iron, and the characters are of many kinds, varying from a series of strokes or series of dots, which possibly indicate numbers, to graphic symbols and artistic patterns of various kinds. The authors have no doubt whatever that these venerable records are really marks produced by human agency. A reference to the work of Ed Piett, "Les galets coloriés de Mas d'Azil" published in "L'Album de l'Anthropologie," they think, will remove any doubt about the matter, if any is left after a study of the page reproduced here, fig. 531, plate CIX. The reproduction in black and white, however, gives no idea of the effect produced by the colour of the actual specimens. It is not for a moment suggested that these marked pebbles conveyed to their originators anything of the nature of what is conveyed to us by our methods of writing. They possibly are tribal marks, curt records of some incident, units in some form of game, or tallies and records of possessions, or crude notes of achievements in the chase. Venerable beyond words, and full of wonderful suggestion are these marked pebbles; but this is not the place for the discussion of the thoughts and strange and varied emotions that they arouse. Likenesses have been found between these signs and early syllabaries such as the Cypriot, and early alphabets such as those of the Phœnicians, and also likenesses have been made out between them and sundry hieroglyphic characters, and though in many instances it is true that strong resemblances exist, it would not be safe to infer that any connexion exists between them.

In any case, these inscribed pebbles are interesting objects because they appear to be, so far as is known, the earliest efforts of mankind to record ideas by hieroglyphic, ideographic, or tonal methods; for, as has been said, there is good reason to believe that they are genuinely marked by human beings, and are not the result of mere coincidence and of the contact of stone surfaces with irregular surfaces of iron peroxide.

Fascinating, however, as these and many other more advanced scripts are, they have at present no practical technology, and therefore further reference to them and to their peculiarities are here out of place.

CHAPTER XXXV.

ANCIENT AND MODERN SCRIPTS AND THEIR USES.

"... from India unto Ethiopia, an hundred twenty and seven provinces, unto every province according to the writing thereof, and unto every people after their language, and to the Jews according to their writing, and according to their language."

Esther.

Brevier tudor.

וְעַתָּה אִם־תִּשָּׂא חַטָּאתָם וְאִם־אַיִן מְחֵנִי נָא מִסִּפְרְךָ אֲשֶׁר כָּתָבְתָּ׃
וַיֹּאמֶר יְהוָה אֶל־מֹשֶׁה מִי אֲשֶׁר חָטָא־לִי אֶמְחֶנּוּ מִסִּפְרִי׃

(שמות ל״ב, ל״ב ל״ג). Exodus xxxii. 32, 33.

Pica Hebrew.

In chapter XXXIII the authors have dealt with the classic Chinese character and its development in times nearer the present day.

In chapter XXXIV they have dealt with hieroglyphics and their derivatives, the hieratic and demotic forms of writing, as well as with the Assyrian and Babylonian developments of the cuneiform character.

In the present chapter those type faces are considered which are used to reproduce manuscripts or inscriptions in characters no longer in living use such as, for instance, Runic; characters which have been revived and brought into use for national or patriotic reasons such as, for instance, Erse; and characters which are in general use amongst the various nations scattered over the face of the globe.

The form of character used for recording languages has been determined in the majority of cases, in modern times, by the insistence of a religious faith, and these new scripts and alphabets may be appropriately termed the legitimate children of missionary enterprise as much as the human converts themselves. It is true that the trader, whether in more humble effort or backed up with modern artillery and big commercial powers, may, in the great majority of cases, have come first, but, as a matter of fact, it is the Bible and the Cross that have ultimately created new typographical domains. Following the slave-raider, or pushed southward by the ivory-caravan, or westward by the rush of Saracen conquest along the shores of the Mediterranean, or carried for war or trade upon dhow and Arab barque to the islands of the East, the swords of the followers of the Prophet have in somewhat lesser degree spread far and wide their beautiful script: and in other regions of the earth religious devotees have borne over vast tracts of country and through great varieties of peoples, of languages and of dialects, their chosen form of writing, as was the case with the devanagari character used for the Sanskrit in which the Brahminic books were written, and with Pali the sacred language of Buddhism. In another instance a character has confined itself almost exclusively to a people of one faith who have been dispersed over many countries; a particular example of this spread and retention of a character under religious stress is afforded by the Hebraic script that accompanies the Jews throughout every continent of the world.

To attempt to classify the various alphabets used for all these languages is an extremely difficult matter, and one that, to be dealt with adequately, would require a volume to itself. The authors have, therefore, adopted a method of dividing these different forms of lettering generally under typographical headings—though in certain instances they are placed under a geographical arrangement—instead of attempting some other classification which might, at first sight, perhaps, appear more rational.

They have commenced with latin, for it is the face in most wide-spread use, and have separated this into several classes according to the admixtures of accented characters and other sorts which have been made with the parent stock.

Latin in its simple form of character without any accents or quantities or additions is used by missionaries and others for over one hundred languages and dialects.

In one language, Iroquois, the figure 8 is used as a letter with the ordinary latin roman fount.

Following these may be taken those languages in which no accents are used, but for which the roman fount is mixed with some italic sorts; this practice is followed by some of the missionaries and Bible societies for languages of the Pacific Isles.

Next in order of classification may be considered those languages and dialects, over one hundred in number, which are currently represented by the use of the latin character supplemented by the accents given in the fount scheme shown in table I, p. 35.

After these may be taken those few languages and dialects which use the latin characters with the addition of the short and long vowel quantities, but which do not use accents.

For yet another small group latin characters are used with both quantities and accents, though not both on the same character.

Certain European languages and dialects make use of the latin character supplemented by some characters bearing accents which differ in form from those previously referred to; some examples of these are given on p. 36.

With the spread of religion over the world, the missionaries, usually educated men, have left, as has been said, examples of their erudition; but unfortunately they have shown little knowledge of typography, as is evidenced by the selection made by them of the miscellaneously accented characters with which they have unhappily endowed the scripts of many countries.

Among the peculiarities they have introduced may be mentioned characters which carry both quantities and accents; characters which are dotted above and characters which are dotted below; characters which are underscored, and characters which are overscored; characters which are doubly underscored, and characters which are crossed with straight or curved lines. Not content with this, they have used figures as characters and peculiars as characters; they have not refrained from using existing characters reversed, distorted, and even inverted, disregarding the difficulties of alinement which are thereby introduced in many body-sizes; and when they have exhausted the resources of the latin fount, they have unhesitatingly introduced admixtures of greek sorts, and, without a qualm, have also endeavoured to improve upon the greek. To separate into classes the many founts in use for over one hundred languages and dialects which embody one or more of these peculiarities would involve much space and a complicated classification.

Figures 532 and 533 show examples of the extremes to which admixture of sorts in some of these alphabets has been carried.

N'mıtóksʊnʊ, spʊmkák ɛ́yʊn; ımı-ɛɯtçeswik-tɛ́sitç kɯısɯʊn; kintçɛ-mʊswɯ́tim pʊkʊtçıhʊtç; Kɯlıdʊhɛ-dʊmɯɛ́gʊn ʊlıhatç ɯskitkʊmikw stʊkɛ́ eláhɛk spámkık. Pemkískɛk mılın-ɛtʊskıs-kɛkágɛwɛ́ n'tʊbɛ́nʊ-mʊn; Hɛ lınheltʊmɯánɛ nɯtçɛmɛgʊn-ʊ́mɯ ʊl stʊkɛ́ nálɯn elıʊneltʊm-ɯ-ɯ́gʊt tɛnik wetçanmɯ-inmʊtçik: Hɛ mɯɪɛɛk liphákek ɛɛılʊɪɛ-dɯɛ́gʊn

10-point Maliseet (set by Wm. Clowes & Sons).

FIG. 532.—*Maliseet.*

SIDA Itse ǀhom*g*u ǃna hatse, sa ǀonsa as khaihe re. Sa *g*aosib ab ha re; sa ǂēi=sa as ī, ǀhomi ǃnās ī khẹmi, ǁnati ǃhūb-eib on ei. Nētse sida tsē-*g*orobe bẹreba ma da. Ẽ sida ǀhawina ǀũba da, si=da ǀhawi-χabena da ra ǁkadi ǀũba khẹmi. Ẽ ta ǃâi-tsâb ǃna ǂ*g*ai-ǂ*g*ui da, ẽ

11-point Nama or Khoi-Khoi (set by Wm. Clowes & Sons).

FIG. 533.—*Nama or Khoi-Khoi.*

Latin characters with the addition of some special characters are used for Anglo-Saxon, fig. 534, and the same face with fewer of these added sorts serves to reproduce Icelandic.

FÆDER úρe þu þe eaρt on heoꝼenum, Sı þın nama ȝehalȝod. To-becume þın ρíce. Ꝣepuρðe þın pılla on eoρðan, ꞅpa ꞅpa on heoꝼonum. Uρne ȝedæȝhpamlıcan hlaꝼ ꞅyle uꞅ to dæȝ. And ꝼoρȝyꝼ uꞅ úρe ȝyltaꞅ, ꞅpa ꞅpa pé ꝼoρȝyꝼað úρum ȝyltendum.

11-point Anglo-Saxon (set by Wm. Clowes & Sons).

FIG. 534.—*Anglo-Saxon.*

Other modifications of the latin character are used for the reproduction of inscriptions typographically; examples of inscription Roman are given in figs. 535 and 536.

CN . PISO . PRO . Q . MAGN . PRO . COS . CAESAR . CN . M . POBLICI . CN
MAGNVS . M . POB . LEG . PRO . IM . ƎMBDNTVD . ⅃ꟻTVM . ƎMBDNTVD
> . ΙΠNNΠ . ƊM . VI⅃ƎTꟻƆ . ƊM . IKƆV⅃ . IM . ƧIꟻƎI . IM . MINIꓭNƧ . Ψ

8-point inscription Roman No. 3 (set by Wm. Clowes & Sons).

FIG. 535.—*Inscription Roman.*

ÆÐELRÆD REX ANGLOX LÆPE OZFERÐ M̄O DOFRA ÆÐELPE M̄O
BAÐAN ÆÐELPÆD REX ⊙FEGE NZMΩ ⊙ DCY ÆÐEÆÆEXD NGLRR
ANGLOX GOD MΩO GFELE HEREBYRHT M⊙ ANGEOX ANGL COL: LE⊙FPG

8-point inscription Roman No. 4 (set by Wm. Clowes & Sons).

FIG. 536.—*Inscription Roman.*

After latin must be considered greek, which is still in use practically in its original form. Examples of early Greek are given in figs. 537 and 538. The normal greek alphabet consists of twenty-four letters, and the sorts

ΠΑΤΕΡΗΜΩΝΟ ΕΝΤΟΙϹ ΟΥΡΑΝΟΙϹ ΑΓΙΑϹΘΗΤΩΤΟΟΝΟΜΑϹΟΥ · ΕΛΘ
ΕΤΩΗΒΑϹΙΛΕΙΑϹΟΥ · ΓΕΝΗΘΗΤΩΤΟΘΕΛΗΜΑϹΟΥΩϹΕΝΟΥΡΑΝΩΚΑΙ
ΕΠΙΓΗϹ · ΤΟΝΑΡΤΟΝ ΗΜΩΝ ΤΟΝ ΕΠΙΟΥϹΙΟΝ ΔΟϹ ΗΜΙΝ ϹΗΜΕΡΟΝ ·
ΚΑΙΑΦΕϹΗΜΙΝΤΑΟΦΕΙΛΗΜΑΤΑΗΜΩΝΩϹΚΑΙΗΜΕΙϹΑΦΗΚΑΜΕΝΤΟΙϹ

10-point manuscript Greek (set by Wm. Clowes & Sons).

FIG. 537.—*Greek; Codex Vaticanus.*

are shown in the fount scheme given in table 21, p. 141, while a specimen, composed on a Monotype machine, is given at the head of the technical vocabulary, appendix III, p. 669. The greek character with the addition of special accents is also used for a few other languages and dialects.

ΠΕΡΗΜΩΝΟΕΝΤΟΙϹΟΥΝΟΙϹΑΓΙΑϹΘΗΤΩ
ΤΟΟΝΟΜΑϹΟΥ · ΕΛΘΕΤΩΗΒΑϹΙΛΕΙΑϹΟΥ ·
ΓΕΝΗΘΗΤΩΤΟΘΕΛΗΜΑϹΟΥΩϹΕΝΟΥΝΩ
ΚΑΙΕΠΙΓΗϹ · ΤΟΝΑΡΤΟΝΗΜΩΝΤΟΝΕΠΙ

18-point manuscript Greek (set by Wm. Clowes & Sons).

FIG. 538.—*Greek; Codex Alexandrinus.*

As in the case of latin a modified form of greek character is used for the reproduction of Greek inscriptions, of which fig. 539 is an example.

ΑΝΔΡΕΣ ΑΘΗΝΑΙΟΙ ΚΑΤΑ ΠΑΝΤΑ ΩΣ ΔΕΙΣΙΔΑΙ
ΜΟΝΕΣΤΕΡΟΥΣ ΥΜΑΣ ΘΕΩΡΩ· ΔΙΕΡΧΟΜΕΝΟΣ ΓΑΡ
ΚΑΙ ΑΝΑΘΕΩΡΩΝ ΤΑ ΣΕΒΑΣΜΑΤΑ ΥΜΩΝ ΕΥΡΟΝ
ΚΑΙ ΒΩΜΟΝ ΕΝ Ω ΕΠΕΓΕΓΡΑΠΤΟ ΑΓΝΩϹΤΩ ΘΕΩ·
Ο ΟΥΝ ΑΓΝΟΟΥΝΤΕϹ ΕΥϹΕΒΕΙΤΕ ΤΟΥΤΟ ΕΓΩ ΚΑΤ
ΑΓΓΕΛΛΩ ΥΜΙΝ · Ο ΘΕΟϹ Ο ΠΟΙΗϹΑϹ ΤΟΝ ΚΟϹΜΟΝ

10-point inscription Greek No. 2 (set by Wm. Clowes & Sons).

FIG. 539.—*Inscription Greek.*

The black-letter used for Old English, an example of which is given at the head of chapter II, p. 4, closely resembles the german character, which is still in use in some countries of Central and Northern Europe. A fount scheme for the various sorts required for the composition of the German language in *Fraktur* is given in table 16, p. 136. The German *Fraktur* character, fig. 540, with or without accents, is used for some twenty languages and dialects.

Unſer Vater in dem Himmel! Dein Name werde geheiliget. Dein
Reich komme. Dein Wille geſchehe auf Erden, wie im Himmel.
Unſer tägliches Brod gieb uns heute. Und vergieb uns unſere
Schulden, wie wir unſern Schuldigern vergeben. Und führe uns

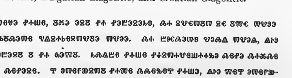
12-point german No. 3 (set by Wm. Clowes & Sons).

FIG. 540.—*German;* Fraktur.

Based to some extent on the original Slavonic and on Greek, the Cyrillic character, in its more modern form, the Russian character, is used throughout the Russian Empire and in certain other Slavonic countries, supplemented, in some fifteen languages or dialects, by accents or special characters.

The Russian alphabet comprises thirty-six letters; a fount scheme for it is given in table 22, p. 142, and an example set in Russian on a Monotype machine is given at the head of chapter XXIX, part i, p. 393.

The Ancient Slavonic form of the character, fig. 541, is used for Ancient Slavonic, Bulgarian Glagolitic, and Croatian Glagolitic.



8-point Ancient Slavonic (set by Wm. Clowes & Sons).

FIG. 541.—*Bulgarian Glagolitic.*

A more modern form of Slavonic character used for Bulgarian is shown in fig. 542.

Ѿтче на́шъ ко́йто си на небеса̀ та, да ся святи̇̀ и̇́ме то твоѐ. Да прїйде ца́рство то твоѐ; да бѫ́де во́ля та твоя̀, какво́то на небо̀ то, така̀ и̂ на земля̀ та. Хлѣ́батъ на̀шъ катадне́вныатъ да́й ни го дне́сь. И̂ прости̇̀ ни дѫ́лгове те на́шн, какво́то и̂ ні́е ги проща́ваме на на́ши те дѫлжни́цы. И̂ не

12-point Bulgarian (set by Wm. Clowes & Sons).

FIG. 542.—*Bulgarian.*

In one instance—Abkhazian, fig. 543—the Cyrillic character has been used largely admixed with latin sorts, and, in an italic example, this

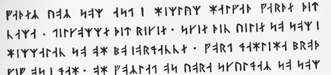
ђара iћабгy, yара iqay ажҩан axjqa, iцқjанг iqалиàjm, yара yxjʒjajàjm yара yңћара iqалàjm yара ıшгyп,ахгy, ажҩан axjqa ajцш jера yбарс аңсабарайij аиа ћара ћабзазарәзг iћаm, ћара jaxjç̌a eij ћазнгжj ћара ћàyалқyа jара yбарс ћарij ћач̆гзқyқоy iшгрзгн-

10-point Abkhazian (set by Wm. Clowes & Sons).

FIG. 543.—*Abkhazian.*

script is extremely confusing owing to the different meanings the same character may bear according as it is used in its Latin or in its Russian sense.

Dealing next with the remaining European characters, an example of Runic is given in fig. 544. In its simplest form the runic alphabet consists of sixteen letters, but others are frequently added, bringing the total to some twenty-three or even more sorts.



11-point runic (set by Wm. Clowes & Sons).

FIG. 544.—*Old Norse; runic character.*

For the typographical reproduction of inscriptions in Etruscan a face has been cut for the *Imprimerie royale de France*, and an example of it is given in "Débuts de l'imprimerie en France," by Arthur Christian.

Gothic, fig. 545, has an alphabet consisting of twenty-five characters, to which nine ligatures are frequently added.

𐌰𐍄𐍄𐌰 𐌿𐌽𐍃𐌰𐍂 𐌸𐌿 𐌹̈𐌽 𐌷𐌹𐌼𐌹𐌽𐌰𐌼: 𐍅𐌴𐌹𐌷𐌽𐌰𐌹 𐌽𐌰𐌼𐍉 𐌸𐌴𐌹𐌽: 𐌵𐌹𐌼𐌰𐌹
𐌸𐌹𐌿𐌳𐌹𐌽𐌰𐍃𐍃𐌿𐍃 𐌸𐌴𐌹𐌽𐍃: 𐍅𐌰𐌹𐍂𐌸𐌰𐌹 𐍅𐌹𐌻𐌾𐌰 𐌸𐌴𐌹𐌽𐍃 𐍃𐍅𐌴 𐌹̈𐌽 𐌷𐌹𐌼𐌹𐌽𐌰 𐌾𐌰𐌷
𐌰𐌽𐌰 𐌰𐌹𐍂𐌸𐌰𐌹: 𐌷𐌻𐌰𐌹𐍆 𐌿𐌽𐍃𐌰𐍂𐌰𐌽𐌰 𐌸𐌰𐌽𐌰 𐍃𐌹𐌽𐍄𐌴𐌹𐌽𐌰𐌽 𐌲𐌹𐍆 𐌿𐌽𐍃 𐌷𐌹𐌼𐌼𐌰
𐌳𐌰𐌲𐌰: 𐌾𐌰𐌷 𐌰𐍆𐌻𐌴𐍄 𐌿𐌽𐍃 𐌸𐌰𐍄𐌴𐌹 𐍃𐌺𐌿𐌻𐌰𐌽𐍃 𐍃𐌹𐌾𐌰𐌹𐌼𐌰 𐍃𐍅𐌰𐍃𐍅𐌴 𐌾𐌰𐌷

10-point Gothic (set by Wm. Clowes & Sons).

FIG. 545.—*Gothic.*

The Irish character or Erse, fig. 546, known in the trade as Gaelic, has been revived, and many Irish works have been printed in it. In its

Ár n-Áṫair atá ar neaṁ, go naoṁṫar ṫ'ainm. Go d-tigeaḋ do ríoġaċd. Go n-déuntar do toil ar an d-talaṁ, mar (déantar) ar neaṁ. Ár n-arán laeṫeaṁuil tabair ḋuinn gaċ lá. Agus maiṫ ḋuinn ár b-peacuiḋe; óir maiṫmid-ne féin do gac

11-point Irish or Gaelic (set by Wm. Clowes & Sons).

FIG. 546.—*Irish or Erse; Gaelic character.*

simplest form the Irish alphabet consists of eighteen letters; both capitals and lower-case are used, and sometimes as many as thirty-nine lower-case ligatures are added, making seventy-five sorts. Among other uses for the character may be mentioned that of painting it upon the few sign-posts which the authors are informed have been erected in Ireland, with the result that should motorists or tourists take the requisite trouble to learn the alphabet they will find further complication in the fact that the characters may give them the Irish name of the town instead of its English appellation, and they will be reduced to the same expedient as if they had not known the alphabet, that is to say immediate reference to the kindly offices of the local priest, who, in country districts—it is stated—is alone capable of undertaking the double burden of reader and interpreter.

Passing to Eastern Europe, the Georgian character is used in some parts of the Caucasus; the alphabet consists of forty letters, making, with one accented letter, forty-one sorts. Examples of Georgian are given in figs. 547 and 548.

Ⴋⴀⴋⴀⴍ ⴙⴣⴄⴌⴍ ⴐⴍⴋⴄⴊⴈ ⴞⴀⴐ Ⴚⴀⴇⴀ ⴘⴈⴌⴀ, Ⴜⴋⴈⴃⴀ-
ⴈⴗⴀⴅⴌ ⴑⴀⴞⴄⴊⴈ ⴘⴄⴌⴈ. Ⴋⴍⴅⴄⴃⴈⴌ ⴑⴍⴣⴔⴄⴅⴀ ⴘⴄⴌⴈ, ⴈⴗⴀⴅⴌ
Ⴌⴄⴁⴀ ⴘⴄⴌⴈ, ⴅⴈⴇⴀⴐⴚⴀ Ⴚⴀⴇⴀ ⴘⴈⴌⴀ ⴄⴂⴐⴄⴚⴀ ⴕⴣⴄⴗⴀⴌⴀⴑⴀ
ⴆⴄⴃⴀ. Ⴎⴍⴣⴐⴈ ⴙⴣⴄⴌⴈ Ⴀⴐⴑⴍⴁⴈⴑⴀ, ⴋⴍⴋⴄⴚ ⴙⴣⴄⴌ ⴃⴖⴄⴑ. Ⴃⴀ

14-point ecclesiastical Georgian (set by Wm. Clowes & Sons).

FIG. 547.—*Georgian; ecclesiastical character.*

მამაო ჩჳენო, რომელი ხარ ცათა შინა, წმიდა
იყავნ სახელი შენი; მოვედინ სუფევა შენი, იყავნ
ნება შენი, ვითარცა ცათა შინა, ეგრეცა ქჳეყანასა
ზედა. პური ჩჳენი არსობისა მომეც ჩჳენ დღეს.

18-point civil Georgian (set by Wm. Clowes & Sons).

FIG. 548.—*Georgian; civil character.*

In the form used for the language from which it takes its name, the arabic character, which is used by the great majority of the Mohammedan nations, comprises dotted, doubly dotted, and trebly dotted letters; the addition of these dots converts various incomplete basic forms into complete letters. In some instances the forms vary according to the position which the character occupies in the word, that is to say whether it is used as an initial, a medial, a final, or a detached letter. These changes of form of character occur in most of the letters of the Arabic alphabet, though in some cases the initial and detached forms are the same, while in others the medial and final forms are identical. Used for Arabic, the alphabet has twenty-eight letters, but these require ninety-eight sorts for their representation under the various conditions of position; for Persian, Turkish, and many other languages other trebly dotted letters are used, bringing the alphabet to thirty-two letters, to which another character—or three sorts—forming the syllable *la* (لا) is sometimes added. To these must be added a large number of ligatures, some fifty to sixty of which are commonly used, and, in addition to characters and ligatures, there are some eight points or accents mostly placed above

the characters, though some
may be used with certain cl
is given on p. 421.

As the arabic charact
sounds used in Arabic but
language, it became necess
new sounds. The obvious
dots were not previously
basic forms of character pr
arabic script, which with t
racters served for Persian.
characters it became the cu
of Northern India and the a
Sindhi, and Kashmiri afford

The arabic character, in
such letters which carry wi
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and dialects.

As was the case in the ea
to produce arabic type we
script as closely as possible
medial, final, and detached.
as those produced by the c
arranged so that the juncti

مبحوث

Double alineme

FIG. 549.—*Arabi*

of the letter; this modifica
a reasonable number of m
more closely resembling ma
system of joining one chara
a system which results in
owing to certain of the cha
at their commencement an
same word set in single ar
produced a tendency to ita
to resemble the most beau

the characters, though some are placed below; one or more of these signs may be used with certain characters or ligatures. An example of Arabic is given on p. 421.

As the arabic character spread to languages using not only the sounds used in Arabic but others that required differentiation in the new language, it became necessary to adopt means for distinguishing these new sounds. The obvious method of adopting three dots where three dots were not previously used and also four dots in combination with basic forms of character previously used, helped to extend the use of the arabic script, which with the addition of these other trebly dotted characters served for Persian. With the further addition of quadruply dotted characters it became the current vehicle of expression for various languages of Northern India and the adjacent country, of which Hindustani or Urdu, Sindhi, and Kashmiri afford instances.

The arabic character, in its quadruply dotted varieties, comprises three such letters which carry with them ligatures corresponding to the trebly dotted forms; these letters and their ligatures may be accompanied by the various vowel and other points to which reference has already been made.

Arabic with trebly dotted characters is used for some thirty languages and dialects.

As was the case in the early production of latin founts, the first attempts to produce arabic type were directed to copying the character of manuscript as closely as possible; this kept the characters in four forms, initial, medial, final, and detached. The early founts made in Germany, as well as those produced by the celebrated Le Bé in the sixteenth century, were arranged so that the junction line was curved down to the lower portion

Double alinement. Single alinement.

FIG. 549.—*Arabic: single alinement and double alinement.*

of the letter; this modification made it possible to produce a fount from a reasonable number of matrices. In later attempts to obtain a result more closely resembling manuscript, it was necessary to follow the same system of joining one character to the next as was practised by the scribes, a system which results in a long Arabic word dropping lower in line owing to certain of the characters joining the next at different alinements at their commencement and at their end respectively: fig. 549 shows the same word set in single and in double alinement type. This peculiarity produced a tendency to italicize the script, with the result that, if made to resemble the most beautiful examples of the written character, arabic type kerned very heavily. The difficulty of change of alinement of the junction between the letters was first overcome by the French, who devised the two-line system, in which, when change of alinement occurs in a word, the upper line is used for commencing the composition, otherwise the lower line is that normally used; but this method, though producing artistic work—and, in the case of certain characters, work that is more legible—is not now so generally used.

The early single-line system, as worked out by Le Bé, has been revived and developed by several able workers, with the result that the bulk of hand-composition is now carried out with type which joins on this system; it is their work in carrying out this typographical improvement that has rendered machine-composition possible.

The composition of arabic, however, in any of the forms above mentioned is frequently a difficult matter owing to the additions of the vowel-points and other signs. In some instances these signs are added as separate type on a small body above the line in which the characters are composed, and also in another line of separate type of small body below the composed line, consequently the total body-size for the fount becomes large. In other cases the type are cast with a recess or recesses for receiving the vowel-points; an isometric view and a section of arabic type with two recesses are shown in fig. 550.

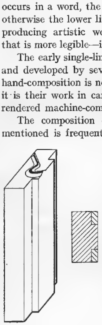
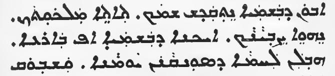


FIG. 550.—*Arabic type with recesses for vowels.* Isometric view and section.

The arabic Linotype machine composes over one hundred and fifty sorts from the keyboard, in addition to the other sorts which may be inserted by hand in the line of matrices when necessary.

An example of Arabic set on the Linotype machine is given in the heading to chapter XXIX, part II, p. 421, in the section which deals with matrix-composing machines. The form of character is perforce more upright than would be the case were kerning permissible, but the result attained testifies to the skill of those workers at the subject, who have overcome the really great and exceedingly complicated typographical difficulties involved in adapting the arabic character to the restrictions of the composing machine. Since arabic reads from right to left, the order of setting must be of the opposite hand to that usual with latin, greek, and Cyrillic characters. As the Linotype requires the matrices to be composed from left to right, the required result is obtained by the inversion of the character on the matrix as compared with the latin sorts. Thus the composing portion of the machine remains the same in operation, but the slug when cast requires to be turned upside down after ejection, and to be placed at the left-hand end of the column of slugs already cast, instead of at the right, as in the ordinary Linotype machine. The arrangement for doing this is shown in the illustration of the arabic Linotype, fig. 407, plate LXII. This figure also shows the manner in which the machine has been adapted to the customs of the oriental compositor, who generally prefers to sit cross-legged at work at the machine rather than upon a chair or stool as is the European practice.

The Nestorian character is used for Syro-Chaldaic, fig. 551; from

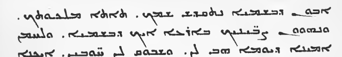


24-point Nestorian (set by Wm. Clowes & Sons).

FIG. 551.—*Syro-Chaldaic; Nestorian.*

this is derived the ancient Syriac or Aramaic, a character which reads from right to left, and typographically resembles Cufic.

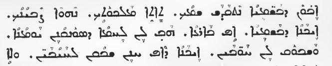
Other early forms of Syriac are Estrangelo, fig. 552, used in the fifth



18-point Estrangelo (set by Wm. Clowes & Sons).

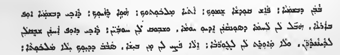
FIG. 552.—*Syriac; Estrangelo.*

century, and Peshito, fig. 553, of later date. An example of Syriac in its modern form is shown in fig. 554.



18-point Peshito (set by Wm. Clowes & Sons).

FIG. 553.—*Syriac; Peshito.*



12-point modern Syriac (set by Wm. Clowes & Sons).

FIG. 554.—*Syriac; modern.*

The Sabæan or Himyarite character, which is the oldest form of Arabic, had an alphabet of thirty-eight letters, and read in alternate lines from right to left and from left to right. It was followed by the Cufic character, which has the peculiarity of kerning but little, in which respect it resembles

ابانا الذي في السموات ∘ ليتقدس اسمك ∘ ليات
ملكوتك ∘ لتكن مشيتك كما في السما كذلك
على الارض ∘ خبزنا كفافنا اعطنا اليوم ∘ واغفر لنا

18-point Cufic (set by Wm. Clowes & Sons).

FIG. 555.—*Arabic; Cufic character.*

inscribed characters rather than written characters. An example of Cufic is given in fig. 555.

Carshuni is Arabic in the Syriac character; an example of this is shown in fig. 556.

ܐܒܘܢܐ ܐܠܕܝ ܦܝ ܐܠܣܡܘܐܬ . ܠܝܬܩ̈ܕܣ ܐܣܡܟ .
ܠܝܐܬ ܡܠܟܘܬܟ . ܠܬܟܢ ܡܫ̈ܝܬܟ ܟܡܐ ܦܝ
ܐܠܣܡܐ ܟܕܠܟ ܥܠܝ ܐܠܐܪܨ . ܚܒܙܢܐ ܟܦܐܦܢܐ ܐܥܛܢܐ
ܦܝ ܐܠܝܘܡ ܘܐܓܦܪ ܠܢܐ ܡܐ ܥܠܝܢܐ ܟܡܐ

24-point Carshuni (set by Wm. Clowes & Sons).

FIG. 556.—*Carshuni.*

Armenian reads from left to right, and is used from Constantinople eastwards over a large portion of Asia Minor, both newspapers and books being printed in this character. The Armenian alphabet comprises thirty-

Մ՚եր Հայր, որ երկինքումն ես. սուրբ ըլնի քո անունը. Գայ քո արքայութիւնը, ըլնի քո կամքը, ինչպէս երկնքումն՝ այնպէս էլ երկրի վերայ: Մ՚եր ամեն օրուայ հացն տուր մեզ այսօր: Եւ թող մեզ մեր պարտքերը, ինչպէս մենք էլ թողում ենք մեր պարտականներին: Եւ

11-point Armenian, No. 1 (set by Wm. Clowes & Sons).

FIG. 557.—*Armenian.*

eight letters; in addition to these, of which there are both capitals and lower-case, there are ten lower-case ligatures and some thirteen points and loose accents, so that a fount for Armenian contains about ninety-nine sorts. The ordinary character, fig. 557, has a considerable slope; but another form of character is also used in which diamond-shaped dots replace the short inclined strokes, the long strokes are made upright and thickened at one end, while the horizontal hair-lines are replaced by thick strokes: fig. 558. This face is used similarly to the latin italic.

[illegible]

11-point Armenian, No. 1 (set by Wm. Clowes & Sons).

FIG. 558.—*Kurdish; Armenian character.*

The Armenian character is used for some six languages and dialects; ancient Armenian is a very similar character.

The Hebraic character is one which has accompanied the Jews through all their wanderings. The extreme antiquity of their sacred lettering, which retains the reverent affection of every believer and co-religionist, as well as the constant study of the sacred books by a large percentage of the people, have resulted in the maintenance of this character, almost unaltered, in all places where the Jewish community is sufficiently large to require the product of the printing-press. The one apparent exception is mentioned among languages using the Ethiopic face, p. 550.

The Hebrew alphabet consists of twenty-two letters, five of which take a different form when they occupy the final position in a word. Moreover, as it is not permissible to divide the words in the composition of Hebrew, short lines are filled out by the assistance of six sorts, which are cast in various increased widths to permit of line-justification being effected without the addition of excessive width to the spaces. In addition to these there are twelve varieties of points for use below the characters, and some fourteen kinds for use above them, as well as

ועתה אם תשא חטאתם ואם אין מחני נא מספרך אשר כתבת: ויאמר יהוה
אל משה מי אשר חטא לי אמחנו מספרי:

Exodus xxxii. 32, 33.

12-point Rabbinical (set by Wm. Clowes & Sons).

FIG. 559.—*Hebrew; Rabbinical character.*

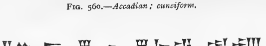
various other sorts for punctuation; the composition of Hebrew, therefore, requires a very large number of sorts or the use of two or of three bodies, as explained subsequently in connexion with the devanagari and Javanese type faces. An example of the simple rabbinical character is shown in fig. 559, and a specimen of Hebrew with the vowel-points is given at the head of this chapter, p. 533.

The hebrew character reads from right to left, and, like the arabic, the dots required above and below may be either on a separate body, or provided for by special sorts representing the combined consonant and vowel. For newspaper purposes these points, most of which come below the body, are frequently omitted, so that the character may be composed from a smaller number of sorts, with the further result that nearly twice the amount of matter can be printed on the page. The reader, however, where this is done, must supply the vowels himself, as in our own early systems of abbreviated longhand, in which the vowels were omitted. This omission of the vowels is a feature common also to many of the languages set in the arabic character. A fount scheme for Hebrew without these vowel points is given in table 24, p. 143.

Among the dead languages of Asia Minor are those recorded in cuneiform letters. Inscriptions and tablets in these characters have been

18-point Accadian cuneiform (set by Wm. Clowes & Sons).

FIG. 560.—*Accadian; cuneiform.*



14-point Assyrian cuneiform (set by Wm. Clowes & Sons).

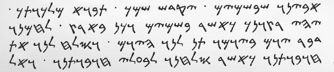
FIG. 561.—*Assyrian; cuneiform.*

described in a previous chapter. The three forms of cuneiform represented typographically are: Accadian, fig. 560; Assyrian, fig. 561; and Babylonian, fig. 562. Of these, the Assyrian form used for the inscriptions of the Ancient Persians and of the Medes is the simplest; it comprises some thirty-two letters, many of which are represented by several different signs, and a fount contains about eighty sorts.

12-point Babylonian cuneiform (set by Wm. Clowes & Sons).

FIG. 562.—*Babylonian; cuneiform.*

The very ancient Phœnician character, of which, as far as the authors are aware, no manuscript exists, reads from right to left; the alphabet contains twenty-two letters, many of which have two forms, while in the case of a few three forms occur; a fount consists of about forty-four sorts.

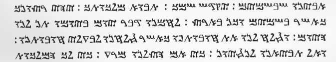


14-point Phœnician (set by Wm. Clowes & Sons).

FIG. 563.—*Phœnician.*

From the predominance of straight lines Phœnician resembles runic in its rude simplicity. A specimen of Phœnician is shown in fig. 563.

The Samaritan alphabet is closely allied to Hebrew, like which it reads from right to left; and the characters have practically identical names in

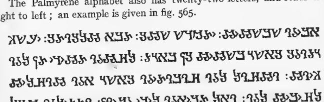


12-point Samaritan (set by Wm. Clowes & Sons).

FIG. 564.—*Samaritan.*

both languages. A fount consists of twenty-two sorts for letters, with four sorts for points. An example of Samaritan is given in fig. 564.

The Palmyrene alphabet also has twenty-two letters, and reads from right to left; an example is given in fig. 565.



12-point Palmyrene (set by Wm. Clowes & Sons).

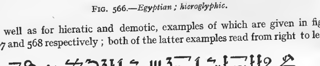
FIG. 565.—*Palmyrene.*

With the Egyptian hieroglyphic scripts the authors have dealt in a previous chapter. Type are also made for outline hieroglyphic, fig. 566;

18-point outline hieroglyphic (set by Wm. Clowes & Sons).

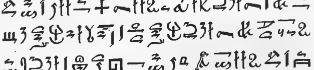
FIG. 566.—*Egyptian; hieroglyphic.*

as well as for hieratic and demotic, examples of which are given in figs. 567 and 568 respectively; both of the latter examples read from right to left.



18-point hieratic (set by Wm. Clowes & Sons).

FIG. 567.—*Egyptian; hieratic.*



12-point demotic (set by Wm. Clowes & Sons)

FIG. 568.—*Egyptian; demotic.*

The Coptic alphabet used for the languages of modern Egypt—Bohairic in the north and Sâ'idic in the south—comprises thirty-two letters; it has capitals and lower-case sorts; in addition to these sixty-four sorts, seven of the letters carry grave accents, and six are overscored for purposes of

Ⲡⲉⲛⲓⲱⲧ ⲉⲧϧⲉⲛⲛⲓⲫⲏⲟⲩⲓ̀, ⲙⲁⲣⲉϥⲧⲟⲩⲃⲟ ⲛ̀ϫⲉⲡⲉⲕⲣⲁⲛ.
ⲙⲁⲣⲉⲥⲓ̀ ⲛ̀ϫⲉ ⲧⲉⲕⲙⲉⲧⲟⲩⲣⲟ. ⲡⲉⲧⲉϩⲛⲁⲕ ⲙⲁⲣⲉϥϣⲱⲡⲓ
ϧⲉⲛⲧⲫⲉ ⲛⲉⲙϩⲓϫⲉⲛⲡⲓⲕⲁϩⲓ. ⲡⲉⲛⲱⲓⲕ ⲛ̀ⲧⲉⲣⲁⲥϯ ⲙⲏⲓϥ
ⲛⲁⲛ ⲙ̀ⲫⲟⲟⲩ. ⲟⲩⲟϩ ϫⲁⲛⲏ ⲉⲧⲉⲣⲟⲛ ⲛⲁⲛ ⲉⲃⲟⲗ

12-point Coptic, No. 2 (set by Wm. Clowes & Sons).

FIG. 569.—*Coptic; Bohairic or Northern.*

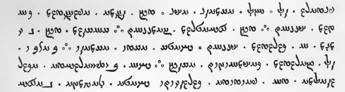
ⲡⲉⲛⲉⲓⲱⲧ ⲉⲧϩⲛ̄ⲙ̄ⲡⲏⲩⲉ, ⲙⲁⲣⲉⲡⲉⲕⲣⲁⲛ ⲟⲩⲟⲡ. ⲧⲉⲕⲙⲛ̄ⲧⲉⲣⲟ ⲙⲁ-
ⲣⲉⲥⲉⲓ. ⲡⲉⲕⲟⲩⲱϣ ⲙⲁⲣⲉϥϣⲱⲡⲉ ⲛ̄ⲑⲉ ⲉⲧⲉϥϩⲛ̄ⲧⲡⲉ ⲛ̄ϥϣⲱⲡⲉ ⲟⲛ
ϩⲓϫⲙ̄ⲡⲕⲁϩ. ⲡⲉⲛⲟⲉⲓⲕ ⲉⲧⲛⲏⲩ ⲛ̄ⲅϯ ⲙ̄ⲙⲟϥ ⲛⲁⲛ ⲙ̄ⲡⲟⲟⲩ. ⲛ̄ⲅⲕⲱ
ⲛⲁⲛ ⲉⲃⲟⲗ ⲛ̄ⲛⲉⲧⲉⲣⲟⲛ ⲛ̄ⲑⲉ ϩⲱⲱⲛ ⲟⲛ ⲧⲛ̄ⲕⲱ ⲉⲃⲟⲗ ⲛ̄ⲛⲉⲧⲉⲟⲩ-

12-point Coptic, No. 3 (set by Wm. Clowes & Sons).

FIG. 570.—*Coptic; Sa'idic or Southern.*

abbreviation. Coptic is shown in figs. 569 and 570; this script partakes of the character of greek, and reads, like Greek, from left to right.

Zend, the sacred language of the Parsees, has an alphabet of forty-four characters, and the fount consists of about forty-seven sorts; it reads from right to left, and an example of it is shown in fig. 571.



14-point Zend (set by Wm. Clowes & Sons).

FIG. 571.—*Zend.*

The Amharic alphabet consists of thirty-three letters, or seven more than Ethiopic; each of these can be used in its unaltered form or with the addition of a mark signifying one of the six vowel sounds by which it can be followed; there are consequently 198 sorts representing syllables, and a still further twenty combinations involve diphthongs, besides two other signs for points. The total number of sorts for the Amharic fount is 253; for Ethiopic there are 182 syllables, twenty diphthongs, four points, and twenty figure signs, that is 226 sorts; this shorter fount is used with a few additions for Tigré and Tigrinya. This character is shown in figs. 572 and 573; it is used in the north-east of Africa.

The one exception to the general use of the hebrew character for the writing and printing of sacred books occurs in the case of the Falashas,

አባታችን ፡ ሆይ ፡ በሰማይ ፡ የምትኖር ፡፡ ስምኽ ፡ ይቀ
ደስ ፡፡ መንግሥትኽ ፡ ትምጻ ፡፡ ፈቃድኽ ፡ በምድር ፡ ትሁን ፡
በሰማይ ፡ እንደ ፡ ሆነች ፡፡ እንጀራችነን ፡ የሚበቃንን ፡
ስጠን ፡ ዛሬ ፡፡ ይቅር ፡ በለነም ፡ በኛ ፡ ያለውን ፡ እኛም ፡

11-point Amharic, No. 2 (set by Wm. Clowes & Sons).

FIG. 572.—*Amharic.*

አቡነ ፡ ዘበሰማያት ፡ ይትቀደስ ፡ ስምከ ፡፡ ትምጻእ ፡
መንግሥትከ ፡፡ ይኩን ፡ ፈቃድከ ፡ በከመ ፡ በሰማይ ፡
ወበምድርኒ ፡፡ ሲሳየነ ፡ ዘለለ ፡ ዕለትነ ፡ ሀበነ ፡ ዮም ፡፡
ወኅድግ ፡ ለነ ፡ አበሳነ ፡ ከመ ፡ ንሕነኒ ፡ ነኅድግ ፡ ለዘአበሰ ፡

12-point Ethiopic, No. 1 (set by Wm. Clowes & Sons).

FIG. 573.—*Ethiopic.*

who, however, it is stated, can only be doubtfully "identified ethnologically with the seed of Abraham."

Passing further east, one finds, derived from the five Aryan dialects which emerged from the covering flood of Buddhism about 600 B.C., the devanagari character, which is used for thirty or forty of the languages and dialects of India.

The Sanskrit alphabet, from which the more modern forms of devanagari (frequently called "clothes-line" by the trade) are derived, consists of about forty-four letters, nearly all of which include a horizontal and a vertical stroke with the distinguishing portions of the letters, frequently combined two or three together, on these main strokes. Some of the resulting characters are of great complexity, and in addition to the total of over 330 sorts, any or all of which can be included in a fount, and the ten figure signs, there are five accents representing vowel sounds, which can be placed above the characters, and six others which can be placed below.

This character has been alluded to already in the chapter dealing with legibility; it reads from left to right.

As previously explained in the case of arabic and hebrew characters, the addition of accents above and below involves working with two or three bodies, and in many cases an 18-point fount is built up of the main character on 14-point with the accent on 4-point; a 24-point with the main character on 18-point and the accent on 6-point, and so on; or, if accents are used below as well as above, these founts become 22-point and 30-point respectively. A specimen of devanagari character is shown in fig. 574; the Marathi character resembles this very closely.

हे हमारे स्वर्गबासी पिता, तेरा नाम पवित्र किया जाय।
तेरा राज्य आवे। तेरी इच्छा जैसे स्वर्ग में वैसे पृथ्वी पर
पूरी होय। हमारी दिनभर की रोटी आज हमें दे। और
जैसे हम अपने ऋणियों को क्षमा करते हैं तैसे हमारी
ऋणों को क्षमा कर। और हमें परीक्षा में मत डाल,

16-point Hindi, No. 3 (set by Wm. Clowes & Sons).

FIG. 574.—*Hindi; devanagari character.*

Derived from the devanagari character is the Bengali, of which the alphabet contains nearly the same number of letters as the Sanskrit, but for which a much smaller total number of sorts is required.

A specimen of this character which is used in some parts of the north-east of India not only for Aryan languages, but for some of the scattered Kolarian groups, is shown in fig. 575.

হে আমাদের স্বর্গস্থ পিতঃ, তোমার নাম পবিত্র বলিয়া মান্য হউক।
তোমার রাজ্য আইস্মুক। তোমার ইচ্ছা স্বর্গে যেমন পৃথিবীতেও তেমনি
পালিত হউক। আমাদের প্রয়োজনীয় খাদ্য অদ্য আমাদিগকে দাও।
আর আমরা আপন আপন অপরাধীদিগকে যেমন ক্ষমা করিয়াছি,

12-point Bengali, No. 2 (set by Wm. Clowes & Sons).

FIG. 575.—*Bengali.*

Another derivative of the devanagari character used in the Punjab, is the Gurumukhi character shown in fig. 576.

ਹੇ ਅਸਾਡੇ ਪਿਤਾ ਜੋ ਸੁਰਗ ਵਿੱਚ ਹੈ, ਤੇਰਾ ਨਾਉਂ ਪਵਿਤ੍ਰ ਰੱਖਿਆ ਜਾਵੇ.
ਤੇਰਾ ਰਾਜ ਆਵੇ; ਤੇਰੀ ਇੱਛਿਆ ਜਿਹੀ ਸੁਰਗ ਵਿੱਚ ਹੈ ਤਿਹੀ ਧਰਤੀ ਪੁਰ
ਬੀ ਕੀਤੀ ਜਾਵੇ. ਸਾਡੀ ਗੁਜਰ ਲਾਇਕ ਭੋਜਨ ਅੱਜ ਸਾ ਨੂੰ ਦਿਹ. ਅਰ ਜਿਸ
ਪਰਕਾਰ ਅਸੀਂ ਆਪਣੇ ਕਰਜਾਈਆਂ ਨੂੰ ਮਾਫ ਕਰਦੇ ਹਾਂ, ਤਿਸੀ ਪਰਕਾਰ

12-point Panjabi, No. 8 (set by Wm. Clowes & Sons).

FIG. 576.—*Panjabi or Sikh; Gurumukhi character.*

The Thakuri character, which is used in the Chamba States of the Punjab, is shown in fig. 577.

[illegible]

18-point Thakuri (set by Wm. Clowes & Sons).

FIG. 577.—*Chamba; Thakuri character.*

An example of Gujarati or Guzerati, which has a slight resemblance in appearance to the last-named, is shown in fig. 578. The alphabet comprises forty-three sorts, to which eighty-seven ligatures, each formed from a consonant and a vowel, may be added.

ઓ આકાશમાંના અમારા બાપ, તારૂં નામ પવિત્ર
મનાઓ. તારૂં રાજ્ય આવો; જેમ આકાશમાં તેમ
પૃથ્વી પર તારી ઇચ્છા પુરી થાઓ. દિવસની અમારી
રોટલી આજ અમને આપ. અને જેમ અમે અમારા
ઋણીઓને માફ કરિયેછિયે, તેમ તું અમારાં ઋણો

14-point Gujarati (set by Wm. Clowes & Sons).

FIG. 578.—*Gujarati or Guzerati.*

A character largely used in Southern India is Kanarese; it reads from left to right, and the alphabet comprises fifty-three characters, in addition to which fifty-four ligatures are commonly used, so that a fount consists of more than 107 sorts; an example of this character is given in fig. 579.

ಪರಲೋಕದಲ್ಲಿ ರುವ ನಮ್ಮ ತಂದೆಯೇ, ನಿನ್ನ ನಾಮವು ಪರಿಶುದ್ಧವಾಗಲಿ.
ನಿನ್ನ ರಾಜ್ಯವು ಬರಲಿ. ನಿನ್ನ ಚಿತ್ತವು ಪರಲೋಕದಲ್ಲಿ ಆಗುವ ಪ್ರಕಾರ
ಭೂಮಿಯ ಮೇಲೆಯೂ ಆಗಲಿ. ನಮ್ಮ ಅನುದಿನದ ರೊಟ್ಟಿಯನ್ನು ಈ
ಹೊತ್ತು ನಮಗೆ ಕೊಡು. ನಾವು ನಮ್ಮ ಸಾಲಗಾರರಿಗೆ ಬಿಡುವ ಪ್ರಕಾರ,

14-point Kanarese, No. 1 (set by Wm. Clowes & Sons).

FIG. 579.—*Kanarese.*

The Telugu alphabet is practically identical with the Kanarese, but has only fifty-one characters; it differs otherwise from Kanarese only in the form of some of its characters; an example of Telugu is given in fig. 580; seventy-nine ligatures are frequently used for letter combinations.

ఆకాశమందున్న మా తండ్రి! నీ నామము పరిశుద్ధపరచబడు
గాక. నీ రాజ్యము వచ్చుగాక; నీ చిత్తము ఆకాశమందు ఏలా
గో ఆలాగే భూమియందును నెరవేరు గాక. మాకు కావల
సిన ఆహారము నేడు మాకు దయ చేయుము. మా ఋణ

14-point Telugu, No. 1 (set by Wm. Clowes & Sons).

FIG. 580.—*Telugu.*

The Tamil alphabet has thirty letters, in addition to which 227 ligatures, consisting of the combinations of consonant and vowel, are used, as well as twelve figure signs; the total fount, therefore, amounts to 269 sorts. This character is also used in Southern India. Tamil reads from left to right, and an example is given in fig. 581.

பரமண்டலங்களிலிருக்கிற எங்கள் பிதாவே, உம்முடைய நா
மம் பரிசுத்தப்படுதாக. உம்முடைய ராஜ்யம் வருவதாக;
உம்முடைய சித்தம் பரமண்டலத்திலே செய்யப்படுகிறது
போல பூமியிலேயும் செய்யப்படுவதாக. எங்களுக்கு வேண்
டிய ஆகாரத்தை இன்று எங்களுக்குத் தாரும். எங்கள் கட

12-point Tamil, No. 2 (set by Wm. Clowes & Sons).

FIG. 581.—*Tamil.*

A cognate but less known script of the Dravidian group is Malayalim, an example of which is shown in fig. 582.

ഞങ്ങളുടെ സ്വൎഗ്ഗസ്ഥനായ പിതാവേ, നിന്റെ നാമം
പരിശുദ്ധമാക്കപ്പെടേണമെ, നിന്റെ രാജ്യം വരേണമെ;
സ്വൎഗ്ഗത്തിലെ പോലെ ഭൂമിയിലും നിന്റെ ഇഷ്ടം ചെ
യ്യപ്പെടേണമെ. ഞങ്ങളുടെ ദിനംപ്രതിയുള്ള അപ്പം ഇന്ന
ഞങ്ങൾക്ക തരേണമെ. ഞങ്ങളുടെ നേരെ കുററം ചെയ്യുന്ന

14-point Malayalim (set by Wm. Clowes & Sons).

FIG. 582.—*Malayalim.*

An example of Oriya or Uriya, the script of Orissa, is shown in fig. 583.

ହେ ଆମ୍ଭମାନଙ୍କର ସ୍ୱର୍ଗସ୍ଥ ପିତା, ତୁମ୍ଭର ନାମର ପୂଜା ହେଉ । ତୁମ୍ଭର ରାଜ୍ୟ
ଆସୁ । ଯେତ୍‌ପେ ସ୍ୱର୍ଗରେ ସେତ୍‌ପେ ପୃଥ୍ୱୀରେ ତୁମ୍ଭର ଇଚ୍ଛା ସଫଳ ହେଉ । ଆଜ
ଆମ୍ଭମାନଙ୍କର ନିତ୍ୟ ଭକ୍ଷ୍ୟ ଦିଅ । ଆମ୍ଭେମାନେ ନିଜ ଅପରାଧିମାନଙ୍କୁ ଯେମନ୍ତ କ୍ଷମା
କରି, ତେମନ୍ତ ଆମ୍ଭମାନଙ୍କର ଅପରାଧ କ୍ଷମା କର । ପରୀକ୍ଷାରେ ଆମ୍ଭମାନଙ୍କ ନ
ଆଣ, ପୁଣି ଦୁଷ୍ଟଠାରୁ ରକ୍ଷା କର ; ଯେଣୁ ରାଜତ୍ୱ, ଗୌରବ, ପରାକ୍ରମ ସଦାସର୍ବଦା

14-point Oriya (set by Wm. Clowes & Sons).

FIG. 583.—*Oriya or Uriya.*

The Sanskrit sacred books of the Brahmins have been trauscribed from devanagari into Bengali, Tamil, Kanarese, Malayalim, Oriya, and various other characters.

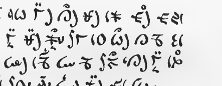
The Cingalese or Sinhalese character is used for the language of Ceylon. An example of this is given in fig. 584.

ස්වර්ගයෙහි වැඩසිටින අපගේ පියානන්වහන්ස; ඔබවහන්
සේගේ නාමය ශුද්ධව පවත්වනු ලැබේවා. ඔබවහන්සේගේ
රාජ්‍යය ඒවා. ඔබවහන්සේගේ කැමැත්ත ස්වර්ගයෙහිමෙන්
භූමියෙහිද කරණු ලැබේවා. අපේ දවස්පතා භෝජනය අපට
අද දුනමැනව. අපේ නයකාරයන්ට අපි ක්ෂමාවෙන්නාක්

11-point Sinhalese (set by Wm. Clowes & Sons).

FIG. 584.—*Cingalese or Sinhalese.*

The Lepcha language, or dialect, of the Tibeto-Burman group, spoken in Darjeeling not far from the border of Sikkim and the peak of Kinchinjunga, makes use of the character shown in fig. 585.



St. John iii. 16. *22-point Lepcha (set by Wm. Clowes & Sons).*

FIG. 585.—*Lepcha.*

Tibetan, the character of the land of Buddhism, is a very beautiful but somewhat cumbrous character; it requires a large body, and presents some difficulties in kerning. The alphabet consists of thirty letters, from which many ligatures are formed. An example of this interesting and decorative character is shown in fig. 586.

།ཀྱི་ངེད་རྣམས་ཀྱི་ཡབ་ནམ་མཁའ་ལ་བཞུགས་པ། ཁྱེད་ཀྱི་དམ་པའི་
མཚན་ལ་བསྙེན་བཀུར་བགྱིད་པར་ཤོག་ཅིག །ཁྱེད་ཀྱི་རྒྱལ་སྲིད་འོང་བར་གྱུར་
ཅིག །ཁྱེད་ཀྱི་དགོངས་པ་བཞིན་དུ་ནམ་མཁའ་ལ་སྒྲུབ་པ་ལྟར། ས་ལ་ཡང་
སྒྲུབ་པར་གྱུར་ཅིག །ཞག་རེའི་ཁ་ཟས་དེ་རིང་ཡང་ངེད་རྣམས་ལ་གནོང་ཞིག

18-point Tibetan (set by Wm. Clowes & Sons).

FIG. 586 —*Tibetan.*

Further east the Burmese character is largely used, with derivative forms in adjacent countries. The Burmese alphabet consists of forty-five letters; the character reads from left to right. An example of Burmese is given in fig. 587.

ကောင်းကင်ဘုံ၌ရှိတော်မူသောအကျွန်ုပ်တို့အဖ၊ ကိုယ်တော်
၏နာမတော်အားရိုသေလေးမြတ်ခြင်းရှိပါစေသော။ နိုင်ငံတော်
တည်ထောင်ပါစေသော။ အလိုတော်သည်ကောင်းကင်ဘုံ၌
ပြည့်စုံသကဲ့သို့၊ မြေကြီးပေါ်မှာပြည့်စုံပါစေသော။ အသက်မွေး

18-point Burmese (set by Wm. Clowes & Sons).

FIG. 587.—*Burmese.*

The Siamese alphabet consists of forty-four consonants (the vowels being represented by signs written over, under, before or after the consonants with which they are sounded), and a fount comprises some 150 sorts; it is a character peculiar to Siam, and an example is given in fig. 588.

โอ้ พระบิดา แห่ง ข้าพเจ้าทั้งหลาย ผู้ อยู่ในสวรรค์, ให้พระนาม ของ
พระองค์เปนที่นับถือ อัน บริสุทธิ. ให้แผ่นดิน ของ พระองค์มาตั้ง อยู่.
พระไทย ของ พระองค์สำเร็จในสวรรค์ อย่างไร, ก็ให้สำเร็จในแผ่นดิน
โลกย์ เหมือน กัน ขอ โปรด ประทาน อาหารเลี้ยงข้าพเจ้า ทั้งหลาย ใน กาล

18-point Siamese (set by Wm. Clowes & Sons).

FIG. 588.—*Siamese.*

The Buddhist sacred books in Pali have been transcribed into this character, as well as into Burmese and Cingalese.

The Lao-tian or Lao-shan character is used in the south of Laos and on the frontier of Annam in French Indo-China; an example of this character is given in fig. 589.

ພະບິດາ ຂອງ ຂ້າ ພະເຈົ້າ ທັງ ຫຼາຍ ຜູ້ຢູ່ໃນ
ສວັນ ເຫ້ນາມຊື່ຂອງພະອົງເປັນທີ່ນັບຖືອັນ
ບໍລິສຸດ ຂໍເຫ້ແຜ່ນດິນແຫ່ງພະອົງມາຕັ້ງຢູ່

St. John iii. 16. *24-point Lao-tian (set by Wm. Clowes & Sons).*

FIG. 589.—*Lao-tian or Lao-shan.*

With the Chinese character, used generally throughout China, the authors have dealt in a previous chapter. The neighbouring nation—

Japan—uses for its classics a character almost identical with the Chinese ideographic writing, known as Kana-majiri; an example of this is given in fig. 590. An abbreviated form of character, comprising some seventy-three sorts, forty-seven of which form the alphabet, used for Japanese writing, is the Kata-kana, an example of which is shown in fig. 591, while yet another written form, known as Hira-gana, is shown in fig. 592.

天に在します我儕
の父よ願くは爾
名を尊崇させ給へ、
爾國を臨せ給へ爾
心の天に成る如く

14-point Kana-majiri (set by Wm. Clowes & Sons).

FIG. 590.—*Japanese Kana-majiri.*

テンニ マシマス ワ
レラノチ、ヨ 子ガハ
クバ ミナヲアガメサ
セタマヘ、ミクニヲキ
タチセタマヘ ミコ、

14-point Kata-kana (set by Wm. Clowes & Sons).

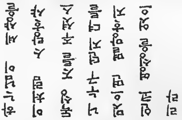
FIG. 591.—*Japanese Kata-kana.*

てんに ましますわ
れらのち、よ ねがは
くば みなをあがめさ
せたまへ、みくにをき
たらせたまへ みこ、

14-point Hira-gana (set by Wm. Clowes & Sons).

FIG. 592.—*Japanese Hira-gana.*

The Korean character, fig. 593, in some respects resembles the Chinese, but in others it is similar to the Japanese Kata-kana, while some of the characters are like those proposed in the new Chinese syllabic alphabet, both being derived from a similar source. The Korean character was many

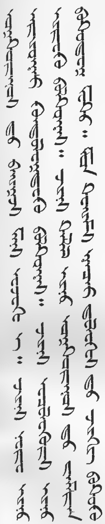


St. John iii. 16. "The Gospel in many Tongues"; British and Foreign Bible Society. *14-point Korean.*

FIG. 593.—*Korean.*

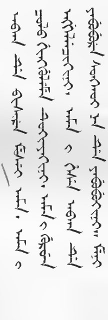
years ago arranged to form an alphabet of eleven vowels, thirteen diphthongs, and fourteen consonants, or in all thirty-eight sorts; in this respect this nation was ahead of its Celestial neighbour, although the form in which its alphabet is presented is not such as would render machine-composition possible without alteration in the method of arranging the letters.

In the interior of Asia a very curious character is used for languages of the Tartar family, examples of which are Kalmuk, shown in fig. 594, Manchu, fig. 595—now a dead language—and Mongolian, fig. 596. The Mongolian alphabet has twenty-four characters; like arabic, most of the letters have different initial, medial, final, and detached forms. The Manchu alphabet has thirty-six letters, most of which exist in several of the four forms, initial, medial, final,



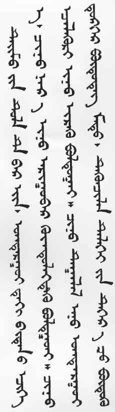
18-*point Kalmuk (set by Wm. Clowes & Sons).*

FIG. 594.—*Kalmuk.*



18-*point Manchu (set by Wm. Clowes & Sons).*

FIG. 595.—*Manchu.*



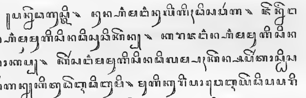
18-*point Mongolian (set by Wm. Clowes & Sons).*

FIG. 596.—*Mongolian.*

and detached, totalling 137 sorts. It has also a large number of ligatures, so that a fount comprises some 200 sorts. This character reads from top to bottom; the vertical lines do not follow, as in Chinese, from right to left, but read from left to right; consequently, any machine intended to compose in the Mongolian character would have to be arranged as is the arabic Linotype, to effect the equivalent of composing matter which is to read from right to left. The type or print would then require to be turned counter-clockwise through a right angle, that is, in the opposite direction to the clockwise quarter-revolution through which the character, written on a latin typewriter fitted with the new Chinese syllabary, requires to be turned to give the Chinese direction of reading.

The Mongolian character, however, possesses certain peculiarities due to the ambiguity of meaning of several sorts, and consequently presents so great a difficulty of interpretation to the reader that it is extremely improbable that machinery will ever be adapted to produce it in its present form.

Of the characters used for the languages of the islands of the Eastern Seas, Javanese, which is one of the most important, reads from left to right; an example of it is shown in fig. 597. The Javanese alphabet consists

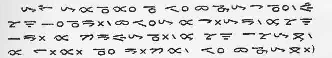


22-point Javanese (set by Wm. Clowes & Sons).

FIG. 597.—*Sundanese; Javanese character.*

of about thirty letters, most of which have two forms, according as the character comes on or below the line; there are also five vowels for use separately, and twelve accents representing vowels, some used above the line, some on the line, and some below the line; added to this there are about 120 ligatures. The large number of sorts and the fact that practically there are three lines to be set, makes the composition of Javanese a very complicated matter. The three lines in the aggregate are equivalent to a very large body on account of the great length of the descending sorts and the height of the accents.

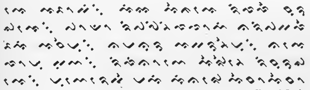
In the island of Sumatra the Batta character is used, an example of which is shown in fig. 598.



10-point Batta (set by Wm. Clowes & Sons).

FIG. 598.—*Batta.*

In the island of Celebes the Bugi character is used for that language and also for Makassar. The alphabet consists of twenty-three letters and five accents for vowel sounds; two of these are placed before and after the letters respectively, one is placed below, and two are placed above; the

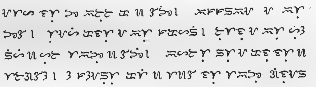


14-point Bugi (set by Wm. Clowes & Sons).

FIG. 599.—*Bugi.*

number of sorts required for a fount is, therefore, not far short of a hundred. An example of Bugi is shown in fig. 599.

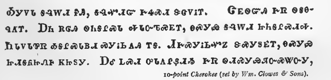
In the Philippines a special character is used, known as Bisaya, or Visaya, of which an example is shown in fig. 600.



18-point Bisaya (set by Wm. Clowes & Sons).

FIG. 600.—*Bisaya or Visaya.*

Passing from the Pacific to North America, a special alphabet was made for Cherokee, an example of which is given in fig. 601; this was, however,

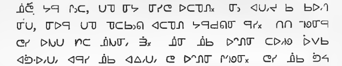


10-point Cherokee (set by Wm. Clowes & Sons).

FIG. 601.—*Cherokee.*

found to be cumbrous and inconvenient. Cherokee, as a living language, is alluded to by Theodore Roosevelt in his account of a journey up the Paraguay, published in the "Daily Telegraph" of 23 March, 1914; in this the late President of the United States of America compares a daily paper published at Asuncion with parallel columns of Spanish and Guarani to a journal in the State of Oklahoma, "published in English and in the tongue which the extraordinary Cherokee Chief, Seguoia, a veritable Cadmus, made a literary language."

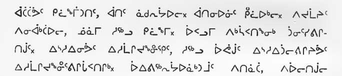
The agglutinative languages of the Red Indian and allied tribes are now, in many instances, represented by the syllabic character, which has



14-point Chippewyan (set by Wm. Clowes & Sons).

FIG. 602.—*Chippewyan.*

several variations, two examples of which are shown in figs. 602 and 603. The first of these, a fount of which consists of about forty-nine sorts, is used



14 point Eskimo (set by Wm. Clowes & Sons).

FIG. 603.—*Eskimo or Innuit.*

for Blackfoot Indian, Chippewyan, Slavé, and Tinné or Tenni, while the other serves for Cree both eastern and western, Ojibbeway, and Eskimo or Innuit.

A very ingenious universal alphabet, which may be termed the **CV** alphabet, consisting of two character components, internal and external, arranged at different angles of rotation, has been proposed by Prof. Robert H. Smith. The two signs **C** and **V** are rotated through eight positions, advancing by 45° from each other, and represent the sixteen vowels and diphthongs of this alphabet. The central character **V**, used in combinations with **C** to represent consonants, occupies a distinctive inclination for each group of four combinations, in which the external character **C** is rotated through 90° for each of the four sorts in succession; thus one group represents the labial sounds, another the dental another the sibilant, and so on. There are eight groups of four letters each, or thirty-two consonants in all. The total alphabet consists of forty-eight sorts, and their relation to each other is shown in fig. 604. All of these sorts come

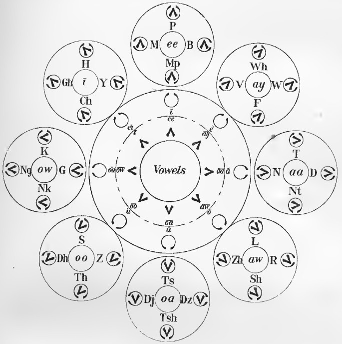


FIG. 604.—*CV or compass alphabet; relationship of characters.*

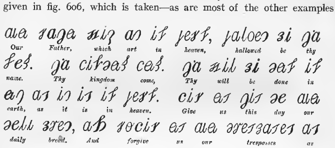
on the em quad. An example of matter set in this character, named compass alphabet by the inventor, is given in fig. 605.

11-point compass.

FIG. 605.—*CV or compass type.*

Many further special character systems have been suggested, one of which is a system of universal syllabics, by which it has been proposed to represent the syllables of any languages, with their proper sound values.

An example of a few lines of "The Lord's Prayer" set in this character is given in fig. 606, which is taken—as are most of the other examples



18-point universal syllabics (set by Wm. Clowes & Sons).

FIG. 606.—*Universal syllabics.*

in this chapter, except where otherwise stated—from "The Lord's Prayer in Five Hundred Languages," published by Wm. Clowes & Sons, Ltd., to whom the authors are indebted, with but one or two exceptions, for the specimens here shown, and for much valuable and reliable information.

Music Composition.

In the description of the composition of some of the foreign characters such as arabic, devanagari, and Javanese, allusion has been made to the necessity of composing simultaneously with two or even with three bodies. The difficulty which occurs in these founts, however, is small in comparison with that found in the composition of music. The appearance of music, with its two staves, each of five lines, and notes capable of falling either on the line or in the space between two adjacent lines, or again isolated between or outside the staves, makes it immediately apparent that many of the signs used must be built up of several component parts. Not only is the composition rendered difficult for the reasons already given, but also on account of the various additions which are made to give value to the notes, and the necessity for treating the length as a measure of time: in fact, the composition of music requires skill much greater than that necessary for the composition of tabular work or the even more difficult arrangement of pedigrees and genealogies. Music composition is a craft so difficult and complicated that it stands in a class by itself, which is only approached in its difficulties by the composition of complex mathematical formulæ.

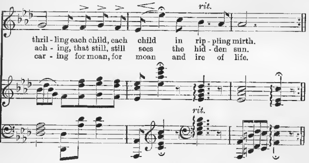
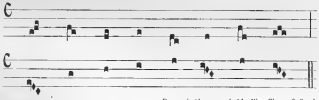
A fount for music comprises some 255 sorts, ranging from the treble and base clefs, which are cast in one piece with the bars, the various signs for sharps, flats, and naturals, the black and white note-heads with their up and down ties, hooks for grace-notes, note stems, rests, bars, slurs, binds, time-marks, and many other peculiar and special marks. The various characters which go to form a short fount of music type are

Diamond music (set by Wm. Clowes & Sons).

FIG. 607.—*Music.*

shown in fig. 89, p. 102. An example of music as composed typographically is given in fig. 607.

An excellent description of the method adopted in music composition is given by De Vinne in his work on "Modern Methods of Book Composition."

Gregorian music, the invention of which is attributed to St. Gregory, and which is used for chanting, has a much simpler notation. A similar

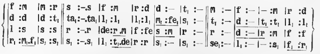


Bourgeois plain-song (set by Wm. Clowes & Sons).

FIG. 608.—*Plain-song.*

form of notation, which also has a single stave of four lines, is known as plain-song. This form of musical composition is as simple as ordinary tabular work, and it does not require the highly specialized skill of the true music-compositor. The Gregorian or plain-song fount comprises about 127 sorts; an example of plain-song is shown in fig. 608.

Still more simple than the plain-song is the tonic sol-fa music, in which no stave is used, the notes being replaced by letters. This form of composition can be carried out by any compositor accustomed to tabular work.



Brevier sol-fa (set by Wm. Clowes & Sons).

FIG. 609.—*Tonic sol-fa.*

The number of sorts used is comparatively small, but comprises some logotypes and a peculiar form of lower-case m particular to this usage; this appears in the example, fig. 609.

CHAPTER XXXVI.

CONCLUSION.

"Let us hear the conclusion of the whole matter."
Ecclesiastes.

10-point antique roman (Stephenson, Blake & Co.).

IN one of the early chapters of this work the authors have briefly touched upon the historyof the art which culminates in the production of the printing-surface, and they have considered the gradual development of the production of a type from its first casting from crude wooden matrices, varied occasionally by its casting from matrices of lead or other soft metal, to its final casting from copper, bronze, nickel or steel. They have discussed the first rough mechanical means for making these matrices, and the various early apparatus connected with them and their product, and have described the latest developments, showing the extremely narrow margin of error allowable in modern practice in every matter connected with the production of the type surface, the mechanisms used in the industry being perhaps among the highest developments of accurate human constructive effort. In this final chapter, therefore, a brief chronological account of the earlier foundries is not out of place. It is not very easy to throw much light on primitive foundry methods; considerable secrecy accompanied at least this portion of the operations of the first printers, who were generally their own typefounders, and even to-day, the spirit of secretiveness as to ways and means of achieving certain results has not died out. There is no evidence to show whether Caxton was, or was not, the first typefounder in England as well as the father of printing, but there is every probability that his first two founts were cast for him at Bruges, and that the second of these was brought over by him to Westminster.

It is stated that the first allusion in any book to English typefounders appears in Archbishop Parker's Preface to Asser's "Ælfredi Regis Res Gestæ" (The Chronicles of King Alfred), London, 1574. It is here stated: "*Iam vero cum Dayus Typographus primus (& omnium certè quod sciam solus) has formas æri inciderit: facilè quæ Saxonicis literis perscripta sunt, ijsdem typis diuulgabuntur.*" The translation of which, given by Talbot Baines Reed, is as follows: "And inasmuch as Day, the printer, is the first (and, indeed, as far as I know, the only one) who has cut the letters in metal; what things have been written in Saxon characters will be easily published in the same type." It is hence presumable that John Day was only one typefounder among others, and that therefore the art of type-founding, or at least of type production, was by no means a novel one. Day printed from about 1546 to 1584; the work quoted from presents the curious feature that the text of the book itself, while in the Latin language, is in Saxon characters; a table is appended to the preface giving the equivalents of each character. It was not till about the beginning of the seventeenth century that typefounding and printing were separated from each other. Typefounding then began to be exercised as a trade by itself, and was divided into the several branches of punch-cutting, casting, and dressing. The workers in these various branches were indiscriminately called letter-founders, though few of them could perform the whole work themselves, or at least few of them did so.

In 1637 a decree was passed "that there shall be foure Founders of letters for printing, and no more allowed, . . ." The fact of the issuing of this regulation shows that typefounding had become by now a distinct trade in London, and that it was under rigid Government protection and supervision. The four founders named under this decree were: John Grismand, Thomas Wright, Arthur Nichols, and Alexander Fifield, all of whom cast from matrices obtained from Holland, no attempt having been made, so far as can be ascertained, to recognize original founders. These restraints on type-founders were taken away altogether, with those on printers, by the dissolution of the Court of Star Chamber on 3 November, 1640, on the assembly of the Long Parliament.

In 1662 an Act more burdensome than the Star Chamber decree of 1637 was passed, namely, 13–14 Charles II, by which the number of master founders was again reduced to four. This restriction, with some slight alterations, continued in force till 1693, when it expired. There must have been some connivance or virtual relaxation of the rules in the later years of its continuance before it expired, for notwithstanding these restraints, Moxon, writing in 1683, states that the "number of Founders and Printers be grown very many." In 1669 was issued the first known dated type-specimen sheet, namely, "Proves of Several Sorts of Letter cast by Joseph Moxon," though, according to Reed, a specimen consisting of a few lines only was specially cut, and privately dedicated to the King four years earlier. In 1685 the appointment of typefounders was revived by James II for seven years and extended for one more. The Act expired in 1693 and this appointment was not afterwards renewed.

The following quotations from Talbot Baines Reed's beautiful and accurate work, "A History of the Old English Letter Foundries," are not without interest as showing in a practical manner the usual disregard Englishmen have for the letter of the law when it does not tally with their own convenience.

"Notwithstanding this liberty, the number of founders during the eighteenth century appears rarely to have exceeded the figure prescribed by the Star Chamber Decree of 1637, and occasionally to have been less.

"One more attempt was made in the closing days of the eighteenth century to control the freedom of the press by law. There is something almost grotesque in the efforts made by legislators in 1799 to refit, on a full-grown and invincible press, the worn-out shackles by which the Stuarts had tried to curtail the growth of its childhood; and the Act of the 39th George III, cap. 79, in so far as it deals with printing, will always remain one of the surprises, as well as one of the disgraces, of the Statute-book. Among its worst provisions, the following affect letter-founders and letter-founding:—

"Sec. 23 ordains that no one, under penalty of £20, shall be allowed to possess or use a printing-press or types for printing, without giving notice thereof to a Clerk of the Peace, and obtaining from him a certificate to that effect.

"Sec. 33 provides that any Justice of the Peace may issue a warrant to search any premises, and seize and take away any press or printing-types not duly certificated.

"The following sections we give in full:—

> "Sec. 25. 'That from and after the Expiration of Forty Days after the passing of this Act, every Person carrying on the Business of a Letter Founder or Maker or Seller of Types for Printing or of Printing Presses, shall cause Notice of his or her Intention to carry on such Business to be delivered to the Clerk of the Peace of the . . . Place where such Person shall propose to carry on such Business, or his Deputy in the Form prescribed in the Schedule of this Act annexed. And such Clerk of the Peace or his Deputy shall, and he is hereby authorized and required thereupon to grant a Certificate in the Form also prescribed in the said Schedule, for which such Clerk of the Peace or his Deputy shall receive a Fee of One Shilling and no more, and shall file such Notice and transmit an attested Copy thereof to one of his Majesty's Principal Secretaries of State; and every Person who shall, after the expiration of the said Forty Days, carry on such Business, or make or sell any Type for Printing, or Printing Press, without having given such Notice, and obtained such Certificate, shall forfeit and lose the Sum of Twenty Pounds.'

> "Sec. 26. 'And be it further enacted, That every Person who shall sell Types for Printing, or Printing Presses as aforesaid, shall keep a Fair Account in Writing of all Persons to whom such Types or Presses shall be sold, and shall produce such Accounts to any Justice of the Peace who shall require the

same ; And if such Person shall neglect to keep such Account, or shall refuse to produce the same to any such Justice, on demand in Writing to inspect the same, such Person shall forfeit and lose, for such offence, the Sum of Twenty Pounds.'

"Such was the law with regard to typefounding at the time when the widows of the two Caslons were struggling to revive their then ancient business, when Vincent Figgins was building up his new foundry, and Edmund Fry, Caslon III and Wilson were busily occupied in cutting their modern Romans to suit the new fashion. And such the law remained nominally until the year 1869, just upon four centuries after the introduction of the Art into this country. It is probable that, during the first few disturbed years of its existence, the Act may have been enforced, that certificates may have been registered, and accounts dutifully furnished. But its provisions appear very soon to have fallen into contempt, and certainly, as far as we can ascertain, failed to trouble the peace of any British letter-founder."

Note.—"The clauses relating to printers and typefounders were repealed by the 32 and 33 Vict., cap. 24: *An Act to Repeal certain enactments relating to Newspapers, Pamphlets, and other Publications, and to Printers, Type-founders, and Reading Rooms.* [12 July, 1869.]"

About 1667 Dr. John Fell presented his University with "a complete typefoundry, consisting of the punches and matrices of twenty founts of Roman, Italic, Orientals, Saxons, Black and other letter, besides moulds and all the apparatus and utensils necessary for a complete printing office.

"The extent of this noble gift, the importance of which can only be estimated by recalling the low condition of letter-founding in England at the time, will best appear . . . " [if the Inventory published by the University in 1695 be consulted.]

"Dr. Fell supplemented this gift by a further signal service, which is thus recorded by Bagford :—

"'The good Bishop provided from Holland the choicest Puncheons, Matrices, etc., with all manner of Types that could be had, as also a Letter Founder, a Dutchman by Birth, who had served the States in the same quality at Batavia, in the East Indies. He was an excellent workman, and succeeded by his son, who has been since succeeded by Mr. Andrews.'"

In 1677, according to Talbot Baines Reed, the University press was further enriched by another important gift of type and matrices presented by Francis Junius, the son of Francis Junius, the theologist, of Heidelberg. These comprised punches and matrices of founts of Gothic, Runic, Danish, Icelandic, Anglo-Saxon, Greek, Roman, Italic, Black-letter, and Swedish.

"The combined gifts of Dr. Fell and Francis Junius laid the foundation of the Oxford University foundry as it now exists."

At this period the types made in England were very coarse, and we were far surpassed by the Dutch, from whom, indeed, our founders often purchased matrices; but even with the help of the Dutch matrices, they could not cast so well as the Dutch themselves. All specimens of type at this period were printed on sheets as a broadside, and several, both English and Dutch, are in the miscellaneous collection of John Bagford in the British Museum.

The eighteenth century witnessed the end of the last of the old school of typefounders, (John) James II, who died in 1772, and the rise of the first of the new race, (William) Caslon I. Despite the restrictive care of the Government during the previous century, the typefounders of Holland and Flanders, as has been stated, supplied English printers with better types than native art could produce, and this state of things continued up to the establishment of the first Caslon foundry. Edward Rowe Mores, a learned and eccentric antiquary and scholar, was the historian of early typefounding, and his "Dissertation upon English Typographical Founders and Founderies" was published in or about the year 1779, after his death. He was born in 1729 at Tunstall in Kent and died in 1778 at Low Leyton, and thus did not live to see the publication of his work. He was in possession of nearly all the early English matrices and moulds. These were sold by auction in 1779, and it is not known what has become of them. In or about the year 1750 a foundry was established by Baskerville at Birmingham, but it is doubtful whether any specimen-book of this foundry was ever issued. The plant was ultimately sold to Beaumarchais and removed to Paris, where it was probably absorbed by one of the large Parisian foundries.

About the middle of the eighteenth century there were working contemporaneously John Baskerville at Birmingham, the Caslons in London, and Alexander Wilson at St. Andrews, Scotland.

Alexander Wilson, Professor of Astronomy to Glasgow University, with John Baine, started, at St. Andrews, the first foundry in Scotland, in 1742. In 1744, they removed to Camlachie, and started the Glasgow foundry. In 1747 Baine went to Dublin and started a branch foundry in that city. He returned to Scotland in 1749, dissolved partnership with Wilson and went to America, where he died in 1790. In 1749 Wilson, who had remained in Glasgow, was carrying on his foundry alone, and there he produced some of the finest founts of type ever cut, faces which, in the opinion of most competent judges in many quarters, were unsurpassed in some respects by even the best productions of Caslon himself.

On the death of Wilson the Glasgow foundry was carried on by his two sons. In 1830 it descended to the grandsons of the founder, Alexander Wilson and Patrick Wilson, who established a branch at Edinburgh in 1832 and transferred their Glasgow business to London in 1834; in 1845 the plant of these foundries was dispersed by sale to various founders.

Some time before 1809 the firm of Miller and Richard was started in Edinburgh by Miller, a typefounder, who had been employed by Alexander Wilson & Son of Glasgow. The first specimen book of this firm was issued in 1809.

William Caslon, born in 1692 and died in 1766, the most celebrated figure in connexion with type production in the history of the art in England, is reputed to have cut his first punches as early as 1716; he ultimately brought the art to a perfection previously unattained in England, and rendered the English printers independent of the Dutch punch-cutters and founders from whom it is admitted they had previously obtained all their best founts. The authors have seen it stated that his punches are in use to the present day.

With regard to the present principal English typefounders, it is worthy of remark that practically all of them have sprung from William Caslon, his apprentices or his successors. This being the case, it is hardly necessary to give any further historic reference to firms that are still in existence. Moreover, with the exception of the central stem to which all their pedigrees can be traced back, their individual pedigrees are of such recent date that their history is practically a matter of contemporary record.

Those who are interested in the history of the early English typefounders can find everything of interest in connexion with them, their lives and work in the work of Talbot Baines Reed, "A History of the Old English Letter Foundries," London, 1887, to whose careful and critical work in the "untrodden bypaths of English typographical history" the authors here render their fullest measure of indebtedness and appreciation.

One of the difficulties in writing this book—a difficulty already referred to by the authors in their preface—has been the difficulty of omission. Endless points of importance as well as of great interest have sprung up during the course of its production, which they have been obliged to exclude as not strictly bearing upon the production of a typographical printing-surface though having close connexion with it. They therefore again apologize for any apparent omission, and again state not only their readiness to hear any suggestion, but their willingness to profit by it, should a reader find any subject connected with the production of the printing-surface, or some matter sufficiently closely allied to and bound up with it, that has not been included in the pages of this work.

It is now, perhaps, just beginning to be felt that a printing-surface may not always be necessary as one of the processes preliminary to the multiplication and spread of human ideas. This question of the future is considered a little further on.

With regard to the production of the modern typographical printing-surface—already so largely created by mechanical means, such as some of the various apparatus described in the work—it does not appear probable to the authors that the old method of casting single type and composing by hand will ever be entirely superseded by machine-composition ; the bulk of display work and a large portion of scientific works cannot be so treated on account of the great variety of sizes of type required on the one hand, and the great variety of sorts required on the other. In the case of most daily newspapers the whole of the ordinary matter, with much of the small-type advertising, is set in the form of slugs, the only exceptions being those advertisements supplied in the form of electro-blocks and that portion of the display advertisement matter which cannot profitably be set up on the machine. One or two of the high-class daily journals are using loose-type machines, and several newspapers within the authors' knowledge are still composed by means of a supply of cast type used cold with a simple typesetter.

The authors have frequently had occasion to notice the poor results obtained by the mixture of old with new type ; this result is, however, quite avoidable by the use of composing machines and fresh type cast either in the form of slugs or in that of individual type. For the period when "The Times" was supplied for each issue with fresh loose type from the Wicks machine, that journal had, in the authors' opinion, the cleanest appearance of any printed sheet of the kind. Probably the advent of cheap accurate type with a simple composing machine and a thoroughly practical automatic line-justifier would enable such a result to be obtained in the future even in face of the competition of the slug and other machines.

The biggest question affecting such a scheme as that suggested is that of plant. If there were only three widths of faces, condensed, standard, and extended, for each body, there would still be some twenty-one type-moulds and seven space-moulds required for ordinary work, from nonpareil to pica ; but there are modern and old-style and other varieties of face required which must be suitably distinguished from each other by a different arrangement of nicks, so that, in all, the number of moulds may soon exceed a hundred and the matrices will run to many thousands. Apart from the capital outlay on these, there would be the work of originating faces, so that a considerable amount of time, as well as money, would have to be spent before achieving any tangible result.

A very large quantity of high-class work for the better weekly periodicals, for magazines, for novels and for text-books is still being set by hand, but it is probable that most of this work also will be performed by machines in the near future because they give a better and more regular product. One word of caution, however, is offered by the authors to those who think of competing in the field covered by these machines. Their details are so complex and the difficulties met with in working them out are so numerous that the time for which a patent is granted may easily be in greater part, if not altogether, absorbed in experiment before a commercial result is obtained. The outlay of both time and money must necessarily be very large before any real improvement can be made.

In conclusion, it may be of interest to record a conservative estimate of the approximate number of machines of the two most important classes in use at the present time :—

Linotype machines	about	33,000
Monoline machines	,,	2,000
Typograph machines	,,	4,000
Monotype machines	,,	5,000
Total about . .		44,000

These machines alone represent a capital outlay of over £20,000,000, apart from the sum invested in the works for producing them and their accessories.

Some 30,000 of these machines are at work in the United Kingdom, America, and other English-speaking countries, while the remainder are mainly used for other European languages, or languages current somewhere in Europe, amongst them being French, German, Dutch, Italian, Spanish, Danish, Norwegian, Swedish, Bohemian, Russian, Roumanian, Polish, Slavonic, Hungarian, Hebrew, Yiddish, and Arabic.

When one regards the wonderful development of the composing machine that has taken place in the last few years, it is very hard indeed to set bounds to its future, especially when one considers the immense amount of technical skill of a superexcellent quality that is being combined with the best brain-work in this department of human activity.

The statement that it is probable that the use of loose type cast separately and then composed, will never go out, may itself have to be modified in view of some of the developments that are taking place. A machine of the future —and such machines are not even now unthought of—may be capable of setting up any advertisement ever likely to be demanded, and, moreover, when the number of copies is sufficiently great to warrant the outlay for matrices, to be capable, at least to a certain extent, of producing illustrated advertisement matter.

Abandoning, however, any idea of entry into the field of advertisement, and returning to the question of the production of a printing-surface of plain straightforward matter, it is of interest to see what is in the mind of capable and thoughtful men.

The opinion of an authority like John S. Thompson whose experience in the field of composing machines, both practical and theoretical, is so wide, and not only wide but deep, must always be regarded with respect ; and as it is his carefully considered pronouncement that the machine of the future will unquestionably be one which casts, sets, and justifies single type in one machine and with but one attendant, and in one operation of casting, it is not for the authors to dispute it, as it coincides entirely with their own opinion. The distinguished authority they have quoted adds that such a machine would not only be a wonderful advance in every way, but that it would find a fallow field notwithstanding the very large number of typesetting machines of various kinds that are already in use throughout the world. Such a machine, casting its whole line of justified, separate, and loose type in one operation, and working with the absolute ease, swiftness, and precision of, say, an ordinary Linotype, especially if at the will of the operator it can cast either a slug, or a line of loose type perfectly justified and delivered, as the slug, to galley, has certainly a very ready welcome awaiting it. What the machine will be when it has had, like the Linotype, a score or two of years of the keenest engineering ability, specializing in that particular line, devoted to its improvement, is hard to tell. Possibly the glorious simplicity of the compositor and a pair of cases previously referred to in this work, may give place to a machine which will be capable, at the touch of an operator, of casting any type from 5 to 72-point, and not only setting it up in line and justifying it, but setting it up in any form desired for advertisement or display.

The idea, and it is one which it is not impossible to carry out, has occurred to the authors, of a machine whereby in answer to a system of spelling into a form of telephone receiver, of particular sounds, a slug or line of type could be produced as it is to-day produced where the letters on the keyboard have been touched by the fingers of the operator. It is, however, unlikely that such a method would be as rapid as the operation of a keyboard.

Photography, moreover, though so far it has not gained any real foothold within the portals of typography, is yet knocking at the door. It certainly has a future for purposes of illustration in conjunction with sound, for telephones, phonographs, and similar instruments will be accompanied by pictures, probably thrown on to a ground-glass screen beside them or into some form of stereoscopic instrument, and mechanical speech together with these pictures accurately representing facts, scenes from nature, or mundane occurrences fixed in momentary appearance or represented in continuous action will largely take the place of the present newspaper. From the carefully synchronized cinematograph worked in combination with a gramophone or auxetophone at music-halls and picture palaces to appliances ready for immediate use—as are the telephone and dictaphone—the step, experience tells us, is not a long one.

It may also be as well to recollect, even in a work devoted to the mechanism and apparatus for the production of a typographical printing-surface, that it is not altogether outside the bounds of possibility that in the future the printing-surface itself, such as the authors have considered it, may cease to exist except if we are to consider as a typographical printing-surface one which is only an automatic record of sound itself and not a combination of symbols conventionally and arbitrarily arranged and the reading of whose conventional and arbitrary meaning we translate into sound. It is possible in the not-far-off future that in civilized centres practically almost all printed matter not required to be put by and used for reference, will be done away with, and its place taken by pages that talk. It is quite probable that the future citizens of civilization will be able to turn on any portion of their morning paper at the breakfast table and listen to it as comfortably and with as little wonder as we to-day listen to the marvel of the electrophone.

This idea, which has probably occurred to many and possibly been often expressed in writing before, is only an extension of what has already taken place with regard to sermons, speeches, musical production of all kinds, and in connexion with the plays and performances of the legitimate stage and the variety theatre. Illustrations, as has been said, will probably accompany sound, and in addition to private lines and private tapping of sources of news, great public newspapers will display their changing notifications of contents and vivid advertisements to crowds too accustomed to marvels to wonder at the miracles that form a part of the ordinary affairs of their daily life.

The bare sides of great buildings and hoardings are at present clothed with advertisement in a comparatively simple manner; the uses to which they will be put in the times to come, if we base our conjectures on the changes witnessed in the past few years, would certainly appear to us as astounding, were we suddenly to see them to-day.

These things, however, for the future. Not yet have we "ransacked the ages, spoiled the climes," not yet have we arrived at our full inheritance, nor will we ever do so; constant progress is the law of life, and man must progress unless some great cataclysm cuts off the race, leaving, maybe, but a few pairs to repeople under changed conditions, a changed earth!

APPENDIX I.

BIBLIOGRAPHY.

"Books are indeed like friends, but the volumes in a man's technical library are more; they are not only friends, but dear counsellors and advisers, helpers upon whose aid and wisdom a man can rely; their presence makes him rich; their loss no weight of gold can replace; they are partners whose mouths speak for him with 'the adversary at the gate.'"

John Philips. *Wanderings in the World of Science.*

9-point Monotype (Wm. Clowes & Sons).

In the very short bibliography that follows, there have only been included books which treat directly or indirectly of the production of typographical printing-surfaces either as their sole subject-matter, or as in considerable part their subject-matter. The work of the authors being one on the production of the typographical printing-surface, they have as far as possible kept themselves within the terms of their reference, and it is surprising how very small is the number of books which come within it, even in part. Had their book been one on printing, their bibliography would have run to scores of pages. A small book-case will easily contain all the books on typographical printing-surfaces; quite a large library would be required to give shelf room to books on the more frequently treated subject of printing or the art of dealing with the typographical surface after that surface has been produced.

Moxon, Joseph. Mechanick Exercises. 1683.
Fournier, Pierre Simon (le jeune). Manuel Typographique. 1764.
Mores, Rev. Edward Rowe. A Dissertation upon English Typographical Founders and Founderies. 1778.
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Leclerc, E. Typographie (Manuel Roret). Paris, 1897.

Wilson, F. I. F. Stereotyping and Electrotyping. London, 1898.

Oldfield, A. Practical Manual of Typography. London, n.d. (about 1900).

De Vinne, Theodore Low. The Practice of Typography. Vol. I: Plain Printing Types. New York, 1900.

Hermann, C. Geschichte der Setzmaschine und ihre Entwickelung bis auf die heutige Zeit. Vienna, 1900.

Thompson, J. S. The Mechanism of the Linotype. Chicago, 1902.

Fournier, Henri. Traité de la Typographie. 4th ed. Paris, 1903.

Thompson, J. S. History of Composing Machines. Chicago, 1904.

Sir Henry Bessemer, F.R.S. An Autobiography. Published by "Engineering," London, 1905.

Legros, L. A. Typecasting and Composing Machinery; Proceedings of the Institution of Mechanical Engineers. London, Dec. 1908.

For short papers in the engineering press see *The Engineering Index*, Vol. III, 1896–1900, Vol. IV, 1901–1905, *et seq.*, under Typefounding and Typesetting Machines; such publications as *The British Printer*, *The Caxton Magazine*, *The American Printer*, *The Inland Printer*, *The International Printer*, *Deutscher Buch- und Steindrucker*, etc., the 40,000th number of *The Times* (10 Sept. 1912), and also the article on Typography in the *Encyclopædia Britannica*.

APPENDIX II.

BRITISH AND AMERICAN PATENTS RELATING TO THE PREPARATION OF THE TYPOGRAPHICAL PRINTING-SURFACE, TOGETHER WITH A BRIEF NOTE ON EACH PATENT.

"It is not a bad definition of man to describe him as a tool-making animal. His earliest contrivances to support uncivilized life, were tools of the simplest and rudest construction. His latest achievements in the substitution of machinery, not merely for the skill of the human hand, but for the relief of the human intellect, are founded on the use of tools of a still higher order."

Ninth Bridgewater Treatise. Charles Babbage.

10-point booklet.

"Sometimes, when we ponder over the fate of inventors, we give way to despairing reflection on the wastefulness of genius, or else we deplore the melancholy contrast between intelligence at its finest and material prosperity at its lowest. But we must not seek to measure spirits touched to fine issues in commercial scales of loss and gain. A man's life does not depend on the abundance of the things he possesses, nor yet does humanity advance solely on lines of physical comfort and ease. A great thought never dies. Ideas govern the world."

Daily Telegraph : leading article on the death of Charles Tellier.

9-point old-style.

In their preface to this work, reference has been made to the magnitude of the task undertaken by the authors in the endeavour to furnish a complete and reliable list of patents bearing on the subject-matter of their treatise, and issued by the patent offices of the two greatest Anglo-Saxon communities.

Had they appreciated all the difficulties of the task they had set themselves, it might possibly never have been attempted. The mere physical labour expended in handling books has been sufficient to lay the brickwork of an ideal home; the time expended has been out of all proportion to that spent on other portions of the work, and the trouble and work involved have been both tedious and wearisome. The affair, however, has been fought through and carried, the authors hope, to an issue which, if not entirely satisfactory, is at least more nearly perfect with regard to the subjects of which it treats, than any other list or classification, national or private, known to them. The early patents themselves are terribly incomplete and not classified. They have, however, been examined one by one, and so far as the subject-matter of this text-book is concerned, the authors do not think that anything of importance has been omitted.

One of the troubles they encountered in their quest was the arbitrary way in which early attempts at classification were made and abandoned by patent office authorities. A bad, but continuous and consistent classification would have been much better than different attempts at good ones. The system of combined dates and numbers is, in the authors' opinion, not a wise one.

Our British Patent Office began well by numbering patents consecutively irrespective of the date. This system was continued until 1852, when, having reached, say, a total of fifteen thousand, some person, miserly of figures, changed the system to one of rotational numbers for each year. The result of this was that instead of the natural expansion of the numbers up to seven figures—a number of digits not likely to be exceeded before the end of this century, if retained—the simple system was abandoned and the other system introduced, which has the disadvantage of a varying number of digits in the reference and a larger total number once the numbers exceed ten thousand in any particular year. It is, moreover, more lengthy, because it is necessary to separate the year from the patent number by a comma or space, or by the word *of*, and it has led to that worst of all abominations, the introduction of abbreviation into the dates in the attempt to keep the references within workable limits.

The endeavour to include a complete list of American patents gave the authors a very large amount of extra work, and was the cause of much expense. As it stands, they cannot guarantee that the list is accurate, seeing that the information in regard to the early patents, before a superior system of registration and numbering was introduced, is as chaotic in the United States Patent Office as it is in our own. Much time has, moreover, necessarily been spent in ransacking outside papers and possible sources of information, such, for example, as the records and lists of the Franklin Institute, and various official letters transmitted to and ordered to be laid upon the tables of the House of Representatives. The list here presented is believed to be as nearly complete as is now possible, and the difficulties of its compilation will be evident when it is mentioned that the authors are not aware of any American work in which there has been an exhaustive attempt to take the subject in hand. So far as they are aware, the best and most complete list given in an American book is that in Thompson's "History of Composing Machines": this list, however, only starts from 1842, as regards United States patents, though four British patents of earlier date are quoted; even this list has been found by the authors to be frequently so far from correct that the total errors amount to an average of several on every page. This, perhaps, is not so much the fault of the compiler as that of his sources of information; moreover, the scope of the writer's work, as its title shows, is more limited in the matter with which it deals. These remarks are made in no captious spirit by the authors, for here, as elsewhere in their work, their fullest acknowledgments have been given to the value of J. S. Thompson's unique book, but are simply made for the sake of accuracy, an especially important matter when dealing with questions involved in patent matters.

With regard to the American enumeration, the early years are dependent on date and name alone for identification; in later years a system of numbering was introduced. Moreover, the sizes of the paper on which the patents themselves were printed, were not standard, and in some years they jumped up to such inconveniently large dimensions that they cannot now be kept upon the same shelves with the other volumes. It is remarkable, too, that about the time that the British Patent Office made its change for the worse, the United States Patent Office took a turn for the better, and adopted the system of consecutive numeration.

Another difficulty that arises when the attempt is made to produce a continuous and consistent list of patents, whether British or American, is the continuous inconsistency of both patent offices. Patents are not infrequently recorded under the names of the patent agents employed by the patentees, the names of the patentees being sometimes given in brackets after the patent agent's name, the patent agent being sometimes quoted as "—— for ——". In the United States patents, the matter is still further complicated by the introduction of the names of assignees. The authors have in their lists throughout excluded the names of all but the actual patentees, with whom they are alone concerned, except in cases of those communicated patents in which the name of the actual inventor is not quoted. In dealing with British patents from the year 1852, it is necessary to remember both date and number for reference; in dealing with American patents, the number alone is sufficient after the year 1839.

It is, however, a matter of considerable complexity to endeavour to trace any American patent back through its earlier stages of invention, when it is remembered that there is not only the actual number given to the patent when issued, that is to say, one of the numbers given in these lists, but the number of the application, the serial number, or even the number of a reissue, where such exists, each of which may be quoted indiscriminately by the patentee.

Patents should either be numbered when they are handed in, or numbered when they are issued. The British Patent Office in this respect has the best and simplest system, as it numbers its patents when they are handed in. The United States Patent Office, while professing to number its patents when they are issued, introduces a further complication by the use of the other numbers mentioned in the preceding paragraph. In the course of application the United States Patent Office often divides the patent applied for into different heads, and compels the patentee to take out different patents, all of which have the same root or application number; in one instance the authors came across a patent which had over fifty divisions.

Enough, however, has been said to give the reader unacquainted with the subject some idea of the difficulties which occur in any extended analysis of the patents of the two countries mentioned.

It may be observed that some of the earlier British specifications are annotated in the list at greater length than any of the later ones, the reason being that in these earlier patents, there is practical anticipation, or at least the germ of anticipation, of many of the greatest and most far-reaching inventions in the history of the printing-surface; in fact, it would be difficult to say what has not been anticipated, perhaps not definitely in law, but without doubt in imagination if not in actuality. This truth is very interesting, and will be plainly evident to any who take up the task of following and studying the labours of the early inventors, as has been done by the authors. In some few instances individual cases have received note and comment.

The authors of this work, in making the above statements, have no wish to appear dogmatic, but rather desire to call kindly attention to those always fertile and frequently great minds which have trod before them the fascinating but hard and thorny pathway of invention, and to render tardy homage and tardy justice to their fellow-men from whom in so many instances justice has been withheld and homage has been filched.

BRITISH PATENTS.

LIST OF SPECIFICATIONS OF BRITISH PATENTS RELATING TO THE PREPARATION OF THE TYPOGRAPHICAL PRINTING-SURFACE.

The priority of British patents up to 1853 is determined by the consecutive number; from 1853 by the application number and the year, usually written thus: 2216/1854.

When it has not been possible to find the name of the inventor, that of the inventor's agent is given in italics.

No.

1617.

1 Rathburne, A., and Burges, R. To make, describe, carve, and grave in copper, brass, or other metal maps of the Cities of London, Westminster, York, Bristol, Norwich, Canterbury, Bath, of the Universities of Oxford and Cambridge, and of the castle of Windsor . . . and to imprint or cause them to be imprinted.

2 Hillyard, N. Printing likenesses. To make, grave, and imprint pictures and representations of members of the Royal Family.

1767.

888 Fougt, H. "New and curious types . . . for the printing of music notes."

1771.

999 Moore, I., and Pine, W. "Metal cases for holding type," band stamp.

1778.

1201 Johnson, H. "A method of printing with types or figures so connected as to prevent the possibility of error in all business where figures are used, particularly of taking down the numbers of blanks and prizes in the lottery. Performed by means of types of figures cast in a body so as at one impression to form any number or numbers, figure or figures, without being liable to the usual errors of misplacing, inverting, or substituting . . . said types may be made of iron, lead, brass, copper, or other metal, and when used are placed in a frame in a common printing press." Stereotyping.

1780.

1266 Johnson, H. "A method of casting and moulding types for the purpose of composing and printing by or with entire words, with several words combined, with sentences and syllables and with figures combined, instead of the usual method of composing and printing with single letters, and of rendering the use of the said types and printing with the same easy and familiar to the most ordinary capacity, whereby other species of printing may be executed in one-fourth part of the time in which they have been usually executed and consequently at much less expense . . . and such syllables and words are formed or

No.

moulded either by single letters cemented together in words with the same metal or else by forming matrices of such syllables and words and casting them therein." Logotypes.

1784.

1431 Foulis, A., and Tillock, A. "A method of making plates for the purpose of printing by or with plates instead of the movable types commonly used . . . whereby a much greater degree of accuracy, correctness and elegance will be introduced in the publication of the works both of the ancient and modern authors than had hitherto been attained. Performed by making a plate or plates for a page or pages of any book and printing from these at the press instead of throwing off impressions from movable types as is usual. Forming moulds or matrices for the page or pages." Stereotyping.

1435 Arnold, S. "Printing vocal and instrumental music of all kinds in a neater and more expeditious manner than has hitherto been used, all notes, characters, etc., used in music cast as types. Some notes cast together from two to six in one piece. The music is sometimes printed at once, sometimes at twice. The lines are sometimes cast with the notes, sometimes without the notes, this depending on the nature of the composition of the music."

1790.

1766 Barclay, R. "Making punches for matrices of printing types;" uses a natural fracture to prevent forgery.

1792.

1852 Wilson, G. Post and commercial time marker. Hand stamp or seal with rotatable disks engraved on flat face to stamp minute, hour, a.m. or p.m., day, month, and year; settings effected by hand or by a ratchet in the case of the hour disk.

1802.

2620 Rusher, P. "Improvements in the form of type to render it more uniform; effected by reducing the width of capitals and abolishing descenders in the lower case."

No.

1806.

2931 Berte, A. F. "A machine for casting or founding types, letters, and ornaments usually made use of in printing. . . . And that I do in preference form my vessel of the figure of a box, or closed receptacle having a pipe or tube rising out of the same, so that the pressure afforded by the statical action of the metal in the said pipe, or tube, shall produce the desired effect at the aperture or place of casting. Or otherwise I produce or increase the said pressure by the statical action of water, or any other fluid, which may be used by the well-known means to compress a body of air against the surface of the type-metal for the purpose aforesaid."

2977 Bramah, J. Improvements in the art of printing; a number of bored disks with letters, figures, or designs engraved or raised on the outer surface capable of being relatively rotated or arranged in different order on the spindle; applicable to all varieties of printing and proposed to be used for conversing machines or universal telegraphs "by which not only information may be conveyed but likewise ordinary conversation in any language may be carried on between persons stationed at hundreds or even thousands of miles distant, and that with incredible facility."

2979 White, E. A machine for casting or founding types, letters, spaces, and quadrats, and for casting a number of letters at a single cast . . . "and in or upon the face of the matrix bar . . . is a wide groove into which is fitted a metallic box or long cell capable of holding as many matrices as the machine will cast letters at a single cast."

1807.

3033 Berte, A. F. Improvements in casting machines. The vertical tube is now fitted with a plug or piston made use of to expel the melted metal through the aperture described into the mould. Also describes a mould with four adjustable pieces. When adjusted, the type is to be ejected through the length of the mould, there being no nicks.

1809.

3194 Peek, J. Improvements in casting machines, and in hand moulds which are fitted with a lever to withdraw the matrix from the type.

1810.

3307 Stuart, P. Printing maps of countries, etc., on wood, metal or other substance, so that they may be thrown off in a common printing-press for books, newspapers, etc. Performed by engraving plates and printing from these typographically so that the outlines of maps, rivers, figures, words, etc., appear white on a black ground when printed.

1811.

3439 Caslon, W., Jr. Improvements in the register belonging to the mould for casting types.

1812.

3610 Caslon, W., Jr. Short-type with dovetail end; stands in two pieces each half the body in thickness for bringing up to height-to-paper, and enabling the type to be locked up.

1813.

3734 Naish, J. Improved method of making movable characters for composing names and professions.

No.

1814.

3757 Bacon, R. M., and Donkin, B. Improvements in printing from types, blocks, or plates. Adapting and fixing the types, blocks, or plates upon a revolving axle so that the printing-surface assumes a prismatic figure.

3845 Didot, A. F. Casting type of special section for script.

1815.

3897 Ridgway, J. Simultaneously casting and fixing metallic type on the surface of metallic cylinders or blocks, for printing on cotton or linen.

1816.

4064 Clayton, R. New method of preparing, making and finishing metal types, etc. Uses a punch driven into end-grain wood, well seasoned and baked, to obtain a matrix, for making successive casts in a readily fusible alloy.

1818.

4249 Applegath, A. Improvements in casting stereotype and other plates.

1819.

4404 Congreve, Sir Wm. Inlaying or combining different metals or other hard substances; compound plates for printing the backs of bank notes in two colours; for preventing forgery.

1820.

4434 Brunel, M. I. Improvements in making stereotype-plates. Multiplying plates for accelerating the printing of daily papers; uses a composition faced with paper which is stripped off after a slight impression has been made in the matrix, but before the final impression is made. Casts under the pressure of compressed air. Cools by injecting water. "Having the advantage of a chamber, which admits of being hermetically closed, I can make use of it to obtain first a vacuum, a method which has been, I understand, practised by others, but not in connection with nor immediately followed by the expansive power of condensed air, which is productive of the best effect, and which, when coupled with the means of cooling the metal, must accelerate very materially the manufacture of the stereotype-plates in general." Also proposes to bend the moulds for casting curved plates.

4521 Congreve, Sir Wm. Printing in one, two or more colours; method of using the compound plates described in No. 4404/1819.

1821.

4594 Fergusson, J. Substitute for certain materials used in printing from stereotype-plates. Cork used instead of paper for remedying inequalities in stereotype-plates.

1822.

4642 Congreve, Sir Wm. Multiplying facsimile impressions to any extent. The type are hollow (as matrices) and are composed in the contrary direction to ordinary type; the forme has laid on it a thin sheet of prepared pewter or other soft metal, and is passed through a mangle-press obtaining a stereotype-plate direct.

4664 Church, W. "Apparatus for printing;" casting type on a multiple-mould casting machine and composing from channels filled with sorts into a raceway.

No.

1823.

4760 Church, W. Segmental types with radial faces secured by rings entering grooves on the sides, for use on rollers for printing calico, linen, etc.

4826 Pouchée, L. J. Typecasting improvements in multiple moulds and methods for ejecting the type. Uses the pump, which he states is not new.

4850 Henfrey, J., and Applegath, A. Duplex machine, with two independent pumps and one metal-pot. This is an automatic machine, and is fitted with sliding drag-pins, normally flush with the surface of the mould, used for ejecting the type.

1827.

5484 Cowper, E. Printing music by blocks and types; the block is made of three-ply wood into which holes are punched with appropriate tools and brass wire, sheet or sections, driven to project about $\frac{1}{16}$ in., subsequently filed and stoned flat; the words of songs are cut from stereotype-plates and fixed with nails.

1828.

5658 Aspinwall, T. Method of suspending the swinging table, or moving the table with parts of the mould towards the melting-pot, and bringing parts of the mould together, with a rectilinear movement of one-half relatively to the counterpart, etc., and the hot well between the plunger-barrel and the nipple.

1831.

6076 Thomson, J. Casting a cake of metal with raised characters thereon, and sawing directly and transversely into individual types.

1832.

6259 Edmonds, G. Philosophic Alphabet, or arrangement of letters, forms or figures, by which the articulate sounds of language may be scientifically denoted. Suggests forty-three characters for representing the consonant and vowel sounds used in different languages with the use of a suffixed dot below the vowel to indicate an additional syllable or with a horizontal line below the vowel of accented syllables; to be printed on opposite pages to the foreign text in its own alphabet, for teaching pronunciation.

1835.

6747 Houstoun, W. Typefounding.

1837.

7389 Woone, G. Forming plates with raised surfaces thereon for printing impressions on different substances (for printing cloth, etc.), engraves a matrix through a plaster and white lead coating to the surface of a metal plate and casts stereotypes from this.

1838.

7585 Bessemer, H. (1) Metal reservoir above mould; (2) body-slide; (3) cover-slide; (4) vacuum; (5) cold-air cooler; (6) breaking-off apparatus and separator; (7) intercepting plates; (8) counting-mechanism; (9) cut-out consisting of a brass pin connecting the driving-mechanism, of only just sufficient strength for ordinary work, to break and be replaced when jamming occurs.

1839.

8159 *Poole, M.* Casting for printing purposes. Making stereotype-matrices of paper composition with glue and successive layers of potter's earth and tissue paper.

8172 Fenillet, L. F. Typecasting machine; automatic with four or more moulds which are arranged on a rotating shaft to come alternately under each of the fillers.

No.

1840.

8427 Gaubert, E. R. Machinery for distributing types into receptacles and placing them in order after setting up.

8428 Young, J. H., and Delcambre, A. Setting up printing-types. Composing-machine with tubes for containing the type, key-operated pushers for ejecting the type singly to an inclined guide-plate, a composing-box for receiving the type from the guide-plate end (which is hinged to prevent breaking by the action of the pusher) and a packing-device for pushing the type into the galley.

8538 Edmondson, T. Printing-presses; printing railway-tickets consecutively; uses two ratchet-wheels each with two sets of figures of printing-type from 00 to 99, with an automatic advance of one tooth for each impression, and with an automatic advance of one division in the second number-wheel for each completed revolution of the first number-wheel.

8726 Clay, J., and Rosenborg, F. Arranging and setting up types for printing. Composing-machine in which the type and spaces are contained in two magazines, ejected to a common raceway by key-operated pushers and swept to the composing-box or, in a modification, received on an endless travelling belt and conveyed to the composing-box.

8743 Mabley, W. T. Producing surfaces to be used for printing (by means of voltaic electricity). Growing by electro-deposition, upon joined surfaces of metal, printing-plates or surfaces suitable for printing or impressing.

1841.

8905 Parkes, A. Production of works of art in metals by growing by electro-deposition of copper matrices for various purposes, and growing metal articles by electro-deposition in the copper matrices or moulds.

8987 Palmer, E. Producing printing-surfaces and printing china, pottery-ware, music, maps, and portraits (by electricity). Drawing or painting on copper or other metallic conducting-surfaces. etc., in such manner as to enable metallic plates with raised printing-surfaces to be produced by electro-deposition; prints may be taken from these plates as from wood-blocks or stereotype-plates.

9010 Benjamin, N. Simultaneous casting in a multiple-mould machine operated by hand. The type as cast are connected and are subsequently separated.

9022 Wheatstone, C. Causing by electromagnetic attraction marks to be made on paper and recording the time at which such marks were made.

1842.

9227 Palmer, E. Producing printing-surfaces. Coating a blackened plate of metal with a white composition and engraving through to the metal; growing up the whites with wax to obtain the desired depth in the plates to be grown by electro-deposition (typographic etching). Also deals with application of similar methods to other forms of printing; glyphography.

9300 Clay, J., and Rosenborg, F. Arranging and setting up types for printing. A distributing machine key-operated by the operator reading back from the matter placed in a galley; also improvements on the composing-machine described in No. 8726/1840.

9308 *Beach, M. S.* Tapered type for arranging radially in a wheel, formed with natural grooves and corresponding projections so as to lock in place on the cylinder.

9374 Leeson, H. B. Depositing and manufacturing metals by electro-galvanic agency, etc. and apparatus therefor.

9465 Cooke, W. F. Printing-telegraphs.

No.

1843.

9731 Mazzini, J. (Partly communicated.) Typographical printing; special fount for each new work; pneumatic casting machine and uniplane composing-machine. The type are only ½ to ⅓ in. in height. Typefounding effected in vacuo. To prevent lifting of short-type in the press the type have nicks on both sides, leads have projections both sides and holes at the ends for threading with wire.

9741 Siemens, C. W. Deposition of certain metals and apparatus connected therewith; uses thermo-electric battery.

9745 Baine, A. Electric printing and signal telegraphs.

9802 Duncan, J. (1) Spring for the injecting stroke of the pump; (2) divided fine through which the jet-pipe passes; (3) plunger of pump with contained valve; (4) radiating arms used as nipple-plates and for ejecting the type; (5) mould attached to a large bar of metal to assist in cooling; (6) the matrix, mould, arm, and jet-pipe all compressed together; (7) method of retracting the matrix; (8) use of smoothing dies; (9) manner of setting up the type by means of a setting-up box; (10) placing the lower face of the mould at an angle to facilitate delivery. Type are carried through a right angle by means of the tang remaining in the revolving arm or nipple-plate; they are then broken from the tang and pushed into the setting-up arrangement.

1844.

10219 *Woods, J.* Improvements in producing and multiplying copies of designs and impressions of printed or written surfaces; anastatic printing; process for preparing metal planographic plates, preferably zinc, from new or old designs, writings or typographic impressions.

[The anastatic process was invented by Baldamus of Erfurt, and introduced into England in 1841 by C. W. Siemens, at whose instance this patent was obtained.]

10275 *Kronheim, J. M.* Stereotyping. Improved method of forming matrices from "flanc" (flong) and a casting-press with hinged lid, swung on pivots to facilitate casting.

1845.

10543 Shaw, W. Machine for paging books and numbering documents consecutively or otherwise; printing words, dates, marks, numbers or impressions alternately (odd or even by changing the wheels), or consecutively for book-pages.

10655 Wheatstone, C. and Cooke, W. F. Electric telegraphs.

10746 de St. Charles, P. P. Cold process for making type from wire of rectangular section by means of punches for face, nick, etc.; makes two type similar or different simultaneously.

10939 Brett, J. Printing-telegraph with sending keyboard and typewheel for receiving.

10947 *Newton, W.* Improvements in machines for casting (single) types. Water circulation in lower frame of mould.

1846.

11060 Hall, G. F. Machinery for writing and booking, numbering, etc., duplicates, tickets, etc., consecutive and repeating.

11122 Woone, G. Engraving in relief (1) preparing a ground on copper using a granulating tool, protecting blacks of design and etching down to get required lightness of tint; another method (2) using a plate coated with white wax, the design when drawn is filled in with gum and vermilion and the wax removed with turpentine.

11451 Beniowski, B. Type marked with a character or figure (not reversed) on sides and lower surface of shank protected by varnish; uses spaces and quadrats some of iron, some of wood for separation by magnetic attraction or floating in water; stores type in a nest of tubes called an "authoriton" for facilitating composition; poly-composing for recurrent words; logotypes and phrasotypes (slugs of several words); producing raised type for the blind.

11455 Brockedon, W. and Hancock, T. Manufacture of articles where gutta-percha or india-rubber is used (includes forms and impressions to print from type).

1847.

11812 Lewthwaite, J. Numbering-machines. Consecutive or alternate; odd or even.

1848.

12022 Morse, S. E. Manufacture of plates or surfaces for printing or embossing; makes a direct drawing on copper, deposits copper on the lines required, backs up with fusible metal, removes from original copper and etches the fusible metal to leave the lines of deposited copper in relief.

12054 Brett, J. Printing-telegraphs; improvement on No. 10939/1845.

12137 Edmondson, T. Marking and numbering railway and other tickets or surfaces consecutively to 9999 with two number-wheels.

12229 *Mackenzie, D.* Jacquard machinery for various purposes including composing printing-types; uses a fixed curved perforated plate for an endless paper-slip with perforations to pass over; proposes to apply the band of paper, with tune punched out, to the purpose of playing musical instruments, etc.

12306 Harris, J. Improvements in typecasting machines, founding type, casting in metal, plaster, etc. Runs type-metal through the mould before completing the cast, so as to get the air into the tang.

12372 *Newton, A. V.* Casting printing-types, spaces, quadrats and other raised surfaces. Improvements in metal-pot, pumps, and details.

1849.

12421 Martin, W. The use of a continuous paper-strip with perforations passing over a fixed perforated plate, in place of Jacquard cards, in machinery for figuring textile fabrics and other purposes; of pegs sliding in a cylinder for actuating the levers of type-composing instruments, applied to the Clay and Rosenborg machine.

1850.

12995 Brooman, R. A. Types, stereotype-plates and other figured surfaces for printing from. Plating the printing-surfaces of type, stereotypes, etc.

13058 *Newton, W. E.* Casting type. (1) Slide with mould-block; (2) jobber.

13062 Siemens, E. W. Combination of a transmitting electric telegraph with a printing telegraphic apparatus, the typewheel of which is impressed on paper by a hammer operated by an electromagnet.

13063 Baranowski, J. J. Machinery for numbering; hand-stamp, consecutive for cheques, etc.

13239 *Newton, A. V.* Cutting types and other irregular figures. Improved arrangement of machinery for cutting large types or letters in wood or other materials. Pantograph with slides.

1852.

14102 Cumming, J. Production of surfaces for printing, etc., by metallic deposition (see No. 12022/1848).

14113 *Newton, A. V.* Manufacture of printing-surfaces; casting or moulding stereotypes in gutta-percha, etc., sufficiently elastic to bend for use on cylindrical printing-press.

No. **1852** *(continued)*.

14309 *Jude, H. G. G.* Manufacture of type. Uses grooves in the wire or blanks, with compression of the faces in suitable matrices and attachment of the faces to bodies otherwise finished.

325 *Johnson, J. H.* Composing and distributing type. Fig. 2, composing-machine practically identical with the Wicks machine except in the delivery. Distribution depends upon the compositor reading the type.

333 Searby, G. Machinery for cutting, carving and engraving wood, stone, metal, etc. Pantograph with vertical and horizontal movements.

342 Michel, F. A. V. Stereotyping in copper by galvanoplasty.

565 Talbot, W. H. F. Improvements in the art of engraving. Coating a metallic plate with a substance affected by exposure to light, etching protected parts on which light has not acted; also uses bichromate of potash and gelatine to obtain a compound insoluble when acted on by light; uses gauze to obtain tint.

597 Walker, H. Machinery and apparatus used in cylinder printing. Types curved to suit cylinder press, and mode of securing.

793 Johnson, J. R. Improvements in the manufacture of type or raised surfaces for use in printing. Consists in use of zinc and its alloys.

1058 Appel, R. Anastatic printing.

1853.

115 Bellford, A. E. L. Manufacture of blocks for printing music. Composed notes, etc.; corrects and takes a plaster stereotype-mould which is then sawn into by five parallel files to cut the stave lines.

189 *Newton, A. V.* Improvements in manufacture of printing-surfaces; moulds for stereotyping.

410 *Newton, A. V.* Improvements in manufacture of printing-surfaces; moulds for stereotyping in india-rubber and gutta-percha.

514 McAdams, J. Improvements on machines for numbering pages, using type chains, one chain for the odd-number type and one for even-number type, so as to print both sides at once.

566 Calles, A. Improvements in manufacturing typographic characters; typecaster.

696 Stather, J. Taking impressions in gutta-percha, shaving off the surface and printing from black relief, leaving characters in white. Applicable to cloth printing chiefly.

737 Perry, T. J. Interlocking-type for use on printing cylinders.

796 *Newton, W. E.* Improvements in producing plates and surfaces which may be used as printing- or embossing-surfaces; producing polychromatic printing-plates from an intagliographic plate.

810 Mavity, W. Improved method of manufacturing letters and figures to be used as printing-type, etc. Makes up from components.

812 Purcell, G. Method of adjustment by means of various sized spaces and quadrats. Proposes to use the pica em quad and its multiples ×2, ×3, ×4, ×5, ×6, also to use $\frac{1}{8}$, $\frac{2}{8}$, $\frac{3}{8}$ up to $\frac{5}{8}$, $\frac{6}{8}$, and $\frac{7}{8}$ths of the body. These set-widths are used for all founts so as to facilitate columnar and tabular work.

864 Urquhart, W. Cuts punches for logotypes for words or parts of words and makes copper matrices therefrom.

1164 *Bradbury, W. and Evans, F. M.* Improvements in taking impressions and producing printing-surfaces. Placing natural objects, leaves, etc., in soft lead and pressing with steel; stereotyping therefrom.

1287 Mitchel, W. H. Distributing and composing type. Type tubes vertical; horizontal rods to composing-machine. Type delivered on to travelling band and to a star-wheel, as in many later machines. Line after composition set up in galley. Uses a bridge to separate thick from thin type in distributing.

1351 Johnson, J. R. Improvements in typecasting. Straight-line presentation and body-slide mould.

1546 *Valls, L.* Improvements in the production of printing-surfaces. Uses gutta-percha for printing.

1639 Boulé, J. T. and Cailland, F. Type withdrawn by key-operated forceps fall down grooved channel; proceeding reversed for distributing.

2049 Calles, A. Improvements in manufacturing typographic characters.

2073 Grant, P. and Doherty, J. Improvements in the method of cutting and finishing brass rule and wood reglet.

2148 *Poole, M.* Improvements in distributing printers' type. Automatic distributor dealing with 30 receiving channels and distributing 25 of the characters most frequently in use; the remaining characters have to pass through the machine a second time, having additional notches cut on the back for the purpose.

2387 Applegath, A. Printing in several colours to prevent forgery by photography; applicable to bank-notes.

2413 Little, W. Improvements in typographic printing. Wedge-formed type for use on cylinders.

2464 *Bogue, D.* Improved method of producing printing-surfaces by transfer, use of bitumen, heating and repeated biting, to result in a relief on metal plates; a typographic etching process.

2481 Vizetelly, J. T. (Partly communicated.) Producing plates for printing purposes by which the manipulatory process of engraving is superseded. Taking a print or transfer on copper and obtaining required depth of whites by repeated etching.

2647 Delcambre, A. Improvements in machinery for distributing printing-type; hand operated.

2748 Feldetrappe, A. Improvements in the production of printing-surfaces. Etching process for cylinders for calico printing.

2836 Underwood, B. Printing oilcloths and other fabrics. Uses movable type, which may be formed with angular projections for fitting into grooves and retaining the type in their places.

1854.

91 Wilkinson, J. Manufacture of dies for producing printing-surfaces; draws with a pantograph on rollers, which are then etched and used to impress the design on other rollers or dies from which the printing-surface is formed.

202 de Simencourt, A. C. Composing and distributing type. Two keyboards; lower case letters and signs, 45; Capitals, small capitals and figures, 65. Type held by nippers at bottom of each tube and freed on the depression of the corresponding key. The type fall into the stick in a vertical position. The distributor is operated by hand like the Hattersley.

289 Graham, J. B. Production of printing-surfaces. The matrix of the printing-surface consists of a system of pins of suitable section bound together. The ends of all are brought to one plane. The operator depresses those pins not intended to print, leaving a relief surface; or a mould may be taken from the side on which the pins project.

316 Boileau, E. Producing raised printing-surfaces. Uses type for various parts of patterns and sets up characters suitable for the different colours in different chases which are printed consecutively for reproducing plaids and other patterns.

462 *Keenan, J.* Improvements in printing-blocks or surfaces for printing. Veneers of thin felt sawn out and mounted.

No. **1854** (*continued*).

556 Devincenzi, G. Improvements in producing ornamented and figured surfaces and surfaces for printing from objects placed in annealed copper and subjected to heavy pressure.
581 *Newton, A. V.* Improvements in the manufacture of raised printing-surfaces, cut out from thin felt and glued to block or cylinder.
661 Perkins, J. Improvements in metallurgy, specially applicable to the production of type, etc. Depositing a thin shell on gutta-percha moulds, and backing up with alloy.
662 Perkins, J. Producing block-surfaces for calico and other printing, by patterns of strip-metal placed on a tinned brass plate heated to secure them by soldering.
763 Devincenzi, G. Improvements in producing ornamented and figured surfaces and surfaces for printing by subjecting annealed metal to pressure and subsequently hardening it.
817 Johnson, J. R. Improvements in manufacture of type and other raised surfaces for printing by use of harder alloys, using little or no lead.
835 Trouble, L. M. Stamping apparatus or auto-peritype; hand-stamp for Post Office.
868 Devincenzi, G. Methods of producing engraved, figured and typographic surfaces for printing, using a limited number of types.
937 *Newton, W. E.* Improvements in machinery for casting type; jobber.
1110 Theiler, M. Printing-telegraphs. Typewheel or two typewheels with relief characters, a hollow inking-roller and paper-presser operated by electro-magnets.
1225 Whitehouse, E. O. W. Effecting telegraphic communications; typewheel printer.
1228 Taylor, I. Manufacture of metallic shells for calico and other printing; cylindrical.
1256 Atkinson, D. Transfer printing-press; cylindrical.
1548 Wiberg, M. Construction, setting-up and distribution of types for printing. Uses pairs of channels for each character in the composer, multiple-unit set widths and different positions and size of nick in the back of the type for distributing.
1554 Brindley, E. H. Ornamenting china, earthen-ware, and glass; printing with elastic blocks.
1582 Fontainemoreau, P. A. le Comte de. Zincography; producing relief zinc plates by etching.
1648 Delaye, P. V. Printing-blocks. Forms blocks as parallelepipeds some higher than others to produce one or more colours.
1720 Cunningham, J. Uses Jacquard card for depressing pins on type forming part of a printing-surface. (An improvement on 289/1854.)
1737 White, C. Printing-blocks of wood for printing ornamental or decorative paper.
1932 Mitchel, W. H. Apparatus for distributing type; shuttle and follower.
2021 Cunningham, J. Preparation or production of printing-surfaces. (An improvement on 289/1854.)
2112 Hare, C. B. Mode of manufacturing printing-blocks of wood with two systems of equidistant grooves at right angles to each other; the spots are removed except such as correspond to the required colour.
2134 Crossley, T. An improved mode of manufacturing printing-blocks. A similar method to that of No. 2112/1854, but the prepared block is impressed on gutta-percha to bind the spots together and prevent warping.
2216 Scheutz, G. and Scheutz, E. Machinery or apparatus for calculating and printing the results of such calculations. Machine with a set of calculating wheels each of which can be turned backwards or forwards at pleasure. The wheels representing even differences turn in one direction, and those representing odd differences in the other, while the calculating wheels which represent tabular numbers are at rest. The figures on these latter are reproduced by typewheels which may impress the tabular terms in lead or in a stereotype-matrix. The calculating wheels have as many teeth as the system of rotation they represent—sexial, decimal, duodecimal, etc. The machine consists of three parts: the calculating-apparatus, the printing-apparatus, and the numerator which is confined to quantities increasing by unities.
2366 Siemens, C. W. Electric Telegraphs. Preparing and punching the paper with single or double holes and an appliance for perforating with two punches which may be depressed singly or together.

1855.

501 Tardif, E. Hand numbering-stamp; consecutive or repeat; zero figure removable on all but units disk.
875 Johnson, J. H. Moulding rubber-type.
1383 Little, W. Curved stereotype- and electro type-plates used.
1478 *Besley, R.* Type-metal of lead, antimony, tin, nickel, cobalt, copper and bismuth.
2084 Scully, V. and Heywood, B. J. Type-metal, of aluminium.
2104 Dellagana, J. Stereotypes cast type-high and hollow.
2380 Beslay, M. Filling electrotype-shells with molten metal.
2385 *Rascol, E. H.* Typecasting and trimming machine.
2571 *Newton, A. V.* Making and backing up electrotypes.

1856.

717 Halvorson, H. Material for making type which will print in colour.
822 Hogg, J. and Napier, J. Stereotype; casting from flong and plaster.
886 Coulon, L. P. Simultaneously composing and distributing type.
1113 Beniowski, B. Logotypes of loose-type cemented with shellac.
1267 *Newton, W. E.* Securing types on rotary printing machines.
1871 *Newton, W. E.* Typesetting and distributing machine.
2067 Duchateau, A. E. Automatic hand-stamp for consecutive numbering.
2444 Delcambre, I. Typesetting and distributing machine.
2872 Négre, C. Producing a relief plate by electro-deposition of copper on a gold or silver plate bearing a photograph in bitumen.
2968 Littlewood, G. Type drilled at end and raised on shouldered pins for printing geometric patterns.
2980 Gerhard, F. W. Type made of aluminium.
3089 Alden, T. Typesetting and distributing machine; horizontal wheel with radial tubes.

1857.

155 Mitchel, W. H. Type-distributing machine; with ratchet-wheels for receiving and packing the type in channels.
223 Constance, F. Typecasting and trimming machine.
481 Foucher, L. L. Typecasting and trimming machine; mould of two main parts adjustable.
725 Juvin, E. J. N. Electrotyping and backing up.
1087 Schaub, G. Casting stems on electro-deposited type-heads in a multiple-mould and subsequently separating.
1371 Vanderborght, M. J. Typecasting and trimming machine.
1400 Trouillet, A. Typographical numbering-machine; consecutive, alternate, or other arithmetical progression.
1794 Hattersley, R. Typesetting and distributing machine.
2563 Robinson, G. T. Automatically dating and counting.
3052 Best, I. A. Casting shank upon an electrically-deposited face.
3057 Stather, J. Relief surfaces or printing in imitation of wood.

No.

1858.

231 Cunningham, R. Typesetting, distributing, producing indented metal surfaces and copy-holding.
341 Schaub, G. Electrically-deposited backed type faces.
391 Galli, L. Preparing wood and stone for typographic printing.
592 Thomas, J. Paging and numbering-machine, alternate, consecutive or duplicate.
600 Müller, H. L. Typographic mosaic block of type formed as prisms of colouring material.
823 Boot, A. J. Casehardened type for printing labels.
831 McElheran, J. Etches and presses type into a wax covered plate from which a stereotype is taken.
1239 Wheatstone, C. Electric telegraph using perforated strip with three lines of holes.
1341 Young, J. H. Typesetting and distributing; ratchet-wheel collector for composing.
1758 Cunningham, R. Typesetting and distributing machine.
1852 Schaub, G. Machine casting type-bodies on copper heads.

1859.

135 Morgan, W. Type formed on cylinders for printing advertisements on pavements.
889 Yonng, J. H. Type-setting and distributing (uses airblast).
1100 Moore, D. Machine for finishing type.
1160 Hadlow, F. V. Type of boxwood.
1562 Wilkinson, J. A. Type notched on one side and with a projection on the other for cylindrical composition.
1968 Shaw, W. Numbering-apparatus, large-wheel, consecutive.
2095 Beslay, C. Making relief stamps by electrotyping.
2179 Collignon, J. V. and George, L. Logotypes of type soldered at low temperature.
2285 Lee, G. L. Design etched on stone leaving lines in relief from which a wax cast is obtained and stereotyped.
2514 Gilmer, J. B. Typesetting and distributing; the composing- or distributing-stick is applied to the end of the type channels.
2828 Johnson, J. R., and Atkinson, J. S. Type-casting and trimming machine; body-slide and ejector.
2962 Rostaing, C. S. Materials for making type which will print in colour.

1860.

215 Davis, R. W., and Davis, D. Addressing machine; chain of indented wood-blocks.
650 Young, J. H. Typesetting and distributing.
668 Shaw, P. Wooden printing-types.
1020 Berri, D. G. Hand-stamp for dating and marking.
1073 Low, W. Machine for finishing type.
1385 Cordnan, J. Coating type or stereotypes with brass.
1469 Pavyer, J. G. Machine for finishing type.
1769 Young, J. H. Typesetting and distributing; copyholders for compositors.
2249 Barnwell, S., and Rollason, A. Various vegetable and other compositions for type.
2462 Wheatstone, C. Electric telegraph. Improvement on 1239/1858.
2708 Prentiss, E. F. Silicate of soda for cleaning type.
2874 Beniowski, B. Type materials; logotypes; electrically soldering type.

1861.

349 Aggio, G. G. Stereotype-plates in one piece type-high.
465 Massey, F. E. Hand-stamp with revolvable stamp.
625 Joyce, A. J. Inserting movable type in map-printing-surfaces.
1056 Dellagana, J. Flong-matrix making in mangle-press.
1510 Napier, J. Stereotype-matrix of plaster on paper back.

No.
1603 Kessler, L., and Michiels, J. A. X. Moulding in gelatine, etc., and treating chemically to obtain enlargements or reductions.
1652 Harland, J. W. Type of horn-shavings, etc., compressed into suitable moulds.
1765 George, L. Soldering type to form logotypes.
2322 Bailey, A. H. Logotypes and logotype cases.
2484 Dellagana, J. Finishing curved stereotype-plates.
2521 Coathupe, H. B. and Waltham, F. H. Producing stereotype-surfaces.
2531 Felt, C. W. Composing, line-justifying, and distributing machine operated either from keyboard or by perforated record-strip. Uses separators and spaces of different widths. Anticipates Paige and others.
2699 Aufray, A. E. and Tabar, F. G. L. Obtaining electro-deposited plate from an engraving in slate.
3081 Debons, F. and Denny, T. Producing typographic surface by repeated etching.
3248 Harland, J. W. Type and furniture of paper-pulp, horn-shavings, etc., compressed.

1862.

38 Coryton, J. Stamping type from a travelling bar of lead.
771 Cumming, J. Typesetting and distributing by special nicks on back or front of type.
915 Caslon, H. W. and Fagg, G. Machine for breaking-off and rubbing type mechanically.
1349 Richard, W. and Richard, J. Machine for rubbing type.
2514 Johnson, J. R. and Atkinson, J. S. Machine for finishing type.
2892 Placet, P. E. Typographic surface produced by moulding from a sensitized coating of a plate; the parts not acted on by light are dissolved and the remainder is removed by gelatine adhering to paper.
3365 Hattersley, R. Distributing type, assists hand by automatically filling sticks with the distributed type; for use with 1794/1857.

1863.

251 Ward, R. Quoins; combined screw and wedge.
314 Norton, M. P. Combined cancelling and postmarking hand-stamp.
529 Hoe, R. M. Thin steel plate backing for curving stereotype-matrices.
697 Young, W. Typesetting and distributing; handling type.
986 Rafter, H. Electrotype and stereotype; combined elastic and non-elastic films caused to adhere to plate and elastic film distended for the whites.
1050 Harrison, S. Casting many type at once on electrically deposited faces.
1934 Tucker, S. D. Stereotype; matrices, and shaving and bevelling plates.
2038 Mauchain, A. Drawing in gum on a chalk or plaster plate and brushing out the whites; resembles the graphotype process.
2306 Chezaud, L. F. and Christen, H. J. Making relief plates or cylinders by pressure on engraved steel for postage stamp printing.
3065 Aspinall, A. J. Hand-stamp; consecutive numbering.
3086 Guthrie, E. (partly communicated). Hand-stamp.

1864.

71 Mauchain, A. Engraving on a wax-coated steel or glass plate, moulding and electrotyping.
664 Day, B. Drawing in non-penetrating ink on chalk plate and rubbing away whites.
970 Guthrie, M. Type cut in reverse for reverse printing.
1008 Leighton, A. Typographic surface of rubber vulcanized in a mould taken from type, woodcut, or stereotype.
1403 Flamm, P. Impression machine for stereotype-matrix composing.
1595 Hay, J. Hand-stamp for making autograph signatures with permutations of additions.

No. **1864** (*continued*).

1981 Kuhlmann, F. Reproducing crystalline designs on copper stereotype-plates.
1999 Smith, J. J. C. Type faces sawn from a slug with electrically deposited type-heads of copper.
2190 Placet, P. E. Photomechanical process producing a relief plate by electro-deposition.
3051 Albert, A. Hand-stamp with revolving block.
3198 Hay, J. Hand-stamp; improvement on 1595/1864 combined with a numbering-device.

1865.

625 Craig, T. and Carlaw, D. Numbering-apparatus; lever, consecutive.
865 Mathieu, A. Automatic numbering hand-stamp.
1252 Mackie, A., Garside, H. and Salmon, J. Type-distributing machine.
1257 Mayall, T. J. Stereotypes of vulcanized rubber.
1271 Low, A. A., Low, J. O., Lyman, E. H. R., Livermore, C. F., Richards, A. C. and Yeaton, C. C. Typesetting and distributing machine.
1277 Welch, P. Machine for finishing type.
1536 Asplnall, A. J. Hand-stamp for postmarking.
1541 Leggo, W. A. and Desbarats, G. E. Stereotypes and electrotypes by photomechanical process.
1791 Swan, J. W. Photomechanical relief plates.
1845 Mackie, A. and Jones, J. P. Typesetting.
2135 Young, A. and Young, W. Typesetting and distributing.
2303 Mackie, A. and Jones, J. P. Typesetting.
3104 Mackie, A. Typesetting and distributing.

1866.

16 Young, A. and Young, W. Typesetting and distributing.
324 Winstanley, D. Making a printing-surface of dots by applying a set of conical ended wires to a photomechanical surface; securing together and rubbing down.
988 Fraser, J. Numbering-machine, hand, consecutive.
1186 Nelson, M. Stereotype-matrix or impression machine.
1334 Dallas, D. C. Photomechanical relief plates.
1380 Cheverton, J. Graphotype process; friable-surface plate.
1448 Sweet, J. E. Flong for stereotype-matrix or impression machine.
1496 Delcambre, I. Combined typesetting and distributing machines.
1683 Hudson, T. S. Hand-stamp for postmarking.
2063 Elverson, J. India-rubber type for hand-stamps.
2303 Mackie, A. Typesetting machine.
2423 Gray, J. A. and Green, S. W. Typesetting and distributing machine.
2609 Hill, C. J. Engraving machine for copying matrices.
2704 Corey, A. and Harper, J. M. Typesetting machine.
3222 MacDonald, J. C. and Calverley, J. Moulds for curved stereotypes.
3396 Mackie, A. Type-distributing machine.

1867.

968 Disderi, A. A. Photomechanical relief surfaces.
1722 Mayer, E. H. Type-metal cast on electro faces and sawn to shape.
1776 Welch, P. Machine for finishing type.
1890 Cornélis, E. Hand-stamp for dating through inked ribbon.
2164 Mackie, A. Typesetting and distributing; simultaneously composing columns in duplicate or multiple.
2432 Knaghminsky, P., Galahoff, P., and Ossipoff, N. Typesetting and distributing machine.
2800 Hattersley, R. Type-distributing machine.

No.
3009 Bordes, E. Relief printing and perforating postage stamps.
3164 Thorne, J. Typesetting machine.
3366 Mackie, A. Typesetting and distributing machine; Jacquard principle.
3516 Cornélis, E. Hand dating-stamp; see 1890/1867.
3542 Reed, D. Material for making type of rubber, gum, etc.

1868.

25 Dellagana, J. Curved electrotype-blocks.
521 Wilkinson, W. H. Cases for logotypes of words, roots, etc.
1307 Chamberlain, E. Hand-stamp.
1343 Brown, C. Surface heating apparatus for stereotype-making.
1525 Wilkinson, W. H. Building up type from blocks united by rubber solution.
1984 Mackie, A. Typesetting and distributing machine; Jacquard principle.
2094 Bebro, M., Hopwood, O., and Elam, W. Apparatus for printing consecutive numbers on tickets.
2108 Francis, L. Stereotypes of glue and gelatine for printing on uneven surfaces.
2150 Wilson, G. R. Stereotypes of vulcanized india-rubber.
2175 Mayall, T. J. India-rubber composition for making types.
2201 Edwards, E. Photomechanical relief plate.
2225 Hannart, L. and Aubertin, N. A. Type cast in long strips and planed and sawn to size.
3136 Worster, J. Backing for stereotype-plates.
3155 Taylor, T., Rogers, E. P., and Coryell, M. Vulcanized-rubber moulds for electrotypes.
3255 Wimbridge, E. Typographic surface prepared by etching.
3470 MacDonald, J. C. and Calverley, J. Casting semicylindrical stereotypes.
3713 Bruce, D. Machine for finishing type.
3728 Mackie, A. Typesetting and distributing machine; Jacquard principle; line-justification by corrugated spaces.
3840 Lennox, W. H., Pearman, J. W., and Pearman, W. J. Stereotypes for printing music.
3956 Michel, F. A. V. Preparing electrotype-plates from a paper mould.

1869.

24 Hannart, L. Type cast in long strips and planed and sawn to size.
149 Phillips, L. B. Filling electrotypes.
306 Daw, T. G. Impression-machine.
367 Dawson, C. S. Hand-stamp; elastic surface of molasses and glue.
806 Roper, E. and Shaw, G. Chalk blocks; improvement in graphotype process.
853 Robinson, J. V. Photomechanical printing-surface.
2031 Kastenbein, C. Typesetting and distributing machine.
2456 Klein, E. (Partly communicated.) Electrolytic deposition of iron on moulds for stereotyping.
2658 Colville, D. Impressing punches, etc., on the surface of a wax-coated plate for electrotyping and stereotyping.
3358 Brown, O. L. Type-distributing machine.
3643 Buirat, S. A. Making electrotypes from type.

1870.

725 Slingerland, J. T. Typesetting machine.
797 Marinoni, H. A. Stereotype; preparing flong-mould.
1776 Cunningham, W. J. and Dabb, A. Machine for cutting type.
2427 Dunn, W. W. Typecasting and trimming machine.
2514 Norcombe, E. S. Stereotype; cutting off the git before the metal has set.
2527 Overend, J. A. T. Typecasting and trimming machine.
2562 Wright, J. W. Large cast-iron type for advertisements.

No.

1871.

321 Winder, R. Typesetting machine.
371 Millar, A. Hand-stamp for numbering automatically.
410 Slingerland, J. T. Type-distributing machine.
518 Leggo, W. A. Wax impressions for electrotypes.
600 Thompson, D. B. Type-distributing machine.
682 Hollins, M. D. Relief surfaces for printing on tiles.
996 Mackie, A. Typesetting machine.
1103 Knight, S. P. Blackleading electrotype-moulds.
1562 Barrett, R. and Wright, S. Hand-stamp for automatic numbering or dating.
2488 Mauger, V. E. Typesetting and distributing machine; magnetic type containing iron wire.
3374 Barrett, R. and Wright, S. Hand numbering-stamp; to repeat indefinitely or consecutively.
3392 Jullien, F. H. Hand-stamp for repeating number.
3490 Tickle, R. P. Bed and clips for mounting stereotypes.

1872.

55 Cunningham, W. J. Apparatus for cutting type.
552 Hattersley, R. Type-distributing machine.
706 Paige, J. W. and Reynolds, D. Typesetting machine.
1056 Greene, J. Electrotype-matrices and markers for type and logotypes.
1060 Fraser, A. Type-distributing machine.
1429 Briggs, J. G. Stereotype-matrix making or impression machine using opposed type and dies.
1626 Dawson, A. and Dawson, H. T. Typographic etching process; coated brass plate and mode of conducting paraffin for building up the whites.
1912 Young, W. Stereotype-matrix machine.
1916 Macrone, W. and Mackenzie, W. Stereotyping by plaster process.
2111 Westcott Typesetting Co. Typecasting and setting machine; casting, trimming and composing characters corresponding to key depressions.
2161 Timiriazeff, D. Stereotype-matrix machine.
2481 Gally, M. Stereotype-matrix and like machines.
2518 Lochhead, W. Stereotype; asbestos in flong.
2563 Sperry, S. D. Typesetting machine.
2768 Heinemann, L. and Muller, M. L. Typesetting machine.
2864 Kastenbein, C. Typesetting and distributing machine.
3461 Fraser, A. Typesetting and distributing machine; magazine and galleys.
3548 Young, W. Stereotype-matrix or impression machine.
3814 Green, F. M. Type-cases for music-composition.
3834 Lauder, G. (partly communicated). Stereotypes cast flat and pressed to segmental form for cylindrical press.
3839 Noad, J. Moulds for electrotype; of lead, sulphur, gutta-percha, etc.

1873.

88 Schmidt, H. Hand numbering-stamp; wheels axial with handle.
539 Noad, J. Residue from preparation of lead sulphide mixed with gutta-percha, etc., for electrotype- and stereotype-moulds.
995 Gough, H. F. Ornamental and geometric type.
1298 Shaw, W. Type cast narrow or slotted to facilitate withdrawing for correction.
1473 Kluh, S. Hand-stamp with impression stereotyped in india-rubber.
1954 Woodbury, W. B. Half-tone printing-blocks; uses netting, grained stone or fine ruled lines.
2390 Macrone, W. and Mackenzie, W. Vulcanized-rubber stereotypes.

No.
3064 Whitney, E. R. Type cut from flint-glass.
3806 Tickle, R. P. Mounting and securing stereotype-plates.
3852 Mackie, A. Typesetting machine.
4145 Bartlett, J. Rhomboidal type with bead and groove to save overhang of kerned letters; for script type.

1874.

99 Mason, T. Backing-plate for securing stereotypes.
477 Hooker, J. Typesetting machine. Electric control.
1445 Lourdel, C. Type for printing music.
1899 Miller, A. Typesetting.
1935 Dillon, T. A. Hollow type and logotypes for inkless printing by means of chemicals.
2178 Robeis and Sons, R. Machine for finishing type.
2510 Mackie, A. and Waldenström, E. H. Apparatus for perforating paper for type-composing machinery.
2627 Nall, J., Goldsmith, G., and Dilkes, J. Making type for posters and show cards from sheet metal.
3137 Winder, R. Electrically-operated typesetting machine.
3410 Shaw, W. Type-cases.
3432 Johnson, S. T. Design on lithographic stone etched to the required depth and moulded for stereotyping.
3444 Holyoake, W. R. Elastic type or type with elastic backing for printing on glass, china, etc.
3721 Smith, W. N. Typesetting machine with revolving table.
4160 Loftin, W., Koolman, W., and Isger, A. J. Curving electrotype-plates.
4485 Abercrombie, W. Hand-stamp with logotype wheels.

1875.

74 Winder, R. Type-distributing machine.
714 Brown, J. Electrotyping from indented lines drawn on thin lead or tin mounted on a yielding backing.
1231 Shaw, W. Type-cases.
1255 Holyoake, W. R. Type of soft material cemented to flexible backing, or type coated with gelatine, for ornamenting glass, china, etc.
1275 Brown, R. Cutting designs in plaster and casting a relief-stereotype direct.
1566 Hattersley, R. Typesetting machine and distributing apparatus.
1659 Trier, F. Stereotype-matrix or impression machines.
1812 Fraser, A. Typesetting and distributing machines.
1957 Massey, J. E. Hand-stamp with movable type.
2020 Richards, T. Logotypes for numbering coupons.
2073 Chapman, G. Typesetting and distributing; assisting hand.
2119 Harding, G. P. and Johnson, J. R. Stereotype-matrix or impression machine.
2168 Brooks, J. S. Making and backing electrotype-shells.
2467 Grasser, C. Apparatus for casting stereotypes.
2649 Richards, A. C. Typesetting machine.
2783 Wilson, R. Revolving disks used for ruling in conjunction with numbering-apparatus.
2965 Westcott, C. S. Typecasting and setting machine.
4153 Wells, J. L. Printing with yielding printing-surfaces.

1876.

163 Ruth, T. Stereotype surfaces of glue, gelatine and glycerine.
338 Morris, E. E. Mounting-block for stereotype-plates.
355 Bertin, L. White pine treated for use as type.
525 Heinemann, L. Typesetting and distributing; assisting hand.

No. **1876** (*continued*).

567 Pattyson, W. D. C. Type-distributing by selector notches.
1058 Mardon, H. Type-high numbering-machine; consecutive.
1255 Green, S. W. Typesetting and distributing; type-cases.
1300 Liebe, P. Type for branding and printing on rough surfaces.
1552 Fleming, J. Holding elastic type in line.
1580 Dellagana, J. Backing up flat electrotypes.
1670 Müller, M. L. Typesetting machine.
1841 Hannan, J. F. Means for preventing ink from cementing type together.
1937 Griffin, T. Large metal-type cast on wood with saw-cuts in it.
2005 Hooker, J. Typesetting and distributing machines.
2029 Foot, R. G. Hand-stamps of electrotype or stereotype.
2160 Cooke, G. K. Hand-stamp; rotating block with two printing-surfaces.
2530 Harrison, A., and Evans, J. Casting flat stereotypes type-high with ribbed backs.
2921 Otter, C. G. von. Printing records of Morse flash-light signals by typewheels on a travelling paper-strip.
3165 Bartlett, J., and Murray, W. M. Casting raised or sunk type.
3203 Phelps, G. M. Perforated strip for telegraphic transmitter with holes punched at distances to correspond to the spacing of letters on a typewheel at the receiving station.
3766 Mackenzie, J. Printing records of weights automatically on paper or tickets.
4262 Mason, T. Type cast with wedge-shaped shoulders on the jet or break.
4401 Heinemann, L. Typesetting and distributing; assisting hand.

1877.

329 Drummond, G. P. Printing on elastic surface; stretching to line-justify and photographing.
2209 Cowper, E. A. Typesetting.
2737 Reynolds, D. Type-distributing.
2985 Mason, T. Machines for trimming and finishing type.
3055 Fraser, A. Typesetting and distributing.
3383 Garbe, G. Wood-type.
3659 Bowman, T. S. Type-high numbering-machine; consecutive.
4009 Capron, E., Duvivier, L., and Ponsolle, N. Producing typographical etched plates from photographs.
4239 Delcambre, I. Typesetting and distributing.

1878.

1282 Bowman, T. S. Type-high numbering-machine with inner case; consecutive.
1420 Conisbee, W., and Morgan, J. W. Consecutive numbering-device; wheels coming through slots in table.
1979 Michaud, A. Relief surface from chromated gelatine.
2200 Lavater, M. L. J., and Lévy, A. Mounting stereotypes and electrotypes.
2289 Moss, J., Smith, J. H., and Hill, G. J. Hand-stamp for recording and receipting.
3096 Lanham, R. Apparatus for casting flat stereotypes.
3103 Richards, A. C. Typesetting and distributing machine.
3221 Griffin, S. Mounting stereotypes.
3369 Wood, J. F. R. Printers' furniture.
4447 Cooke, G. K. Flanged india-rubber type.
4921 Weston, E. Making electrotypes of nickel.
5170 Slote, D. Plate coated with plaster, or chalk, etc., engraved for reliefs and stereotyped from direct.

1879.

94 North, J. Type-distributing.
950 Wicks, F. Type-distributing apparatus.
1033 Kaiser, F., and Duplessy, A. A. Sensitized coating of plate exposed, inked and etched.

No.
1203 Clowes, E. A., and Batey, J. Improvements in machinery for coating the surface of wax or other moulds with blacklead for electrotyping.
1422 Jannin, L. E. Matrix of massicot and gelatine whence plates are made in caoutchouc, gelatine or gutta-percha.
1535 Day, B. Flexible printing-surface.
1545 Culross, D. Matrices of wax for electrotyping line-rules, etc.
1561 Bland, W. Flat stereotypes.
1611 Smith, T. W. Preventing burrs on type by machining the matrices to set width and securing hard-metal sides thereto.
1640 Wicks, F. Typesetting, distributing and line-justifying by compression of spaces.
1874 Humby, W. R., and Rose, H. Type formed by compression of steam or compressed air.
1999 Le Moussu, B. C., and Swain, J. Hard-metal veneer surface etched away for whites which are then cut deeper.
2374 McNish, T. T. Type-galley.
2706 Spence, J. B. Metallic sulphides and sulphur used for stereotype.
2808 Eisele, O. Typesetting and distributing machine.
2969 Swan, J. W. Producing photo-relief plates.
2984 Gear, A. S. Type made hollow and perforated at the sides for printing and branding.
2993 Thomer, J., and Koházy, F. Hand-stamp combined with lock for transport boxes; marking date and station.
3064 Johnstone, A. B. Stereotype-beds of T-section.
3743 Smith, W. T. Stereotype-plates and means of securing.
3770 Calonne, Viscount A. A. de. Distributing type; assisting hand.
3816 Scott, F., and Collins, J. S. Treating sensitized surfaces with water, after exposure to light, to produce relief blocks.
3853 Byles, W. P., and Allan, G. Drying stereotype-matrices.
3855 Sutherland, G. Converting a transfer to zinc into a typographic surface.
3903 Robinson, J. Hand-stamp for dating railway-tickets.
3925 Fischer, C. G., and Langen, A. von. Type-composing and distributing apparatus.
4321 Smith, W. T. Stereotype-plates and -beds.
4326 Ward, W. Preventing formation of burrs on edges of stereotypes.
4738 Petit, C. G. Typographic lined-plates from half-shade negatives.
4856 Winder, R. Type-composing and distributing.
5242 Macdongald, G. D. Successive-impression device.

1880.

356 Porter, T. J. Type-cases; assisting hand-composition.
510 Hilfiker, A. Composing and distributing apparatus.
769 Schmidt, J. Hand roller-stamps with detachable type.
863 Pearce, G., and Hughes, E. Drying flong-matrices.
864 Hepburn, J. M. Typecasting, trimming and finishing machine.
928 Reed, R. B. Stereotype-mould for curved plates.
1419 Sachs, J. J. Obtaining relief blocks from exposed chromated gelatine surfaces.
1503 Macdougald, G. D., Adie, W., Adams, G. R., and Fleming, P. Producing matrices for electrotypes and stereotypes.
1917 Bebro, M. Numbering-machine for tickets, cheques, etc., consecutive, or alternate, using two machines for odds and evens.
2190 Chaumeil, A., and Chaumeil, J. Porcelain type.
2275 Rogers, E. D. Mounting stereotypes.
2676 Fleming, J. Casting printers' leads and slugs.
2840 Hubbard, H. P. Holding curved or angular lines of type.
3024 Green, J. Type with typographic face at one end for printing, and impressed at other end for reading.

1880 (*continued*).

No.

3098 Thoma, J. G. Forming type-moulds; impression machine.
3308 Dittrich, J., and Ganty, P. Type-distributing and composing apparatus.
3345 Wicks, F. Type-distributing machine.
3346 Wicks, F. Dry-flong applied by a mangle-press with an intermediate plate.
3470 Parker, A. J. Mounting stereotypes.
3547 Myers, F. Type-plates cast from routed wood patterns for printing on wooden boxes, etc.
3623 Dittrich, J., and Ganty, P. Type-distributing and composing apparatus.
3650 Sachs, J. J. Sulphur-compound type.
3934 Thorne, J. Typesetting, distributing and feeding.
4314 Marinoni, A. H. Stereotype-plates; cutting, trimming, bevelling, routing, etc.

1881.

38 Clemens, S. L., Slote, D., and Sneider, C. Type made of bronze.
420 Faber, A. Stereotype-moulds of flong.
1339 Weylandt, A. Roller hand-stamp with vulcanized-rubber type.
1462 Wicks, F. Rotary typecasting machine.
1669 Brackelsberg, E. W. Typesetting and distributing apparatus.
1803 Weiss, L. Type and logotypes.
1924 Taylor, J. E., Allen, P., Evans, W., and Braithwaite, D. Drying stereotype-matrices.
2053 Noad, J. H. Type coated with iron.
2527 Woodbury, W. B. Pressing ductile metal into plaster moulds and backing with gelatine hardened with alum.
2674 Delcambre, I. Typesetting and distributing machine.
3012 Sachs, J. J. Type made of sulphur and slate-dust.
3191 Cooke, G. K. Rubber-faced metal-type.
3201 Rogers, A. H. Type with holes for composing sticks.
3302 Faber, A. Making flong-matrices for stereotypes.
3477 Reeve, T. Type-distributing machine.
3780 Munson, J. E. Controlling the operation of typesetting machines.
4184 Perrachon, J. E. Type stamped from a metal ribbon.
4229 Fischer, C. G., and Langen, A. von. Type-distributing and composing apparatus.
4924 Márquez, J. A. Stereotype-matrix machine.
4979 Johnson, L. K. Compositors' rule.
5081 Harrild, F. Casting type-high cored stereotype-plates.
5127 Burr, H. A. Type-nicking machine. (This patent includes composing and distributing machines.)
5133 Mössmer, J. Types with crosses or squares for printing embroidery patterns.
5478 Richford, E. M. Rubber typewheels for hand-stamps.
5746 Hanscom, P. L. Numbering-machine; consecutive or repeating indefinitely.

1882.

67 Blum, E. B. Dating hand-stamp.
303 Sowler, T., and Ward, W. Stereotypes with sunken edges to avoid the formation of burrs.
817 Parsonage, C. Making stereotypes from flong-matrices.
1260 Hagemann, H. Impression machine.
1316 Liwczak, J. Casting and composing chains of threaded type.
1628 Noad, J. Sulphur composition for making surface-printing blocks.
1876 Heuse, J. A., and Jouanny, G. Curving electrotypes or stereotypes.
2156 Meisenbach, G. Photomechanical printing; uses a hatched transparent plate moved one or more times during the taking of the negative from which a typographic block is made.
3818 Low, A. A., and Johnson, L. K. Type-cases for assisting hand-composition.

No.

3879 Brackelsberg, E. W. Composing apparatus, and distributing apparatus.
4071 Haigh, W. C. Gelatinous or rubber composition for printing-blocks for posters.
4258 Low, A. A., and Johnson, L. K. Composing and distributing apparatus.
4560 Delcambre, I., and Riesz, V. Composing and distributing apparatus.
4749 Silvestre, J. A. Nickel-plating zinc plates or stereotypes.
4789 Kolk, H. J., Gursch, C. A. J., and Klemm, C. H. J. Type-metal formed with iron; platinum, palladium and osmium used for facing the type.
5004 Saulé, E., and Durozoi, M. Type-distributing.
5474 Taylor, W. W. Mounting stereotypes.
5847 Thompson, C. H., and Thompson, C. W. Hand-stamps for recording time.
5907 Berger, E. Type-dressing machine.
6129 Taylor, J. E., Allen, P., Evans, W., and Scott, C. P. Securing movable type in stereotype-plates.
6188 Anthony, E. Curved flong-matrices for stereotypes.

1883.

997 Wyvill, F. C. Type-distributing.
1104 Cooke, G. K. Hand-stamps for band of rubber type.
1508 Marinoni, H., and Michaud, J. Trimming and shaving curved stereotype-plates.
1665 Davids, C. H. Impression machine.
1851 Lewthwaite, J. Apparatus for numbering railway-tickets, etc.
1954 Gibergues, M. de, Soc. de Typographie par Procédés Rapides. Type-cases for assisting hand-composition.
2231 Posselt, L., and Schimansky, H. Preparing flong for making matrices for stereotypes.
2439 Eaton, G. S. Type-dressing machine.
2531 Hepburn, J. M. Typecasting machine.
2676 Black, J. M. Numbering tickets, etc., consecutively.
2826 Hodgson, T. T. Mounting stereotype-plates.
2981 Ortiz, F. B. y. Impression machine.
3267 Cooke, G. K. Hand-stamps.
3476 Brown, R., Barnes, R. W., and Bell, J. Photo-mechanical relief plates of electrotype or stereotype; improvement on Woodbury's process.
3502 Wilson, G. A. Mounting stereotypes.
3625 King, T., and Wilson, R. Numbering strip-tickets.
3733 Dement, M. H. Impression machine.
3734 Dement, M. H. Breaking stereo-bars into type.
3785 Albizu, P. P. y. Typesetting and distributing machine.
4032 Heywood, J., and Ross, R. C. Printers' galleys with type-locking gear.
4114 Sauvée, A. Moulds for casting stereotypes; curved.
4350 Black, J. M. Numbering strip-printed tickets consecutively.
4576 Anders, G. L. Typesetting in a central office and distributing the news to others; electric.
4705 Brown, R., Barnes, R. W., and Bell, J. Producing by photography grained or stippled typographic surfaces.
5778 Benton, L. B. Type of multiples of standard units.
5808 Shields, T. Casting stereotypes with curved blocks in place.

1884.

246 Daw, T. G., and Daw, H. Stereotype-matrix machines.
382 Shaw, I. B., Shaw, E. S., and Shaw, W. S. Compound type for printing posters.
383 Shaw, I. B., Shaw, E. S., and Shaw, W. S. Type for transfers cast in the positive form.
385 Shaw, I. B., Shaw, E. S., and Shaw, W. S. Elastic printing-surface of printers' roller composition.
1430 Clayson, J. H. Mounting stereotypes and electrotypes.
1682 Cooke, G. K. Hand-stamps.

No. **1884** (*continued*).

1992 Laval, A. A. Moulds for typefounding machines.
3447 Moseley, C. Nickel or cobalt plating stereotype-plates.
3484 Black, J. M. Numbering tickets, cheques, etc., consecutively.
3865 James, T. Obtaining typographic impressions from photo-reliefs.
4160 Hilder, C. F., and Cotterell, S. J. A. Stereotype-matrix machine.
5408 Lowe, W., and Cavagna, D. Producing electrotype-moulds in wax.
5490 Kimberley, R. L. Stereotype-matrix machines.
5795 Titchener, O. Casting hollow quads and type-matrix delivery.
5804 Cottrell, C. B. Casting curved stereotypes and backing electrotype-shells.
5958 Bacon, W. R. Numbering strip-tickets.
6318 Fischer, C. G., and Langen, A. von. Type-distributing.
6581 Daw, T. G., and Daw, H. Stereotype-matrix machines; paper-feed.
7101 Dixon, G. C. Hand-stamp; holder for india-rubber type.
7642 Nelson, R. W. Securing stereotypes to base-blocks.
8205 Robinson, J. C. Dating, timing and endorsing stamps.
8678 Black, J. M. Numbering strip-tickets consecutively.
9800 Barker, A. J. Stereotype-matrix machine.
10139 Fischer, C. G., and Langen, A. von. Type-setting.
10525 Fraser, A. Type-distributing.
10718 Dement, M. H. Stereotype-matrix machines.
10901 Engelen, A. J. Printing-surfaces; stamping relief characters.
11670 Mergenthaler, O. Stereotype-matrix machines.
12784 Wicks, F. Rotary typecasting, and improvements thereon.
13002 Baker, A. R. Numbering-mechanism for plane or cylinder presses.
13376 Petch, J., and Marshall, J. Fudge; means for inserting type or logotypes in stereotypes.
13505 Maynes, J. Numbering railway-tickets, cheques, etc.; operates on ten rows simultaneously; drop-ciphers; consecutive.
13640 Iago, C. T. Photo-mechanical relief blocks.
13696 Palmer, W. J. Producing moulds for stereotypes or electrotypes by consecutive application of two plates for outline and shading.
14092 Smith, T. W., and Gamblen, C. J. Hollow metal mounting-block for stereotypes.
14103 Baddeley, F., and Reynolds, W. J. Hand-stamps; T-shape type with sunk letters in the large end which forms the base.
14378 Hayes, G. Tubular type.
14519 Spark, F. R. Fudge; means for inserting rapidly in stereotypes.
15246 Smith, T. W., and Chitson, R. J. Matrices laid side by side with spacing-pieces between to form phrases or logotypes.
15256 Marinoni, H., and Michaud, J. Mould for casting curved stereotypes.
15368 Oudin, M. A. P., Oudin, H. M. J., and Codignola, E. Stereotype-matrix machines.
16095 Harrap, G. T. Impression machine.
16585 McCardle, A. Mounting stereotypes; grippers.

1885.

761 Dement, M. H. Stereotype-matrix machine.
1085 Stonhill, W. J. Type of various regular or irregular forms.
1151 White, J. H., and Clephane, J. O. Stereotype-matrix strip; line-justifying by bending up between the words.
1153 White, J. H. and Clephane, J. O. Preparing printing-surfaces from a series of independent slugs bearing line-justified characters cast in a special slotted mould from a stereotype-matrix sheet.
1726 Foster, J., Foster, F., and Foster, J. Y. Type leads and rules for large-type for posters.
1833 Mergenthaler, O. Stereotype-matrix machines.
2168 Marshall, A. W., and Smith, O. J. Electrotypes for sending to papers at a distance; plate-matter.
2571 Lagerman, A. Typesetting and distributing.
2688 Brackelsberg, E. W. Stereotype-matrix machines.
2729 Wright, E. Stereotype-matrix machines.
2823 Mergenthaler, O. Long vertical bars carrying matrices of all characters, moving up and down to position before mould; Linotype machine.
5823 Mergenthaler, O. Linotype and stereotype-matrix machines; assembles lines of independent matrices.
6218 Edmondson, J. B. Renewing types in machines for dating railway-tickets.
6359 Moussu, B. C. le. Photo-mechanical relief-plates.
6398 Reinhardt, J. H., and Schmalzried, G. Type-high numbering-machine; slide in separate compartment from numbering-disks; drop-cipher.
7417 Fischer, C. G. Typesetting; assisting hand.
7635 Munson, J. E. Typesetting machine; Jacquard system.
8054 Richford, E. M. Rubber-faced type.
8457 Mergenthaler, O. Linotype machines; wedge-spaces.
8539 Colley, W. W., and Hart, M. Numbering railway-tickets, etc.; consecutive.
8995 Dreyer, W. Typesetting machines; electro-magnetic.
9782 Jones, S. Composite large-type for posters.
9854 Codignola, E. Typecasting and setting.
9899 Carter, J. R. Numbering-machine for high-speed work.
10926 Knowles, W. H. Typesetting; stereotype-matrix machines.
11528 Knowles, W. H. Plates of soft wood, end-grain, for casting stereotypes.
11648 Knowles, W. H. Type, self-justifying on a numerical basis.
11737 Welch, F. B. Producing stereotype-matrices by fluid pressure.
11894 Benton, L. B. Punch-cutting machine.
12621 Titchener, O. Improvements in casting hollow quads.
12776 Taylor, J. A. Type-cases; for large founts with logotypes.
12777 Taylor, J. A. Apparatus for double matrices for logotypes.
13328 Smith, T. Moulding-material of sulphur and ground porcelain for stereotypes.
14982 Corsam, H. Mounting stereotypes.
15516 Colley, W. W., and Hart, M. Printing and numbering railway-tickets consecutively.

1886.

1786 Whitaker, D. W., and Lyon, J. E. Galley lock; toggle levers with right and left screws.
1965 Wallace, J. S. Composing-stick, for pierced or double-notched type.
2624 Johnson, L. K., and Low, A. A. Type-cases; for assisting hand-composition.
3672 Bush, E., and Pickersgill, W. Mangle-press method for making flong-matrices, for stereotypes.
4427 Black, J. M. Numbering railway-tickets, cheques, etc.; disks have eleven faces to provide for blank instead of zero first figure.
4657 Baldrige, G. W. Stereotype-matrix machines.
4855 Peach, R. W. Double folding-wedge quoins.
5470 Buxton, J. H., Braithwaite, D., and Smith, M. Fudge; box with notched rules.
6383 Thomson, D. C. Stereotypes with engravings embedded.
7699 Carter, J. R. Duplex numbering-apparatus for both sides of paper.
7738 Leland, H. C. Type-distributing.
7942 Edmondson, J. B., and Carson, J. Dating and clipping railway-tickets.
8642 Hall, H. C. Machinery and typewheels for consecutively numbering tickets.
9000 König, E. Rules and quoins for composite blocks of type and electrotypes.
9115 Mergenthaler, O. Linotype machines and stereotype-matrix machines.

No. **1886** (*continued*).

10305 Jones, W. Numbering-apparatus; consecutive.
10522 McMillan, J. L. Typesetting machine.
10523 McMillan, J. L. Type-distributing.
10525 Mergenthaler, O. Linotype machines.
11960 Langen, A. von, and Fischer, C. G. Type-distributing.
14294 Oldfield, B., and Oldfield, W. Moulds of paper for stereotype-plates for posters.
15470 Hedderwick, P. D. Type-distributing.
16485 Law, E. FitzG. Typesetting machines electrically operated.
16802 Chossefoin, A. Type for printing music.

1887.

264 Laraway, E. D., and Bridge, E. Wood impregnated with paraffin pressed into type.
1330 Kammann, F., and Jurschina, F. Type moulded of finely ground quartz and solution of water-glass.
1411 Hall, H. C. Numbering railway-tickets, etc.
2562 Ward, E., Lock, G., Bowden, J., Lock, J. H., and Wells, H. G. Type for producing pictures or drawings.
4688 Low, A. A. Typesetting.
5271 Dallas, J. D. Typesetting; electromagnetic operating.
5420 Hogg, T. W., and Jackson, P. J. Gelatine type.
5893 Hagemann, H. Typesetting. Adding up lengths of letters and words.
6840 Lagerman, A. Typesetting and type-cases.
8176 Eastwood, G. Flong-matrices; coating and backing.
8183 Lanston, T. Type; typesetting; ribbon-controlled apparatus; type formed by compression.
8881 Smith, O. J. Mounting electrotypes or stereotypes.
9991 Little, R. D. de. "White-letter" type for setting up posters.
10162 Porte, A. E., and Ritchie, R. O. Producing effect of superposed design by using light and heavy type, etc.
11428 Carlaw, D. Numbering-machine for cheques, etc.; consecutive, with blank spaces on wheels.
12025 Law, E. F. Electrically actuating typesetting machines.
12780 Weston, T. R. Stereotype-matrix impressing device.
13984 Hawkes, J. M. Mounting-block for clamping electrotypes or stereotypes.
14517 } 14518 } Thorne Machine Co., and Thorne, J. Typesetting and distributing.
14519 Thorne Machine Co., and Thorne, J. Line-justifying apparatus.
15717 Randall, C. A. Date- and time-printing stamps; operated by electricity and clock.
16304 Hoke Engraving Plate Co. Plate with coating cut away to form matrices for stereotypes or electrotypes.
17649 Foucher, L., and Foucher, A. Typecasting machines; trimming and grooving.

1888.

88 Setchell, G. C. Dies and method of making wood-type with pantograph.
103 Davids, C. H. Numbering-apparatus; consecutive.
201 Setchell, G. C. Dies for wood-type worked in conjunction with pantograph.
202 Page, W. H., and Setchell, G. C. Dies for wood-type.
460 Statham, H. S., and Chudleigh, A. O. Mounting-block for stereotypes with dovetail grooves and catches.
2066 Lagerman, A. Typesetting.
2788 Sergeant, T. A., and Cook, W. E. Mitring leads and rules.
3221 Golding, W. H. Rules; mitring.
3270 Winder, R. Typesetting.
3323 Golding, W. H. Cutting and mitring printers' rules.
3359 Law, E. F. Typesetting; electrically controlled.

No.
3918 Thorne Machine Co. Typesetting and distributing.
4822 McClure, T., and Vivian, J. H. Two-letter logotypes.
4939 Eaton, G. S., and Birch, J. C. Type trimming and finishing.
5712 Ellis, C. S., and Sturla, J. J. Numbering-mechanism, for locking up in chase; numbers carried on chains.
5989 Buxton, J. H., Braithwaite, D., and Smith, M. Fudge; type-boxes and securing same.
7308 Randall, C. A. Date- and time-printing stamps.
7515 Bensly, F. G., and Cooper, J. Compressed-felt type.
7912 Wentscher, E. Typesetting and line-justifying.
8178 Scott, J. S., and Carroll, A. Stereotype-matrix machines.
9244 Mills, J. L. Preparing relief-printing surfaces by sand-blast.
10214 Schirm, J. W. C. C. Printing-surface of agar-agar and glycerine.
10704 Johnson, L. K. and Low, A. A. Type-cases for assisting hand-composition.
10736 Rogers, J. R. Stereotype-matrix machine. Sets type in line, uses india-rubber spaces for line-justifying, makes a matrix from it, and distributes the type.
11621 Reid, D. Method of fixing stereotypes to base-blocks.
12079 Fietsch, H., and Ryan, D. W. Mounting-blocks for locking stereotypes and electrotypes.
13378 Winder, R. Type-distributing.
14529 Keehn, F. Typefounding machine.
14845 Patterson, J. and Ashenhurst, T. R. Preparing flong-matrices for stereotypes.
15026 Petch, J. C. and Mussell, T. Fudge; rapidly inserting in stereotypes.
15666 Baker, J. Flong-matrices for stereotypes.
16026 Thompson, T. C. Type coated with glue or glycerine and treacle.
17510 Bundy, W. le G. Hand-stamps for time-recording.
18058 Dow, L. and Powers, D. Type-distributing machine.

1889.

92 Hattersley, M. R. L. and A. M. (executors of Hattersley, R.). Typesetting and distributing.
264 Sauvée, A. Casting curved stereotypes with electrotype-blocks in position.
1057 Adams-Randall, C. Date- and time-printing stamps.
1585 Johnson, L. K. and Low, A. A. Type-cases for assisting hand-composition.
2088 Dalziel, H. Mounting-blocks for stereotypes or electrotypes.
2098 Küstermann, F. H. Typecasting machines.
2506 Rogers Automatic Time Stamp Co. Date- and time-printing stamps.
3394 Martindale, W. B. Date- and time-printing stamps.
3692 Küstermann, F. H. Typecasting machines.
4421 Philips, J. Numbering-apparatus; consecutive, gear-operated on return stroke.
4481 Bräunig, J. Type-dressing machine.
6631 Manning, J. Machines for bevelling stereotypes, etc.
7007 Studders, C. and Kohl, G. Photomechanical plates; holding screens in a revolvable frame.
7146 Craven, P. P. Typesetting and distributing machines.
7147 Craven, P. P. Typesetting machines.
7637 Page, W. H., Wood Type Co. Dies for forming wood-type.
8047 Knight, S. P. Blackleading apparatus for electrotype-moulds.
8504 Tissington, R. Thin type for direct photographic or lithographic printing.
9687 Benedict, G. H. and Furlong, P. M. Preparing matrices for curved electrotypes.
10967 Petty, W. and Taylor, J. E. Locking up formes.
11346 Cummings, G. W. Galley with pivoted side for releasing type.

No. **1889** (*continued*).

12617 Thorne Machine Co. Typesetting and distributing.
14418 Higgins, J. F. Typesetting, line-justifying, and distributing machine.
14549 Wynne, W., Topliss, J. R. and Kay, J. A. Type on unit system equal to one-fourth of the em quad.
14918 Clay, R. and Marchant, J. E. Typesetting.
15291 Wynne, W., Topliss, J. R., and Kay J. A. Typesetting, line-justifying, and distributing machine.
15829 Dow, L. Typesetting machine.
16162 Thorne Machine Co. Typesetting and distributing.
16214 Shaw, C. H. Date- and time-printing stamps.
16599 Adams-Randall, C. Date- and time-printing stamps.
16907 Sinclair, D., Dobbie, J. C. and Malcolm, W. A. Hand-stamps for giving a certain number only of repetitions of impression.
17006 Reid, D. Key for securing stereotypes to base-blocks.
17229 Sturrock, J. and Macdougald, G. D. Apparatus for drying flong-matrices.
17614 Goodson, G. A. Stereotype-matrix machine.
18225 Savage, H. Moulds for producing rubber numbering- and dating-stamps.
18490 Sauvée, A. Flong for stereotype-matrices.
19446 Priddle, E. and Donovan, G. O. Manufacture of type-disks for numbering-machines.
20067 Wentscher, E. Means for correcting composed type.
20114 Priddle, E. and Donovan, G. O. Typewheels for date-printing or stamping.
20646 Cassagnes, G. A. Printing-telegraph operated by a small number of keys.
20968 Odell, J. B. Typesetting.

1890.

6 Bowditch, F. J. Type of rubber or gelatine incorporated with aniline dye; for hand-stamps.
1521 Tickle, R. P. Mounting stereotypes and electrotypes.
2490 Wehmann, H. and Muller, P. Composition for facing flong-matrices.
3053 Smith, M. Mangle-pressing flong-matrices under two rollers consecutively.
3964 Merritt, J. C. Stereotype mounting-block.
4264 Howell, W. J. Stereotype-matrix machines.
4271 Topliss, J. R. and Kay, J. A. Type of set widths multiples of one-fifth of the em quad.
4755 Wehmann, H. Drying frame for flong-moulds.
4911 Topliss, J. R. Type-distributing.
5418 Horn, W. W. Composing-sticks; adjusting movable slide.
5577 Pitcairn, D. Keyboard for typesetting; for striking several keys simultaneously.
5582 Mergenthaler, O. Improvements in linotype machines; "blower" machine; Linotype.
5902 } 5903 } Healey, R. H. Drying stereotype-matrices.
7093 Hill, J. Mounting-block for holding stereotypes.
7403 Chadwick, J. W. Typesetting; Typotheter.
7453 Goodson, G. A. Stereotype-matrix machines.
8093 Odell, J. B. Type-distributing; one key serving three different characters.
9192 Pink, T. Hand-stamps for printing amounts of £ *s. d.*
9677 Botton, G. A. Typesetting.
9705 Bath, J. Hand-stamp for receipt checking.
10008 Topliss, J. R. and Kay, J. A. Machine for grooving or nicking printing-type.
10096 Tissington, R. Flexible printing-surfaces of glycerine and gelatine, etc.
11208 Sturrock, J. and Macdougald, G. D. Drying flong stereotype-matrices.
11439 Kletzker, A. J. Stereotype-matrix machines.
12305 Ball, E. Hand-stamps of rubber for printing and copying music.
13169 Munro, F. P. Expanding quoin for locking up.
13424 Odell, J. B. Typesetting.
13427 Odell, J. B Typesetting.
13739 Glover, J. M. Time-printing stamps.

No.
13740 St. John, R. H. Bars with an edge of soft metal impressed on composed matrices; Typobar.
14173 Osborne, J. W. and Edelheim, C. Making stereotype impressions in flong by compressed air.
14257 Lambert, E. J. Numbering-apparatus; repeat or consecutive.
14582 The National Typographic Co. Improvements in linotype machines. Linotype.
15060 Rogers, J. R. and Bright, F. E. Linotype machines; disk wedge-space. Typograph.
15182 Bundy, W. le G. Time-printing stamps and hand-stamps.
15215 Dobbie, J. C. Numbering-apparatus; consecutive or repeat two or more times.
15391 Sauvée, A. Producing stereotypes with electrotypes inserted in place.
15638 Wentscher, E. Locking-up device for type-galleys.
15799 Retaux, J. G. and Medawar, J. A. Typesetting and distributing.
16391 Dillberg, G. and Philp, J. A. Stereotype-matrix machines.
17804 Fels, A. and Crowle, J. Type-holders and channels for typecasting machines.
18159 Phillips, J. and Hornby, F. Numbering-mechanism. Construction of centre of type-disk and other components.
18468 Jurschina, F. and Gunesch, R. R. von. Various substances made into a paste with sodium water-glass moulded and hardened, for type-moulds and matrices.
18478 Oldroyd, J. P. Hand-stamps for recording £ *s. d.*
18646 Lamp'l, P. J. Vulcanite and cement type for posters.
19045 Botton, G. A. Line-justifyi ıg apparatus.
19173 Mallonee, J. D. Date- and time-printing stamps.
19265 Butter, H. Supporting script on kerned type.
19529 Fraser, A. Typesetting.
20764 Jaffe, H. Time-printing stamps for workmen's cards.
20984 Corsa, G. Stereotype-matrix machines; linotype machines; typesetting.
21128 Hooker, J. Typesetting and distributing.

1891.

130 Sherwood, E. P. Stereotype-matrix machines.
672 Landsberg, V. and Kohler, P. Stereotype-matrix machines.
1951 Allen, J. H., Newton, C. D. O. and Morton, E. W. Hand date- and time-printing stamps.
2344 Johnson, F. A. and Crane, W. E. Linotype, stereotype-matrix and like machines.
2361 Alzugaray, J. B. Type of aluminium, antimony, and their salts.
2733 Hempel, H. A. and Dingens, J. A. Quoins in pairs, wedge-shaped, with rack teeth.
3092 Bundy, W. le G. Time-printing stamps for tell-tales.
3361 Electric Typographic Co. Linotype machines; stereotype-matrix machines.
3818 Hargrave, T. C. Stereotype-matrix machines.
3839 Wolfe, J. C. Mounting-blocks and furniture for electrotypes and stereotypes.
4973 Wilson, J. C. Date- and time-printing stamps for telltales.
5274 Standiford, E. C. and Hyers, S. A. Typesetting machine.
5767 Badoureau, E. Combined wood and metal mounting-blocks for stereotypes, etc.
5971 Dodge, P. T. Matrices with two strikes for casting two slugs simultaneously.
7039 English, J. C. and Burnett, R. L. Time-printing stamps for telltales.
7162 Kucharz, L. Numbering-apparatus; consecutive or repeated.
7329 Wicks, F. Typesetting machine.
8852 Flinsch, H. Type for printing script with supported kerns.
9218 Sturrock, J., and Macdougald, G. D. Stereotype flong-matrix drying-press; hot air.
9260 Gustafson, J. Typesetting; Typotheter.
9337 English, J. C. Time-printing stamps.
9797 Hoggson, S. H. and Stevenson, W. H. Types mounted on a belt for time-printing stamps.

No. **1891** (*continued*).

9979 Mitchell, A. S., and Nutter, J. Machine for numbering sheets consecutively, etc.
10620 Kerridge, T. H., Lane, C. E., and Lane, A. Type-distributing.
10647 Redfield, C. L. Machine for cutting type-dies.
11078 Godwin, B. Script type with rectangular faces and squaring-up spaces.
12750 Wetter, J. Hand numbering-stamps; consecutive or repeat.
12754 Bates, E. G. Hand numbering-stamps; consecutive or repeat once or indefinitely.
13120 Beals, E. V. Stereotype-matrix machines.
13478 Warwick, B. W. Date- and time-printing stamps operated from a central clock.
13653 Reid, D. Mounting stereotypes and electrotypes.
13728 Scott, J. S., and Mills, F. B. Linotype and like machines; stereotype-matrix machines.
14623 Ward, W. Forming stereotypes without superfluous metal at edges.
14932 Stoesser, A. D., and Stoesser, A. Backing up and curving electrotypes.
15082 Griffith, W. Sidesticks or furniture of two sliding parts.
15207 Buck, T. S. Hand-stamps.
15236 Mowers, E. P., Murray, T. P., and Grovenor, M. L. Quoins, two frames and two opposed wedges with rack teeth.
15799 Daw, T. G., and Daw, H. Stereotype-matrix machines.
16885 Auerbach, R. Numbering-apparatus with sliding box and typewheels.
17147 Mackenzie, J. W. Special nicking machines for cutting distributing-nicks in type.
17223 Wright, C. Hand-stamps for printing addresses.
17380 Kay, J. A. Typesetting machine.
18025 Otto, P. Pantograph; three-dimensional for engraving matrices, seals, etc.
18521 Retaux, J. G., and Medawar, J. A. Typesetting and distributing.
19129 Wicks, F. Matrices with body of hard-metal and strike in soft-metal.
19192 Pavyer, J. G. Machines for casting and dressing type; pivotal.
20519 Tachytype Manufacturing Co. Linotype and like machines; stereotype-matrix machines.
20920 McMillan, J. L. Type-distributing.
21373 Odell, J. B. Type-distributing.
22366 Mammen, O., Hagelmoser, R., Mosig, R., and Mosig, E. Short-types mounted on bases for printing.
22381 Symonds, F. H., and Garner, A. B. Time-printing stamps.
22475 Dodge, P. T. Linotype and like machines; supplying melting-pots automatically with metal.
22637 Leland, H. C. Disttibuting type.
22684 McMillan, J. L. Typesetting and line-justifying.

1892.

349 Marc, L. Matrix of thin sheet-lead backed with plaster for stereotypes in celluloid, rubber, etc.
416 Capelle, H. Electrotypes prepared by depositing thin copper, thin nickel or iron and backing with copper.
637 Badoureau, E. Mounting-block of wood and metal for stereotypes.
1739 Alfaro, A. Stereotype-matrix machines.
2681 Ker, W. A. Printing-surfaces produced by drawing on a wax-coated lead or card-board sheet and electrotyping.
3040 Chicago Matrix Machine Co. Stereotype-matrix machines.
3110 Hooker, J. Type-setting machines.
3936 Grothe, W. Adjustable typecasting apparatus.
5922 Claremont, C. Tinfoil pressed into a framed surface is mounted on glass, drawn upon and electrotyped.
6350 Buck, S. S. Hand-stamps.
6647 Taylor, G., and Watkinson, C. J. Casting, machining and straightening printer's leads.
6782 Michaud, J. Making and registering stereotypes combined with electrotypes.

No.
7139 Fowler, J. C. Linotype and like machines; spring-spacers.
8056 Worbey, T. G. Scales engraved upon celluloid matrices are electrotyped and used for printing.
9300 Mitchell, W. Electrically heated matrix-press for stereotypes.
9386 Bentzien, J. R. L. Recessed type for hand-stamps.
10324 Sears, C. Stereotype-matrix machine for impressing a line of characters in a matrix blank adapted for casting linotype-slugs.
11165 Linotype Co. and Place, J. Linotype and like machines; projection on matrix to preserve the strike of the preceding matrix from injury.
13524 Hilder, C. F. Type-distributing.
13524A Hilder, C. F. Typesetting machines.
14548 Linotype Co. and Place, J. Matrices with characters on both sides; "Janus".
15494 Annand, R. C. Drying stereotype-matrices.
15573 Hinshillwood, T. K. Typecasting.
15574 Fels, A. Matrices for typecasting machines.
15907 Gallice, E. Type rules, leads, etc., of aluminium or aluminium alloy.
17236 Heath, T. T. and Verdin, A. N. Stereotype-matrix machines.
17265 Hoggson, S. H., and Stevenson, W. H. Date- and time-printing stamps; electro-magnetically operated.
17606 Place, J., and Linotype Co. Strengthening spacers by longitudinal ribs.
18579 McCarter, T., and Starrett, S. Quoins of two opposed wedges and rack teeth.
18651 Fels, A. Improvements in typecasting and finishing machines; body-slide.
18652 Bates, E. G. Numbering-machines; type-high for consecutive numbering, with locking action.
19150 Bullock, C. Apparatus for trimming and finishing type.
19549 Warwick, B. W. Date- and time-printing stamps.
19642 Blake, R. A. Linotype, stereotype-matrix and like machines; improvements in spacers.
20094 Kletzker, A. J., and Goesel, J. G. Stereotype-matrix machines.
20121 Martin, W. H., and MacCoy, J. S. Date- and time-printing stamps for telltales.
20131 Maynes, A. W. Linotype and like machines; forming linotype-slugs and line-justifying by compression.
20730 Gursch, J. M. H. Hollow metal-furniture with corrugated plate cast in place.
22207 Carr, L. and Southey, G. Numbering-apparatus for printing on a travelling web.

1893.

299 Praunegger, F., and Toobe, H. L. B. Type-setting and distributing machines.
534 Barnes, W. F. Type for making rubber stamps.
754 Sears, C. Linotypes; casting a composite slug.
888 Eastwood, G. Stereotype flong-press with hot-air drying.
1392 Wiberg, K. E. Numbering-apparatus for loose sheets or continuous paper.
1456 Hooker, P. Machine for numbering tickets.
2011 Partridge, A. Paging- and numbering-machine.
2915 Titchener, O. Typecasting machines.
3425 Warburton, E. and Warburton, H. Type-setting and distributing.
3681 Savage, H. Hand-stamp.
3791 Levy, M. Photomechanical screens attached face-to-face.
4614 Higgins, F. H. W. Vulcanized rubber type for covering telegraphic typewheel.
4747 Dupont, J. A. and Lambert, E. Numbering bonds; numbers are carried on the plane faces of concentric rings and follow according to a key or index.
4769 Lavender, H. P. Numbering-mechanism; consecutive.
5074 Rodwell, G. J. B., Moore, S. J., and Secord, H. C. Printing-surfaces for rubber-stamps.

No. **1893** (*continued*).

5702 Davis, G. A. Drying stereotype-matrices; gas-heated cylinder.
5896 Maisey, A., and Dingley, W. Sidestick with multiple opposed-wedge faces and two sets of wedges actuated by right and left screws.
6442 Jackson, A. J. Stamps; hand- or treadle-operated.
6914 Low, A. A. Typesetting apparatus.
6938 Haynes, J. I. Typesetting machine.
7584 Dubeux, G. A. Means for fixing linotype-slugs on cylinders.
8155 Pavyer, J. G. Typecasting and finishing machine.
8364 Foucher, A. Typecasting machine; Duplex.
8527 Sharpe, J. Date- and time-printing stamp.
9457 Adshead, G. H. Stereotype-matrix of asbestos.
9904 Lowe, W. G. Dating and numbering consecutively pawntickets, etc.
10002 Hart, G. W. Machines for setting types in lines and taking stereotype-matrices.
11523 Houten, F. R. van. Apparatus for making rubber-faced type.
11621 Bishop, W. W., and Bishop, J. McE. Typesetting machines; bifurcated type to slide on carrier.
14624 Hilder, C. F. Type-distributing machine.
16200 Scudder, W. S. Space-bars for slug-casting and like machines. Monoline.
17135 Scudder, W. S. Machine for casting lines of type. Monoline.
17677 Smith, M. Stereotypes combined with other printing-surfaces; curved.
17853 Méray-Horváth, C. Stereotype-matrix machine. Perforated strip machine controlled electrically.
18622 Edwards, D. Fudge-box for rapid insertion of slugs.
19265 Smith, T. W., and Ross, F. Galleys with wedge faces locking-up device.
19511 Healey, R. H. Apparatus for use in drying stereotype-matrices.
21143 Sears, C. Stereotype-matrix, etc., machines. Method of line-justifying lines of matrices or types.
21614 Banks, B. R. Rotary typecasting machine.
21921 Barth, H. Casting types with grooved bodies in a body-slide mould.
22732 Eastwood, G. Stereotype-matrices.
23510 Foot, J. E. T. Typecasting machine. Six pivotal moulds revolving on a drum.
23849 Schulze, F. W. Typesetting machine.
23940 Place, J., Girod, E., and Linotype Co. Improvements in matrix-magazines. Linotype.
24288 Bright, F. E. Linotype machines. Preventing casting when too few or too many matrices are set.
24966 Latimer, R. J. Backing up electrotypes.

1894.

1069 Crocker, S. H. Producing matrices for relief-printing by drawing in adhesive ink, placing a rubber film in contact, and distending the loose parts by fluid pressure.
4453 Watson, G., Watson, A. E., and McLaren, A. Numbering-machine with chain of blocks for consecutive printing.
4986 Wicks, F. Improvements in rotary type-casting.
6218 Allen, C. F. Electric keyboards for typesetters.
6420 Taylor, W., Taylor, T. S., and Hobson, H. W. Pantograph engraving-machine.
6541 Salomon, J. Type-distributing.
7065 Hattersley, M. A. M., and R. L. Typesetting and distributing.
7909 Hill, J. Mounting-block for stereotype-plates.
8200 Beck, O., and Beck, O. Composing-stick.
8258 Whittaker, M. H. Trimming-knives and type-blocks. Linotype.
8504 Fraser, A., and Ross, F. Type-distributing.
8513 Whitehead, W. Typewheel mechanism of time-printing stamps.
9101 Werner, E. Stereotype-matrix machine.
9384 Linotype Co., and Sigurdsson, O. V. Ejector blades; Linotype.
9695 Martindale, W. B., and Brackett, L. M. Date- and time-printing stamps; operated pneumatically.

No.
10167 Hilder, C. F. Typesetting machines.
10257 Whittaker, M. H. Forming two-line capitals on type-slugs.
10348 Calendoli, V., and Savarese, A. Short types with grooves or recesses for sliding on a bar of correspondingly headed section.
10349 Calendoli, V., and Savarese, A. Typesetting machines.
10921 McMillan, J. L. Typesetting machines.
11589 Löwendahl, V. Drawing in pencil on aluminium; depositing electrolytically on the pencil lines; dipping to alloy the deposited metal with the molten metal; raising from bath; cooling and removing the aluminium.
11716 Hughes, A. T. Date- and time-printing stamps.
11839 Levy, M. Photomechanical printing screens.
12718 Gent, J. T., Staveley, A. W., and Parsons, I. H. Time-printing stamps for telltales.
13351 Johnson, L. K., and Low, A. A. Typesetting machines.
13676 Cordeaux, W. Producing designs in relief on foil and printing therefrom.
14459 Spear, M. H. Numbering-machine; large-wheel, driven by eccentric.
14525 Porzsolt, E. Photographing the letters for printing-matter successively on a plate to be used as a photomechanical printing-surface.
14695 Johnson, L. K., and Low, A. A. Typesetting apparatus; assisting hand.
15644 Healey, R. H. Apparatus for drying stereotype-matrices.
15821 Thompson, G. H. Hand-stamps.
17517 Vorreiter, A., and Mullendorff, E. Typesetting; line-justifying and distributing machine; electric.
18744 Coghill, A. S. Means for fixing stereotypes or other plates in formes.
18916 Vorreiter, A. E., and Müllendorff, E. Typesetting, line-justifying and distributing machine; electric.
19026 Paige, J. W. Typesetting and like machines; engaging-device for clutches.
19143 Farmer, W. W. Type-dressing machine.
19200 Salomon, J. Typesetting and line-justifying.
20176 Weaver, G. W. Type for imitating typewriting; fine intersecting lines on face.
21335 Cox Typesetting Machine Co. Typesetting machines.
21728 Capehart, A. S. Producing electrically deposited matrix-bars. Monoline.
22428 Johnson, L. K., and Low, A. A. Typesetting; assisting hand.
22921 Linotype Co., and Holliwell, C. Trimming-knives; Linotype.
23130 Linotype Co., and Girod, E. Improvements in casting-mechanism; Linotype.
23243 Bundy, W. le G., and Bundy Manufacturing Co. Time-printing stamps for telltales.
23471 Linotype Co., Ireland, C. L., and Place, J. Linotype shifting-mechanism.
23578 Sears, C. Making ready by the use of several sheets of plastic paper some of which are removed.
23684 Goodson, G. A. Type-composing, casting and setting mechanism; electric control from strip perforations.
24264 Eastwood, G. Press for making flong-matrices for stereotypes.
24603 Dodge, P. T. Linotype escapement-mechanism.
24604 Dodge, P. T. Justification of type-matrices; Linotype.
24605 Mergenthaler, O. Improvements in magazine etc.; Linotype.
24702 Mergenthaler, O. Production of two-line initial letter; Linotype.
24870 Place, J., and Linotype Co. Improvements in moulding-mechanism.

1895.

473 Fowler, J. C. Typecasting and setting machines.
858 Smith, R. H. Hand-stamp; removable type.
1389 Linotype Co., and Wicb, F. J. Automatically moving trimming-knives; Linotype.

1895 (*continued*).

No.

2513 Maskelyne, J. N. Iron type made by hydraulic pressure.

539 Sauvée, A. Casting-boxes for curved stereotypes.

2549 Linotype Co., Girod, E., and Thomason, W. C. Adjusting length of mould; Linotype.

2554 Tachytype Manufacturing Co. Typecasting and composing machine; controlled by perforated strip; Tachytype.

3009 Linotype Co., and Fletcher, W. Adjustable moulds.

3574 Cox Typesetting Machine Co. Typesetting machines.

4037 Méray-Horváth, C. Stereotype-matrix machines. Electric and strip-controlled.

4119 Méray-Horváth, C. Stereotype-matrix machines. Electric contact strips.

4754 Wentscher, E. Typesetting; method of line-justifying lines of type.

5240 Gleazer, P. J. Hand-stamp with type arranged in holders on a wheel for rolling.

5718 Tachytype Manufacturing Co. Manufacture of mechanical controllers; perforated strip; Tachytype.

6336 Alexander, A. H. Moulds for casting lines of type.

7114 Rogers, J. R. Matrix-composing; linotype machines.

8075 Dodge, P. T. Linotype machines. Space bars; stepped; Linotype.

8076 Mergenthaler, O. Linotype machines; spacing lines of type.

8077 Woodruff, C. P. Linotype machines; compressible space-bars, with expanding springs between the members; Linotype.

8078 Skatulla, C. Linotype machines; means for controlling the action of the pump for lines composed too short; Linotype.

8079 Ripson, P. L. Linotype machines; controlling delivery of space-bars into assembly block; Linotype.

8133 Calendoli, V., and Savarese, A. Typesetting machines.

8290 Sears, C. Stereotype-matrix machines.

8646 Hilder, C. F. Typesetting; assisting in line-justifying.

9012 Whiteley, H. D. Moulding large rubber-type.

9732 Linotype Co., and Ireland, C. L. Strengthening matrices; Linotype.

10581 Low, A. A. Typesetting; assisting hand.

10590 Mather, L. F. Linotype machines; leading mechanism; Linotype.

10591 Muehleisen, C. Linotype machines; means for spacing; Linotype.

10592 Dodge, P. T. Linotype machines; justifying lines of assembled matrices; Linotype.

10593 Dodge, P. T. Linotype machines; means for spacing lines of matrices; Linotype.

10594 Dodge, P. T. Linotype machines; providing additional or sorts matrices; Linotype.

11644 Dodge, P. T. Linotype machines; regulating heat of melting-pot; Linotype.

11645 Mergenthaler, O. Rendering length of mould-cavity adjustable; Linotype.

11931 Sauvée, A. Casting-box for flat stereotypes.

12552 National Typographic Co. Additional magazine for sorts; Linotype.

12971 Linotype Co., and Ireland, C. L. Linotype moulds; Linotype.

13114 Schimansky, H. Dry-flong matrix for stereotypes.

13117 Hodgkin, S. H., and P. E. Typesetting machines; Pulsometer.

13226 Meisel, F. Numbering-machine; for both sides of slips consecutively.

13231 Carter, J. R. Numbering-machine; for both sides of slip consecutively.

13238 Meisel, F. Numbering-apparatus; consecutive, for rotary machines.

13292 Walker, G. Large wooden type for posters.

13714 Linotype Co., and Wich, F. J. Linotype machine; interchangeable ejector-blades; Linotype.

14047 Linotype Co., Ireland, C. L., and Wich, F. J. Slug-trimming mechanism; Linotype.

14366 Wentscher, E. W. Typesetting machines; line-justifying.

14497 Savorgnan, D. di B. Postmarking machine; for coin-freed letter-box.

No.

15700 Linotype Co. Means of raising and lowering assembly-block; Linotype.

15948 Mergenthaler Linotype Co. Mechanism of mould-wheel slide; Linotype.

16727 Schreier, E., and Auerbach, R. Numbering-mechanism; actuating wheels by pressure on the face of the block; moving the block bearing the abbreviation "No."

17868 Hallet, A. Coating face of composed-type with silk, etc., to produce imitation of typewriting.

17955 Linotype Co., and Fletcher, W. Ejector-mechanism; Linotype.

18886 Dodge, P. T. Linotype machines; matrices with duplex or multiple characters, one roman and one italic; Linotype.

19530 Giroud, P. G. Date- and time-printing stamps.

20181 Bönsch, J. Hand-stamp with curved printing-surface, for marking cases by rolling.

20318 Linotype Co., Ireland C. L., and Wich, F. J. Trimming two-line letter; Linotype.

20778 Wright, D. Clamps for securing stereotypes.

21075 Hughes, G. R. Facing linotype-slugs with harder metal electro-deposited.

21366 Deville, E. G. D. Producing photomechanical screens of chess-board pattern by two exposures through pin-holes and an intermediate heavily cross-ruled plate.

22478 Holdsworth, F. Type-distributing machine.

22584 Cox Typesetting Co. Type-distributing machine.

22825 Linotype Co., and Girod, E. Making new linotype-slugs appear old.

24154 Johnson, L. K., and Low, A. A. Typesetting; assisting hand.

24167 Thiele, H. Numbering-head; consecutive.

24182 Hoe, R. Mounting flat or curved stereotype plates.

24705 Gressitt, J. H., and Fox, H. W. Hand-stamps.

25032 Sigurdsson, O. V. Pantographing type for a former from enlargement thrown on glass.

1896.

202 Placet, E. Chromium alloy for type.

217 Richford, E. M. Date- and time-printing stamps.

992 Abbot, H., and Currier, E. A. Time- and date-printing stamps with money record.

1355 Hughes, G. R. Typesetting; scale for reading length of line.

2009 Hilder, C. F. Compressible spaces of bent sheet-metal.

2557 Heath, T. T. Machine for cutting type or steel punches direct.

2559 Heath, T. T., and Verdin, A. N. Stereotype-matrix machines.

2817 Reeves, T. Case for printers' furniture with inclined trays.

2857 Linotype, Co., Ireland, C. L., and Wich, F. J. Vice-jaws; Linotype.

2934 Méray-Horváth, C. Electric contact-strips for typesetting.

3114 West, J. Typecasting machines; carbon plungers for pumps.

3126 National Typographic Co. Space-bands; Linotype.

3154 Whiteley, H. D. Type for posters.

3293 National Typographic Co. Pump-stop mechanism; Linotype.

3294 National Typographic Co. Keyboard-mechanism; Linotype.

3552 Young, C. Pen for applying molten wax to a glass typographic-etching plate.

5621 Linotype, Co., Ireland, C. L., and Wich, F. J. Adjustable moulds; Linotype.

6170 Linotype Co., Ireland, C. L., and Wich, F. J. Tapered moulds for slugs for cylinders; Linotype.

6265 Gardner, J. Hand-stamps.

6845 Hodgkin, S. H., and Hodgkin, P. E. Typesetting machine; means for ejecting type; Pulsometer.

7189 Cummins, W. J. Mounting-block for electrotypes, etc.

7399 Lanston Monotype Machine Co. Typecasting and setting machine; Monotype.

8082 Bohensky, J. Hand-stamps.

8166 National Typographic Co. Trimming-mechanism; Linotype.

1896 (*continued*).

No.

8302 National Typographic Co. Adjustable moulds; Linotype.

8603 Sherer, G. W. Spaces of thin sheet metal for line-justifying.

9334 Ritzema, T. P. Trimming-mechanism; Linotype.

9438 Linotype Co., and Ireland, L. M. Trimming-mechanism; Linotype.

9858 National Typographic Co. Ejector-mechanism; Linotype.

9859 National Typographic Co. Distributing-mechanism; Linotype.

10374 Linotype Co., and Place, J. Star-wheel mechanism; Linotype.

12170 Lartirana, A. Automatic engraving machine for relief plates.

13237 Johnson. L. K., and Low, A. A. Type channels; assisting hand-composing.

13591 Linotype Co., and Wich, F. J. Curved slugs; Linotype.

13592 Linotype Co., Place, J., and Pearce, H. Delivery spout of metal-pot; Linotype.

13884 Houten, F. R. van. Hand-stamps with yielding backing.

13890 The Stenotype Co. One-machine mechanism for automatically setting a line of type, taking an impression from it, distributing the type, and permitting composition of the succeeding line to proceed while the first is being distributed.

14453 Forth Graphotype Co. Linotype machines.

14878 Prinetti Stucchi and Co., and Ricchieri, G. Typesetting and distributing machines.

15490 Valk, C. C. van der. Date- and time-printing stamps.

15606 Reifgraber, J. J. Transmitting from perforated strips telegraphically and receiving as a stereotype-matrix or as a perforated strip for operating a typesetting machine.

15607 Reifgraber, J. J. Punching perforated strip for telegraphic type-composing.

16612 Linotype Co. Matrices for rules, dashes, etc.; Linotype.

16623 Bright, F. E. Improvements in casting; Linotype.

16752 Balls, P. T. Trimming-mechanism; Linotype.

17816 Mergenthaler, O. Intermittent casting; Linotype.

17817 Mergenthaler, O. Spacing and line-justifying and casting and trimming; Linotype.

17882 Golding, W. H. Cutting printer's rules and leads.

17990 Rogers, H. R. Proving lines as cast; Linotype.

18227 Converse, F. B. Typesetting and distributing.

18718 Burg, H. Typesetting, line-justifying and distributing machine.

18748 Cahill, T. Impression machine.

19118 Leonard, E. G. Linotype and like machines; arrangements for tabular work; Linotype.

19878 Boyes, J. T. Type-distributing machine.

20230 Litchfield, W. Types for typewriters to give different characters according to force of striking.

20785 Ullmer, F. Printers' leads; making by casting and hot-rolling.

21452 Wynne, W. Trimming-mechanism; Linotype.

22214 Griffin, T. Furniture and quoins of combined wood and metal.

22822 Braly, A., and Braly, L. Hand-stamps.

23397 Pierpont, F. H. Microscope with camera lucida for delineating type-faces.

23590 Catherall, T. H. Linotype machines; trimming-mechanism; Linotype.

25937 Place, J. Linotype machines; mouths for metal-pot, multiple discharge; Linotype.

26636 Dow, A. Type-distributing machine.

26648 Linotype Co., and Girod, E. Distributing-mechanism; Linotype.

26649 Linotype Co., and Lawless, P. C. Ejecting-mechanism; Linotype.

28078 Bates, G. A. Trimming-mechanism; Linotype.

28079 Mergenthaler Linotype Co. Mould-wheel mechanism; Linotype.

28080 Fairchild, B. L. Means for justifying type-matrices; Linotype.

No.

28081 Mergenthaler Linotype Co. Pump-stop mechanism; Linotype.

28399 Catherall, T. H. Linotype machines; casting type-slugs of varying heights; Linotype.

28460 Delaze, C. Limestone and silicate of potash for making type.

29348 Beatty, H. A., and Wheeler, G. H. Composing-stick with alternative sets of notches for setting to multiples of different units.

29924 Eyre, G. E. B., Spottiswoode, W. H., Spottiswoode, C. A., and Passingham, E. J. Process blocks; imposing fine conically-pointed wires on a photographic relief.

1897.

505 Linotype Co., and Place, J. Alining matrices; Linotype.

506 Linotype Co., Lock, W. H., and Place, J. Moulding-mechanism; Linotype.

3168 Reed, J. Linotype machines; identifying slugs; Linotype.

4517 Linotype Co., and Wich, F. J. Trimming-mechanism for slugs with two-line letters; Linotype.

4518 National Typographic Co. Trimming-mechanism; Linotype.

4766 National Typographic Co. Two-line trimming-mechanism.

5006 Wicks, F. Line-justifying with compressible spaces.

5436 Linotype Co., and Pearce, H. Distributing-mechanism; Linotype.

5570 Cox Typesetting Machine Co. Type-distributing machine.

6165 Scotford, L. K. Hand-stamps.

7509 Capehart, A. S. Linotype machines; matrices; Monoline, etc.

7510 Capehart, A. S. Linotype machines; melting-pots; Monoline.

8740 Eaton, G. S. Type-dressing machine.

9080 Sigurdsson, O. V. Stereotype-matrix machines.

9326 Rosdestwenskij, A., and Bounimowitch, E. Typesetting and distributing.

9568 Linotype Co., and Place, J. Improvements in mouth-pieces of metal-pots; Linotype.

9569 Linotype Co., and Girod, E. Improvements in linotype machines; Linotype.

9570 Linotype Co., and Elliott, R. C. Improvements in matrix-liberation; Linotype.

9585 Goodwin, H. Scales for measuring up composed matter.

11105 Woolterton, H. H. Hand-stamp; flexible surface for printing on eggs.

11115 Cox Typesetting Machine Co. Typesetting and line-justifying machines.

12213 Linotype Co., and Holliwell, C. Improvements in matrix-delivery mechanism for facilitating change of magazine; Linotype.

12214 Linotype Co., and Girod, E. Moulds and ejectors; Linotype.

12960 Thorne Typesetting Machine Co. Linotype and stereotype-matrix machines; line-justifying mechanism.

13267 Lanston Monotype Machine Co. Casting and composing machines; Monotype.

13669 Michaud, J. Drying stereotype-matrices.

13891 Méray-Horváth, C. Monotype and like machines.

14003 National Cash Register Co. Paging- and numbering-apparatus. Type-disks with duplex type diametrically opposite for duplicate printing.

14451 Johnson Typesetter Co. Typesetting and line-justifying.

15498 Bundy Manufacturing Co. Engraving machine for printing-surfaces.

15617 Rieder, J. Making electrotype-blocks.

16245 Thorneloe, W. J., and Hardy, T. J. Linotype machines; casting short slugs.

16590 Johnson, L. K., and Low, A. A. Typesetting; assisting hand.

17430 Davies, C. Fudge-box with three dovetailed sides.

17469 Wicks, F. Improvements in rotary type-casting machines.

18033 Electric Compositor Co. An electric composing or linotype machine.

No. **1897** *(continued)*.

18703 Carr, H. L. Combining half-tone blocks with stereotypes.
18742 Campbell Printing Press and Manufacturing Co. Casting and finishing curved stereotype-plates.
18868 Scudder, W. S. Electro-deposit of matrix-bars or matrices; Monoline.
18938 Mascord, G. W. Linotype machines; trimming-mechanism; Linotype.
18939 Mascord, G. W. Linotype machines; automatic trimming-mechanism; Linotype.
19571 Grant, J., and Rothery, G. C. Type of paper or wood-pulp.
20000 Alexander, A. H. Stereotype-matrix machines.
20035 Johnson, L. K., and Low. A. A. Typesetting machines.
21298 Linotype Co., Lewis, W. J., Pearce, H., and Holliwell, C. Improvements in line-justifying mechanism.
21299 Linotype Co., Lewis, W. J., and Pearce, H. Cams and cam-stops.
22208 Lanston Monotype Machine Co. Monotype keyboard machines.
22855 Bürk, R. Date- and time-printing stamps.
22945 Catherall, T. H. Linotype machines; compressible space-bars; Linotype.
23142 Smith, J. J. C. Casting bronze type in the form of a comb.
23427 Levy, M. Screens for photomechanical plates; opaque squares overlapping at corners; chess board pattern.
23476 Sears, C. Casting characters on slugs using lines of matrix-blocks.
24114 Boyes, J. T. Typesetting.
24363 Sandeman, G., and Brown, G. M. Monotype keyboard machines.
24587 Young, C. Typographic printing-surfaces produced in wax by electrically heated pen.
24713 Linotype Co., and Booty, E. L. Matrices for linotype machines.
24835 Townshend, W. Means for inserting fudge-linotypes in stereotypes.
27216 Pegler, A. S. Linotype machines; preventing wear of star-wheels.
27630 Monoline Composing Co. Monoline machine.
28704 Pierpont, F. H. Spacing-mechanism.
28705 Pierpont, F. H. Casting apparatus.
29236 Ryder, J. Composing curved lines; using V-shaped spaces.
29879 Hall, I. Linotype machines; star-wheels.
30575 Ritzema, T. P. Linotype machines; levelling matrices and spaces.
30640 Impresa Macchina Compositrice Lamonica Garlanda & Co. Typesetting machine.
30656 Sears, C. Casting slug-edges on lines of matrix-bars.

1898.

668 Smith, M. W. Machine for composing; casting individual type for each key-depression, inserting compressible spaces, and line-justifying by compression.
1202 Lübke, O. Hand-stamps.
1273 Whittaker, M. H. Matrices with a normal strike and an inverted strike, used turned through 180° about horizontal axis; plain V at one end so that inverted matrices are not elevated to distributor; Linotype.
1905 Lock, W. H., Lawless, P. C., and Chambers, R. Wiper-mechanism; Linotype.
1979 Kirby, E. B. Keyboard mechanism for type-setting and stereotype-matrix making.
2138 National Typographic Co. Trimming mechanism; Linotype.
2139 Linotype Co., and Lawless, P. C. Expelling air from mould-cavity; Linotype.
2337 Roebelen, A. Aluminium and other alloys for type.
2904 Linotype Co., Place, J., and Barr, M. Electric heating for melting-pots.
3085 Linotype Co., Barr, M., and Lewis, W. J. Improvements in matrices with steel side-walls; Linotype.
3135 Pegler, A. S. Linotype machines; reflector for assembly-box; Linotype.
3168 Ritzema, T. P. Linotype machines; star-wheel mechanism.

No.
3500 Wetter & Co., J. Type-high numbering-machine with paper-lifter to obviate blurring.
3921 Law, G. H., and Ingle, W. Linotype machines; distributing-apparatus.
4379 Boyes, J. T. Typesetting and line-justifying.
5385 Dedrick, N. Punch-cutting machine.
5824 Law, G. H., and Ingle, W. Linotype machines; indicating devices.
6117 Ohmer, W. J., and Kelch, W. M. Date- and time-printing stamps.
7430 Bolton, W. H., and Bolton, C. H. Hand-stamps for musical characters.
7541 Lock, W. H., and Place, J. Pump; Linotype.
7786 Ritzema, T. P. Linotype machines; casting slugs for fudge-boxes.
7867 Paris, L. Stereotype-matrix machines.
8068 Tuerk, A. Date- and time-printing stamps.
8228 Lock, W. H., Chambers, R., Dolby, F. C., Elliott, R. C., Heap, W., Holliwell, C., Lewis, W. J., Pearce, H., and Whittaker, M. H. Improvements in linotype assembling-mechanism, line-justification block, vice-screw, space-band delivery, and matrix-lift; Linotype.
8269 Wicks Rotary Typecasting Co. and Wicks, F. Compressed-air regulator and other improvements; pawl for type; mould-sectors.
8586 Ritzema, T. P. Linotype machines; lid of assembly-box.
8722 Lock, W. H., and Nadall, B. Linotype machines; italic matrices.
9246 Burg, H. Machine for dividing a continuous line of composed type for line-justifying by hand.
9381 Towler, C. Fudge-box for receiving linotype-slugs.
9601 MacCoy, J. S. Date- and time-printing stamps for telltales.
10019 Griffiths, A. Time-printing stamps.
10142 Murray, C. R. Corrugated spaces.
10148 Deubner, J. W. Time-printing stamps.
10267 Lock, W. H., and Pashley, C. W. Holding type-matrix blanks and gauge for setting registers of pivotal moulds.
11033 Mergenthaler Linotype Co. Matrices for columnar-printing with strike at right angles to normal; Linotype.
11238 Cox Typesetting Machine Co. Supplying typesetting machines with corrugated spaces.
11239 Cox Typesetting Machine Co. Type-distributing and lead-discarding.
11396 Landgren, W., and Holm, V. H. Composition backing for electrotypes, etc.
11402 Lock, W. H., Nadall, B., and Barr, M. Metal-pot mechanism; Linotype.
11615 Lock, W. H., Place, J., and Lewis, W. J. Mechanism for metal-feeding to pot; Linotype.
12633 Paterson, A. Printers' furniture; "Locket."
13246 Cahill, T. Double magazine machine; Linotype.
13922 Duncan, J. S. Relief zinc, etc., printing-plates prepared by dies and counterparts.
14553 Smith, E. W. Electrotypes and stereotypes obtained from lithographic stone engraved away by sand-blast.
15345 Gilbert-Stringer, H. J. S. Monotype and like machines; Quadrant.
15923 Lock, W. H., Holliwell, C., and Lewis, W. J. Improvements in moulds; Linotype.
16254 Muehleisen, C. Linotype machines with two magazines and two keyboards; Linotype.
16255 Muehleisen, C. Line-closing mechanism; Linotype.
17302 Dickinson, C. W. Line-justifying type-lines set with temporary wedge-spaces.
17962 Rogers, J. R. Matrices with multiple characters; Linotype.
18041 Manning, J., and Manley, G. Reproducing printing-surfaces by electrotyping.
19223, 19224 Smith, R. H. Hand-stamps.
19234 Lock, W. H., Dolby, F. C., and Tattersall, W. Mechanism for releasing space-bands; Linotype.
19713 Muehleisen, C. Separating matrices for distribution to their own magazines; Linotype.

No. **1898** (*continued*).

20641 Lock, W. H., Speechley, W. R., and Barlow, H. E. Improvements in assembling-mechanism; Linotype.
20642 Lock, W. H., Place, J., and Pashley, C. W. Engraving machine for punches and matrices.
20888 Lock, W. H., and Barr, M. Apparatus for reproducing the face of a type to a large scale.
21479 Titchener, O. Driving-gear with dwell for casting quads or large type.
22456 Burg, H. Typesetting; supplying type to composing-machine channels.
23204 Lock, W. H., and Nadall, B. Engraving machine for matrices.
23453 Partridge, A. Paging- and numbering-apparatus, consecutive.
23709 Wicks, F. Composing-stick for line-justifying type set with compressible spaces.
23761 Lock, W. H., and Gardner, H. J. Cleaning indicating-character of matrix; Linotype.
24011 Mergenthaler Linotype Co. Linotype machine with long matrices hung on rods.
24012 Mergenthaler Linotype Co. Matrices for rod machines.
24305 Hodgkin, P. E., and May, W. Typesetting machine; race-connexion; Pulsometer.
24624 Thorne Typesetting Machine Co. Type-distributing machine.
24911 Day, R. J., and Collins, A. Securing type-blocks to cylinders.
26086 Dedrick, N. Engraving machine for punches and matrices.
27273 Sears, C. Stereotype-matrix machines.
27581 National Typographic Co. Casting-mechanism; Linotype.
27582 Ennisson, W. J. Typesetting and line-justifying.

1899.

375 Albrecht, C. A. Linotype machines; auxiliary magazine and keyboard; Linotype.
617 Lock, W. H., Dolby, F. C., Elliott, R. C., Holliwell, C., and Lawless, P. C. Linotype machines; improvements in magazines and keyboards, changing fount, altering mould-block, advancing metal-pot, etc. Linotype.
617A Lock, W. H., and Lawless, P. C. Securing late-news linotype-slugs. Linotype.
617B Lock, W. H., Holliwell, C., and Lewis, W. J. Securing linotype-slugs for late-news. Linotype.
1587 Converse, F. B. Typesetting; automatic line-justifying.
2181 Bertram, W. E. Monoline machines; improvements.
2720 Mergenthaler Linotype Co. Vice-adjusting mechanism. Linotype.
2721 Lock, W. H., and Wich, F. J. Improvements in adjustable moulds; Linotype.
2959 Tiano, A. Thick flong of paper pulp.
3368 Dowell, A. E. Forming slugs by fusion of lines of single type.
3649 Baine, J. G. Fudge-box for linotype slugs.
3980 Kelly, A. R. Hand dating-stamps.
4052 Wicks, F. Improvements in rotary type-casting machines; pump.
4289 Murray, C. R. Improvements in typecasting.
4351 Risley, I. Stereotype-matrix and like machines.
4440 Fischer, G. Monoline machines; making matrix-bars.
4523 Guest, A. R., and Richmond, E. T. Arabic type; single-line junction, non-kerning.
4983 Gardam, J. Time-printing stamps for time cards.
4992 Lock, W. H., and Barr, M. Pantograph for cutting formers.
5227 Fraser, A., and Rose, F. Type-distributing.
5632 Gilbert-Stringer, H. J. S., and Wicks, F. Line-justifying type by ejecting spaces.
6143 Derbyshire, H. J. Moulds; Linotype.
6459 Lock, W. H., and Girod, E. Improvements in mould-mechanism; Linotype.
6706 Hoe, R. Stereotype casting-box.
6927 Savarese, A., and Chateau, J. D. C. Typesetting machine.

No.
7691 Kraus, A. Stereotype-matrix and like machines.
8633 Lanston Monotype Machine Co. Improvements in Monotype casting machines; Monotype.
8634 Lanston Monotype Machine Co. Apparatus for punching record-strips; Monotype keyboard.
9487 Bundy, W. le G. Date- and time-printing stamps.
9643 Lock, W. H., Barr, M., and Isherwood, H. Improvements in casting-mechanism; Linotype.
9644 Lock, W. H., and Mosley, F. Adjustable moulds; Linotype.
9645 Lock, W. H., Nadall, B., and White, W. G. Improvements in the production of type-matrices; Tachytype.
9951 Lock, W. H., and Heap, W. Steel side-walls of matrices; Linotype.
10779 Cottrell & Sons, Co., C. B. Composite electrotype from type and engraving.
11410 Lock, W. H., Holliwell, C., and Lewis, W. J. Late-news linotype-slugs; Linotype.
11712 Zellenka, R., Kolbinger, J., and Hagyi-Ristic, S Acid-resisting mould-material for casting type.
11753 Mohr, F. G. Type-matrices with nickel faces.
11778 Murray, D. Linotype and other machines; operating keyboards by means of a perforated strip obtained by telegraphic or other method.
11878 Widmann, R. Making relief printing-surfaces by transfer and etching.
12082 Ohmer, W. I. Time-printing stamps.
12217 Knaak, F. C. F., and Campbell, J. S. Stereotype-matrix process for forming character faces.
12530 Hodgkin, P. E. and Kenney, G. E. Type-distributing.
13168 Rogers, J. R. Matrix-assembling and -distributing devices; Typograph.
13555 Davenport, J. Numbering- and marking-machines for laundry linen.
13683 Kley, A. C. Hand-stamp for keyhole-slotted type.
13706 to 13708 Lock, W. H. and Barr, M. Pantograph engraving machines; three-dimensional.
13735 Gesellschaft für Huber Pressung, C. Huber & Co. Making stereotype-plates by liquid pressure.
14400 Burg. H. Type-distributing apparatus for nicked-type.
14986 Rouse, H. B. Machine for cutting leads and rules.
15065 Maybell, S. and Maybell, M. Mounting-block for stereotypes, etc.
15575 Linke, E. F. Supplying types to channels of distributing machine; Thorne.
16145 Botz, C. J. Typesetting and line-justifying.
16267 Lock, W. H. and Milner, J. J. Sorting blanks for linotype matrices.
16268 Lock, W. H. and Wich, F. J. Improvements in magazines and escapements; Linotype.
16660 Nydahl, E. F. Type-distribution.
16831 Rowntree, T. M. Chase for one or more lines of type for margins of newspapers, magazines, etc.
17060 Hoyweghen, H. C. van. Stereotype-matrix machines.
17569 Knaak, F. C. F. and Campbell, J. S. Line-justifying appliances.
17875 Hall, I. Linotype and like machines; moulds.
18004 Chapman, A. and Walker, J. Dry-flong faced with asbestos-faced paper.
18228 Lock, W. H. and Wich, F. J. Linotype machines; automatically adjusting assembler gong; improved detent for vice-screw; Linotype.
18427 Garratt, J. H. Time-printing stamps for time-clocks.
18592 McClintock, F. Line-justifying apparatus.
18638 Lanston Monotype Co. Apparatus for preparing perforated strips; Monotype keyboard.
18991 Lock, W. H., Barr, M., Lewis, W. J. and Hughes, G. W. Linotype machines; manufacture of matrices; Linotype.

No. **1899** (*continued*).

20500 Winter, J. L. Paste for stereoty potato-flour, gelatine and boiling
21770 Lock, W. H. and Pritchard, W. mechanism; Linotype.
22294 McClintock, F. Typesetting mach mechanism.
23095 Lam, I. Apparatus for casting stereotypes.
23722 Dow Composing Machine Co. an Typesetting machines.
23725 Baine, J. G. Setting up types slugs for late-news.
23980 Rogers, J. R. Auxiliary magazi type.
24508 Mergenthaler Linotype Co. Eje Linotype.
24890 Converse, F. B. Typesetting mac
25472 Rogers, J. R. Duplex magazines
25519 Lichtenberg-Madsen, D. Stampi containing camphor into a matr pressed in material mainly ni and camphor.

1900.

482 Lock, W. H. and Broadhouse, J. music-type; Linotype.
1152 Unitype Co. Typesetting and machine; Thorne.
1365 Kalberer, E. and Feuchtwange sticks and quoins with cam loc
1610 Garvin, G. K. Lines of logotyp justified spaces cast on fr matrices.
1882 Sears, C. Stereotype-matrix ma
1903 Gilbert-Stringer, H. J. S. Monot machines; Stringertype.
1960 Sears, C. Stereotype-matrix ma
1979 to 1982 Lock, W. H. and Barr, M. Imp three-dimensional pantograph
1983 Lock, W. H. and Barr, M. Tr conical end for three-dimens graph.
2525 Wood, H. A. W. Casting and f cylindrical stereotypes in o Autoplate.
3541 Kirby, E. B. Stereotype-matri
3618 Trownsell, W. C. and Trego, J. R linotype matrices in lines of le for surrounding cuts or pictur
3813 Haddad, S. S. Type for arabi twice-unit width, single-line characters.
3955 Whittaker, M. H. and West, C. slugs or leads for fudge-boxes
4123 Lucke, F. Linotype machines; slugs from composed lines of
4734 McGrath, P. H. Typesettin justifying.
4808 Doolittle, W. H. Casting quad
4820 Cox, S. L. Linotype machin ments in moulds.
4963 Bates, A. H. Ejecting single ty in type-setting and distributi
4967 Bates, A. H. Type-distributin
5054 Goodson, G. A. Composing, casting and typesetting ma controlled; Graphotype.
5079 Lock, W. H. and Barr, M. Tr punch-cutting machine.
5275 Beals, E. V. and Gray, F. machines forming printing-fa blanks.
5325 Simpson, J. H. and Walker, E. able mounting-blocks for ste
5731 Stover, J. W. Date- and time with automatic-change mech
5884 Lock, W. H. and Wich, F. J. in distributing-mechanism;
6299 Lock, W. H., and Brown, spring for second elevator;
6692 Lock, W. H., Holliwell, C., ar Linotypes for display adve repeat linotype-slugs; Lino
6716 Wetter, J., and Wenz, plunger-operated, numberin
6942 Duncan, J. S. Combined li holder for addressing-machi

No. **1899** (*continued*).

20500 Winter, J. L. Paste for stereotype-flong of potato-flour, gelatine and boiling water.
21770 Lock, W. H. and Pritchard, W. C. Wiper-mechanism; Linotype.
22294 McClintock, F. Typesetting machines; key-mechanism.
23095 Lam, I. Apparatus for casting cylindrical stereotypes.
23722 Dow Composing Machine Co. and Dow, A. Typesetting machines.
23725 Baine, J. G. Setting up types or linotype-slugs for late-news.
23980 Rogers, J. R. Auxiliary magazines; Linotype.
24508 Mergenthaler Linotype Co. Ejector-blades; Linotype.
24890 Converse, F. B. Typesetting machine.
25472 Rogers, J. R. Duplex magazines; Linotype.
25519 Lichtenberg-Madsen, D. Stamping celluloid containing camphor into a matrix originally pressed in material mainly nitro-cellulose and camphor.

1900.

482 Lock, W. H. and Broadhouse, J. Matrices for music-type; Linotype.
1152 Unitype Co. Typesetting and distributing machine; Thorne.
1365 Kalherer, E. and Feuchtwanger, E. Side-sticks and quoins with cam locking-gear.
1610 Garvin, G. K. Lines of logotypes with line-justified spaces cast on from linotype matrices.
1882 Sears, C. Stereotype-matrix machines.
1903 Gilbert-Stringer, H. J. S. Monotype and like machines; Stringertype.
1960 Sears, C. Stereotype-matrix machines.
1979 to 1982 Lock, W. H. and Barr, M. Improvements in three-dimensional pantographs.
1983 Lock, W. H. and Barr, M. Tracer-rod with conical end for three-dimensional pantograph.
2525 Wood, H. A. W. Casting and finishing semi-cylindrical stereotypes in one machine; Autoplate.
3541 Kirby, E. B. Stereotype-matrix machines.
3618 Trownsell, W. C. and Trego. J. R. Setting up linotype matrices in lines of lengths required for surrounding cuts or pictures.
3813 Haddad, S. S. Type for arabic of unit and twice-unit width, single-line system, 58 characters.
3955 Whittaker, M. H. and West, C. H. Linotype slugs or leads for fudge-boxes; Linotype.
4123 Lucke, F. Linotype machines; casting type-slugs from composed lines of matrices.
4734 McGrath, P. H. Typesetting and line-justifying.
4808 Doolittle, W. H. Casting quads; Linotype.
4820 Cox, S. L. Linotype machines; improvements in moulds.
4963 Bates, A. H. Ejecting single types or matrices in type-setting and distributing machines.
4967 Bates. A. H. Type-distributing machines.
5054 Goodson, G. A. Composing, line-justifying, casting and typesetting machine; strip-controlled; Graphotype.
5079 Lock, W. H. and Barr, M. Tracer grinder for punch-cutting machine.
5275 Beals, E. V. and Gray, F. A. Linotype machines forming printing-faces of slugs on blanks.
5325 Simpson, J. H. and Walker, E. W. H. Adjustable mounting-blocks for stereotypes, etc.
5731 Stover, J. W. Date- and time-printing stamp with automatic-change mechanism.
5884 Lock, W. H. and Wich, F. J. Improvements in distributing-mechanism; Linotype.
6299 Lock, W. H., and Brown, H. Cushioning-spring for second elevator; Linotype.
6692 Lock, W. H., Holliwell, C., and Elliott, R. C. Linotypes for display advertisements and repeat linotype-slugs; Linotype.
6716 Wetter, J., and Wenz, W. Type-high, plunger-operated, numbering-mechanism.
6942 Duncan, J. S. Combined ink and type-holder for addressing-machines.

No.
6943 Duncan, J. S. Moulds for making rubber-type in sheets.
6944 Duncan, J. S. Composite rubber-type.
7141 Liley, E. and Cullen, W. H. Stereotype-matrix machine; impressions made by pneumatic or fluid pressure.
7347 Hansell, W. H. Numbering-apparatus for cylinder-printing sales-slips.
8096 Nydahl, E. F., and Harling, G. A. Type-distributing.
8397 Vice, J. H. Stereotypes with ribs or flanges for securing to sectional foundation-blocks.
8422 Reid, D. Mounting stereotype-plates.
9029 Miles, H. Quoins of pairs of opposed-wedges with racks.
9288 Des Jardins, B. M. Typesetting and line-justifying.
9345 Rosinkiewicz, C., and Ramult, L. Type-distributing.
9357 Monoline Composing Co. Improvements in Monoline machines.
9431 Wentscher, E. Linotype and like machines; improvements in distributing. Linotype matrices.
9625 Mole, F. M. Plastic mounting for stereotypes made type-high by pressure.
9627 Lock, W. H., and Fletcher, W. Mouthpiece of metal-pot; Linotype.
9628 Lock, W. H., and Cox, H. L. Linotype machines; wiper-mechanism; Linotype.
9815 Rouse, H. B. Composing-sticks.
9915 Low, A. A. Type-distributing; Alden distributor.
10685 Bowley, J. W. Roller hand-stamp.
10930 Dittmann, C., and Schutze, A. Type with multiple printing surfaces.
11285 Mullendorff, E. Line-justifying machine.
11492 Wicks, F. Type-slicer.
11568 Thorne Typesetting Machine Co. Typesetting and distributing.
11947 Krause, R. J. Quoins; pairs of opposed wedges with racks.
12304 Gasse, P. A. Dating hand-stamps.
13345 St. John, R. H. Impression machine; St. John Typobar.
13400 Beseke, A. Printing-surface combining outlines with type.
13789 Reinhardt, G. E. Mounting and locking up stereotype-plates.
13886 Bowley, J. W. Roller hand-stamps.
14036 Lock, W. H., Holliwell, C., and Elliott, R. C. Slotting linotype-slugs to receive loose-accent type for capitals, etc.
16364 Stockall, J. J. Date- and time-printing stamps.
16522 Rosenhain, W. Counting words typewritten, composed in type or telegraphed by keyboard transmitter.
16584 Pendlebury, H. Improvements in trimming-knives of linotype machines; Linotype.
17026 National Typographic Co. Improvements in escapement-mechanism; Linotype.
17550 Kühn, J., and Lopez, J. Stereotype-matrix machines.
17871 Haan, F., Hönig, I., and Freund, J. Dry-flong for stereotypes.
18094 Schleicher, A. Type for line-justifying by compression.
18375 Creed, F. G. Strip-perforating machine for automatic-telegraph or typesetting.
18542 Rozár, C. Monotype and like machines; electrically strip-controlled.
20178 Maruhn, E., and Uhthoff, E. Linotype machines; moulds of variable length.
20602 Lock, W. H., and Barr, M. Automatic engraving machine.
20953 Gilbert-Stringer, H. J. S. Monotype machines; moulds; Stringertype.
21668 Dyson, H. Automatic time-printing stamp.
21699 Lock, W. H., and Fletcher, W. Linotype machines; matrices for tabular work.
22106 Lock, W. H., and Barr, M. Punch-cutting machine head; with microphone in circuit through the cutting-tool.
22107 Lock, W. H., and Holliwell, C. Fudge, or late-news linotype-slugs; Linotype.
22496 Elias, L. Stereotype-matrix of asbestos board.
22674 Réveillé, A. Stereotype-matrix machine.
23114 Lanston Monotype Co. Monotype machines; improvements in punching and paper-feed; Monotype keyboard.

No. **1900** (*continued*).

23115 Lanston Monotype Machine Co. Monotype and like machines; keyboard machines for perforating record-strips; Monotype keyboard.
23205 Lock, W. H., Pendlebury, H., and Thomas, W. H. Producing late-news linotype-slugs; Linotype.

1901.

1050 Lock, W. H., Elliott, R. C., and Holliwell, C. Production of fudge-linotype-slugs of small height-to-paper; Linotype.
1077 Pierpont, F. H. and Lanston Monotype Corporation. Cutting uniform lengths from a bar of metal for matrix-blanks.
1078 Pierpont, F. H. and Lanston Monotype Corporation. Accurately positioning conical holes in matrix-blanks.
1079 Pierpont, F. H. and Lanston Monotype Corporation. Matrix-milling and measuring machine.
1080 Pierpont, F. H. and Lanston Monotype Corporation. Machine for striking matrices.
1121 Lock, W. H. and Bean, A. Actuating several matrix-escapements consecutively from a single key.
1152 Pierpont, F. H. and Lanston Monotype Corporation. Striking characters on matrices.
1483 Gilbert-Stringer, H. J. S. Apparatus for line-justifying composed lines of type.
1496 Low, A. A. and Breakey, J. Type-distributing.
1686 Schleicher, A. Monotype and like machines; moulds and matrices.
1934 Lichtenberg-Madsen, D. Vulcanite or ebonite matrices for producing celluloid printing-surfaces.
1978 Schmidting, J. Electrotypes from photo-reliefs.
1983 Lock, W. H. and Lawless, P. C. Wiping mouthpiece of metal-pot after casting. Linotype.
2470 Fowler Composing and Typesetting Co. Composing, casting and line-justifying machine.
2895 Drewett, T. J. C. Flong for stereotype-matrices.
3104 Calmels, G. H. Zinc typographic blocks with cross-lined tint.
3343 Selleck, W. L. Extensible base-sections for mounting stereotypes or electrotypes.
3603 Breakey, J. Type-distributing.
3604 Low, A. A. Type-distributing.
4030 Hoe, R. Stereotype casting-boxes for curved plates.
4985 Nuernberger, P. G. Plurality of type-bodies or slugs cast and cut simultaneously.
5019 Albrecht, C. A. Linotype machines; trimming slugs.
5208 Hensley, D. A. Linotype machines; space-bars; Linotype.
5237 Lock, W. H. and Whittaker, M. H. Linotype machines; slugs with holes for inserting separate type; Linotype.
5295 Sander, E., Migula, W. and Krafft, R. Dry-flong for stereotyping.
5358 Gasse, P. A. J. Hand-stamp with rubber-tape type.
6153 Dodge, P. T. Soft steel matrices locally hardened at the strike; Linotype.
6541 Groningen, I. van. Hand-stamp; type-wheel for printing-characters for maps.
7073 Smith, M. Apparatus for casting curved stereotypes.
7781 Peoples, U. S. G. and Walther, C. F. Locking type or slugs in galley, sidestick wedged downwards.
8024 Cesana, L. Linotype machines; automatically supplying metal to pot.
8516 Lock, W. H. and Holliwell, C. Fudge or late-news slugs; Linotype.
8979 Lanston Monotype Machine Co. Matrix-positioning mechanism of typecaster; Monotype.
8980 Lanston Monotype Machine Co. Monotype and like machines; metal-pots and pumps.
8981 Lanston Monotype Machine Co. Monotype and like machines; improvements in galley-mechanism.

No.
8982 Lanston Monotype Machine Co. Monotype and like machines; improvements in strip-feeding mechanism.
9165 Lock, W. H. Billington, G. and Elliott, R. C. Improvements in yoke or first elevator; Linotype.
9477 Follett, O. S. Typewheel for number-printing; cast in one piece.
9508 Elias, L. Felted asbestos stereotype-matrices.
9884 Rockstroh, W. M. Making plane stereotype-matrices.
9899 Converse, F. B. Typesetting and line-justifying.
9907 Gilbert-Stringer, H. J. S. Stringertype adapted to Monoline machine.
10217 Composite Type Bar Co. Typesetting; casting types simultaneously in moulds and supplying to magazines.
10499 Mole, F. M. Mounting electrotype- or stereotype-plates.
10649 Roxburgh, J. and McClean, R. Sawing slots in linotype-slugs for inserting rules for tabular work.
10787 Lock, W. H. and Wich, F. J. Trimming-mechanism; Linotype.
10854 Ziegler, G. H. and Jordan, G. F. Machines for trimming and finishing type.
11079 Converse, F. B. Adjusting typesetting machines to different body-sizes of type.
11476 Lanston Monotype Machine Co. Monotype and like machines; combined strip-perforating and casting machines.
11920 Bates Machine Co. Hand-stamps for numbering and dating; consecutive, duplicate or repeat.
11967 Pendlebury, H. Linotype machines; adjustable trimming-knives.
12445 Rogers, J. R. Linotype machines; improvements in matrices and distribution.
12569 Lock, W. H. and Gray, J. Short-measure slugs; Linotype.
13710 Baruch, A. Means for printing long rows of figures or words in consecutive order; helical.
13937 National Typographic Co. Linotype machines; simplified construction for assembling matrices, elevator, line-justifying, mould and casting, and distributing matrices; Linotype.
14315 Zagdmann, H. Forming characters on numbering-disks.
14401 Albrecht, C. A. Linotype machines; ejector-mechanism.
14457 Lagarde, J. Operating keyboards of type-setting machines, telegraphic transmitters, etc.
14978 Rogers, J. R. Improvements in composing and slug-casting machines; Typograph.
15362 Scott, W. Moulds for casting curved stereotypes.
15457 Roxburgh, J. and McClean, R. Linotype machines; slugs for tabular work.
15538 Maruhn, E. and Uhthoff, E. Linotype machines; mould-mechanism.
15539 Maruhn, E. and Uhthoff, E. Linotype machines; improvements in mould-mechanism.
15540 Maruhn, E. and Uhthoff, E. Linotype machines; ejector-mechanism.
15759 Maruhn, E. and Uhthoff, E. Means for composing matrices; Typograph.
16019 Levy, M. Screens formed by fastening together two ruled-glass plates.
16740 Gilman, A. S. Linotype machines; distribution of matrices.
16754 Maschinenfabrik Elektrogravure. Copying and reducing relief-engraved steel dies.
17280 Adams, F. W. Galleys with sides and end notched for sticks.
17851 Dow Composing Machine Co. and Dow, A. Composing and line-justifying.
18306 Lock, W. H. and Wich, F. J. Trimming-mechanism; Linotype.
18698 Roberts, T. H. Date- and time-printing stamps.
19838 Zinsch, H. and Grosser, W. Type of ground-cork and varnish or linoleum.
20006 Hine, C. L. Monotype and like machines; compressible and soft-metal spaces.

1901 (*continued*).

No.

20109 Dodge, P. T. Producing slugs from several different founts; multiple-strike matrices; Linotype.

20263 Wood, H. A. W. Composite stereotype and half-tone plates.

20430 Miller, G. H. Numbering-head.

20638 Dodge, P. T. Linotype machines; Linotype Junior.

21542 Dodge, P. T. Keeping molten metal at constant level in pot.

21592 Tcherkassov, Baron P. and Hill, R. E. Arabic characters for type or slugs; Nashki style; 60 primary characters and 30 others.

22255 Albrecht, C. A. Trimming edges of slugs as ejected from linotype machines; Linotype.

22871 Johnson Typesetter Co. Typesetting machine with line-justifying arrangement for casting and inserting spaces of the required width.

23257 Llewellin, W. M. Hand-stamp for workmen's time-sheets.

23642 Muller, W. Electrotype nickel matrices.

24505 Levy, F. Type-distributing

25691 Rozár, C. Apparatus for perforating strips for controlling type- or matrix-composing machines.

25764 Rozár, C. Keyboard-mechanism for composing machines.

25868 Retaux, M. Monotype and like machines; a variation of the Monotype with multiple mould-cavity bars.

25948 Lock, W. H. and Pinel J. Linotype machines; production of slugs with accents.

26218 Model Menu Maker. Type-case for containing slugs or logotypes.

26290 Garratt, J. J. R. and Atkinson, E. H. Adjustable mounting-block for printing-surfaces.

26406 Ritzema, T. P. Linotype machines; casting type-furniture.

1902.

57 Lock, W. H. and Cotsworth, A. G. Alining-mechanism; Linotype.

776 Duncan, J. S. Frames for printing-types; Addressograph.

1024 Moseley, C. S. Date- and time-printing stamp; controlled electro-magnetically.

1983 Stutchbury, W. T. and Schultz, H. R. Monotype and like machines; electric line-justifying mechanism; Graphotype.

1985 Stutchbury, W. T. and Gorick, C. Monotype and like machines; electric indicating mechanisms; Graphotype.

2469 Thomae, R. L. Typesetting and composing-machine.

2627 Llewellin, W. M. Time-printing stamps.

2762 Mason, T. Mounting and securing stereotype- and electrotype-plates on multiple block.

2900 Cox, A. Quoins for locking up and adjusting blocks; screw adjustment.

3270 Rosinkiewicz, C. and Ramult, L. Typesetting from type-cases, assisting hand.

3445 Low, A. A. and Breakey, J. Type-distributing.

3486 McClintock, F. Typesetting and line-justifying.

4257 Lanston Monotype Machine Co. Monotype and like machines; manufacture of justified matrices; Monotype.

4259 Lanston Monotype Machine Co. Monotype machines; pump-actuating mechanism; Monotype.

4261 Lanston Monotype Machine Co. Monotype and like machines; fluid-metal injecting-mechanism; Monotype.

4263 Lanston Monotype Machine Co. Monotype machines; feeding controlling-strips in typecasting machines; Monotype.

4265 Lanston Monotype Machine Co. Monotype machines; record-strip feeding mechanism for typecasting machines; Monotype.

4667 Pulsometer Engineering Co. and Adcock, E. A. Typesetting; means for operating type-ejectors. Pulsometer.

5957 Lanston Monotype Machine Co. Monotype machines; automatic-leading mechanism for typesetting; Monotype.

No.

6001 Watson, J. Typesetting and line-justifying.

6872 Cleghorn, T. Linotype machines; production of tabular printed matter; matrices struck at a right-angle to normal.

6959 Cottrell & Sons Co., C. B. Making ready by building up on back of stereotype-matrix.

6962 Lock, W. H. and Martin, T. Linotype machines; setting short measures of tabular matter.

6985 Wood, H. A. W. Machines for casting and finishing stereotypes.

7284 General Typing Machine Co. Linotype and stereotype-matrix machines.

7290 Hoch, A. and Wendling, G. X. Machine for printing rows of figures in arithmetical order and for calculating and printing the sum at the foot.

7691 Bell, J. B. Linotype machines; double-magazine mechanism.

8736 Lanston Monotype Machine Co. Monotype machines; type-composing machines for tabular work; Monotype keyboard.

8737 Lanston Monotype Machine Co. Monotype machines; composing tabular matter, the sections of each line being separately line-justified; Monotype keyboard.

9113 Holbourns, J. G. and Longhurst, H. A. Slug-casting machines; positive distributor used instead of tilting the frame; Typograph.

9543 Mechanical Improvements Co. Date- and time-printing stamps.

9548 Bower, W. M., Mee, A. C. and Lawry, R. H. Addressing-machines; chain-feed galleys of linotype-slugs.

9752 Pitman, E. Mounting-blocks for stereotypes or electrotypes.

9889 Baker, C. Shallow linotype-slugs for printing addresses.

10229 Davenport, J. Stamping numbers or marks on linen.

10847 Stockall, J. J. Time-printing stamp with quick movement for typewheels.

11157 Silva, J. F. da. Triangular spacing-blocks or furniture, for setting up oblique matter.

11198 Des Jardins, B. M. Typesetting and line-justifying apparatus.

11511 Watson, J. Trip-lever mechanism of line-justifying machines.

11512 McClintock, F. Improvements in line-justifying machines.

11960 Wicks, F. Improvements in type-composing machines.

12442 Bartlett, H. B. Linotype machines; distributing different founts of matrices.

12631 Cordeaux, W. Producing relief printing-surfaces from sheets of tin-foil.

12690 Holdsworth, F. Line-justifying machines; improvement on 3486/1902.

12775 Peacock, F. E. Improvements in pumps for typecasting machines; Wicks.

13092 Bartlett, H. B. Linotype machines; matrix-escapement.

13122 Duncan, H. M. and Pierpont, F. H. Monotype machines; adjustable nick-formers.

13199 Franklin, H. H. Improvements in type-moulds, for escape of air.

13341 } Thorne Typesetting Machine Co. Typesetting
13342 } and line-justifying.

13476 Ballantine, R. F. Stereotype-matrix impressing.

13773 McClintock, F. Typesetting.

13774 McClintock, F. Type-ejecting mechanism of typesetting machines.

14388 Lagarde, J. Monotype and like machines, electrically-operated machine producing perforated strip.

14453 Lock, W. H. and Girod, E. Assembling-mechanism; Linotype.

14590 Saunders, A. E. Moulds for stereotypes of carbonaceous clay.

15356 Lagarde, J. Monotype and like machines; electrical mechanism for controlling perforated-strip making machines.

15549 Graves, J. G. and Gunby, T. H. Composing-sticks; means for adjusting and fixing angle-piece.

15668 Pinel, J. Monotype and like machines; machine for typecasting or automatic typecasting and composing; strip-controlled.

No. **1902** (*continued*).

15798 Kraus, A. and Collins, N. Stereotype-matrix and like machines.
16626 Mergenthaler Linotype Co. Feeding metal to melting-pot; Linotype.
16939 Lagarde, J. Automatic control of typesetting and composing machines, situated at a distance from the operator, by electric keyboard.
16947 Link, R. P. and Rowlands, W. E. Date- and time-printing stamps.
17753 Albrecht, C. A. Linotype machines; distributing-mechanism; Linotype.
18063 Muehleisen, C. Magazine-mechanism; Linotype.
18495 Wicks, F. Improvements in rotary typecasting machine moulds; angle-base segments.
18637 Piscicelli, Count R. Taeggi. Postmarking machine; date- and time-printing stamp; time to nearest 5 minutes.
18681 Turck, P. M. and Tracey Manufacturing Co. Numbering-apparatus for sales-slips.
18848 Duncan, H. M., Prichard, C. H. and Macauley, C. R. Monotype and like machines; casting low-quads; Monotype.
20258 Schulze, A. Photomechanical screens with rulings at 60° and special stops.
20301 Dodge, P. T. Space-magazine mechanism; Linotype.
20302 Dodge, P. T. Distributing-mechanism; Linotype.
20432 Llewellin, W. M. Time-printing stamps.
21087 Brackelsberg, E. W. Stereotype-matrix machines.
21810 Cole, B. and Wilson, A. O. Linotype machines; leading-mechanism.
21897 Bates, G. A. Linotype machines; double-magazines and single keyboard.
22091 Bryan, J. P. Mounting electrotypes and stereotypes.
22653 Creed, F. G. and Coulson, W. A. Apparatus for controlling typesetting machines; translating Wheatstone telegraphic perforated-strip automatically into printed characters.
22707 Mergenthaler Linotype Co. Adjusting movable vice-jaw; Linotype.
23699 Wächtershäuser, J. Stereotype-matrix machines.
23725 Newman, H. C. Means for securing slugs in fudge-boxes.
23726 Dalziel, H. Securing electrotypes and stereotypes.
25530 Lock, W. H. and Broadhouse, J. Trimming-knives for producing parallel-sided slugs; Linotype.
25781 Kley, A. C. Hand-stamps.
26659 Duncan, H. M. and Pierpont, F. H. Monotype machines; apparatus for grinding type-matrices; Monotype.
26887 Duncan, H. M. and Macauley, C. R. Monotype machines; pneumatically controlled means for casting low-quads and spaces; Monotype.
27035 Burda, F. A. E. Date- and time-printing stamps.
28233 Lock, W. H. and Wich, F. J. Preventing formation of a vacuum in the delivery pipe of stereotype-casting machines.

1903.

37 Roberts, T. H. Date- and time-printing stamps.
368 Lebrun, L. Typesetting and distributing; line-justification by spring space-types.
622 Pulsometer Engineering Co. and Kenney G. E. Typesetting machine; Pulsometer.
755 Duncan, H. M. and Pierpont, F. H. Optical apparatus for measuring matrices; Monotype.
756 Hoe, R. Securing stereotype-plates to beds.
868 Smith, R. H. Vulcanising rubber-type.
1019 Stavenow, G. A. W. Stereotype-metal; preparing from two alloys remelted with additions.
1656 Thommen, P. Linotype and like machines impression- or matrix-disks.
1705 Winkler, F. Type-distributing machine.

No.
2091 Post, A., Klarwasser, A., Willner, I. and Markus, P. Typesetting machine operated electro-magnetically.
2170 National Typographic Co. Linotype machines; guard for distributing-mechanism; preventing matrices from falling.
2490 Kraus, A. Matrix-composition for stereotype-matrix machines.
3396 Cornelius, J. W. Mounting-block of two sliding parts for clamping stereotypes by locking up.
3617 McGowan, H. Linotype machines; preventing transposition of spacers.
4914 Warwick, B. W. Date- and time-printing stamps; time-printing mechanism.
5284 Peacock, F. E. Typecasting machine with moulds carried on an endless band before nozzle of metal-pot.
5738 Storey, F. G. Linotype machines; moulds for ingots.
6024 Seeds, W. A. Mould-blade for typecasting machines for low-quads.
6330 Bellows, B. F. Linotype and like machines; Electric Compositor.
7465 Maley, H. A. Mounting electrotypes and stereotypes.
7475 Ottmar Mergenthaler Co. Linotype, monotype, stereotype-matrix and like machines; producing line-justified lines of type, logotypes, impressions or linotypes.
8060 Lanston Monotype Machine Co. Centring matrices on typecasting machine; Monotype.
8169 Jacobson, J. Screens for photomechanical printing.
8266 Hansen, H. C. Type-matrix holders and depth gauges, for matrix-justifying.
8272 Muehleisen, C. Linotype machines; two or more moulds on mould-wheel; Linotype.
8755 Stappen, R. Date- and time-printing stamps.
8823 MacMaster, P. Date- and time-printing stamps.
8998 Lock, W. H. and Lawless, P. C. Linotype machines; double-magazines; Linotype.
9325 Wehrlin, M. Line-justifying and space-casting mechanism; Monotype.
9909 Mayer, J. Linotype machines; magazine-delivery.
10797 Johnson, F. A. Typesetting.
10813 Wildridge, G. J. Flong for making stereotypes.
10901 Boecker, C. Adjustable hand-stamp.
11134 Wehrlin, M. Monotype and like machines; clutch-device for line-justifying mechanism.
11590 Lock, W. H. Flong for taking impressions of both type-matter and half-tone blocks.
11733 Wehrlin, M. Monotype and like machines; means for stopping machine at end of composition.
11872 Esson, J. and Esson, C. C. Galleys for monotype and like machines.
11903 Converse, F. B. Typesetting and line-justifying.
12118 Dey, A. and Dey, J. Date- and time-printing stamps.
12136 Jaazer, C. and Lawson, E. Mangle-press with jockey-rollers for making flong stereotype-moulds.
12176 Mergenthaler Linotype Co. Ejecting-mechanism; Linotype.
12494 Brown, F. H., Hanrahan, J. E. and Boyden, G. A. Typecasting machine; casting sorts in the printing establishment.
12850 Hopkins, C. E., and Wesel, F. Machine for casting and trimming curved stereotype-plates.
13495 Wehrlin, M. Monotype and like machines; device for increasing kinds of type composed without increasing the number of combinations of perforations in strip of strip-controlled machines.
13772 Scudder, W. S. Monoline machines; matrix-bar accelerating and stopping devices.
13879 Black, J. Work-holder and stop for reducing stereotype-plates to width.
13881 Müller, F. J. Typesetting and distributing.
14064 Tunaley, J. Linotype machines; matrix-assembly mechanism.
14183 Hummel, A. Mould for casting type-high stereotype-plates.

No. **1903** (*continued*).

14447 Haddon, W. and Larder, F. T. Typesetting and composing.
14662 Dodge, P. T. Two-magazine machines; Linotype.
14895 Wilson, J. C. Time- and date-printing stamps.
14983 Christy, M. Electrotype- and stereotype-blocks for printing garment patterns.
15044 } 15045 } Mergenthaler Linotype Co. Linotype machines; improvements on 14582/1890.
16011 Dougall, J. R. Linotype machines; improvements in assembling, line-justifying and distributing.
16068 Hews, F. W. Typecasting machines; finishing and delivering various bodies of type at one time.
16297 Roovers, A. W. and Roovers, A. H. Stereotype-matrix and like machines; embossing in thin metal.
16447 Dittmann, T. Screens for photomechanical plates used otherwise than in the camera.
16708 Pinel, J. Monotype and like machines; apparatus for perforating controlling-strip. Dyotype.
17118 Greef & Co., A. Electrotyped shells or segments; curved.
17312 Bonneau, J. C. Drying stereotype-matrices by dry fluid pressure. [*sic.*]
17635 Lock, W. H. and Speechley, W. R. Linotype machines; casting linotype-slugs for tabular matter with notches to receive rules.
17807 Jelenko. I. Hand-stamps; for recording hour and minute.
18180 Rogers, J. R. Linotype machines; a modified linotype with vertical magazine.
18430 Brusselet, V. A. Barometric, etc., curves set up of special rules with notches for the readings.
18490 Vilbiss, A. de. Time-printing stamps worked in conjunction with locks.
19587 Dodge, P. T. Linotype machines; supporting sectional-mould; Linotype.
19636 Corey, J. A. Wooden mounting-blocks for stereotypes with metal-casing except at top.
19853 Martyn, A. Forming type with hard face on soft body.
19853A Martyn, A. Moulds of *papier mâché* for casting type.
21291 Lamp'l, P. J. Mould for casting type-lines, headings and blocks.
22063 Pierpont, F. H. and Duncan, H. M. Monotype and like machines; moulds; Monotype.
22558 Wolters, O. Mechanically-operated keyboard machine for producing perforated record-strip.
22611 Scott, J. R. and Guthrie, C. Drying stereotype-moulds by electric heaters.
23006 Timmis, W. S. Monotype, linotype, stereotype-matrix and like machines; apparatus for producing perforated controlling-strips; line-justifying.
23007 Timmis, W. S. Monotype and like pattern-controlled machines; mechanism connected with pattern or perforated-strip; line-justifying.
23067 Tuch, O. Stereotype-matrix machines; a continuously rotating typewheel impressing flong.
23100 Jubb, T. and Jubb, R. Linotype and like machines; special composition for use in remelting metal.
23744 Wetter Numbering Machine Co. Numbering-apparatus; type-high with paper-lifter.
24314 Lanston Monotype Machine Co. Monotype machines; detachable keyboard for permitting different arrangement of symbols; Monotype.
24499 Bailey, W. T. Characters or figures, consecutive or repeated, printed by multiple numbering-appliances on rotary cylinder for printing sales slips, etc., on strip.
25007 Lanston Monotype Machine Co. Monotype and like machines; matrix-centring mechanism; Monotype.
25684 Rockstroh, C. F. Holder for electrotypes and stereotypes; curved.
26953 Booth, S. Printing-surfaces cast in composition of wax, sulphur and boiled oil, etc.

No.
27476 Lanston Monotype Machine Co. Monotype and like machines; matrix-centring mechanism; Monotype.
27480 Lanston Monotype Machine Co. Monotype and like machines; moulds; Monotype.
28628 Winnett, W. H. Hand-stamps; for use singly or in combination.

1904.

832 Bartholomew, W. F. Hand-stamp with movable arrow for printing time.
2168 Parker, A. J. Mounting-block built up of wood-blocks with grain at right angles to each other.
2169 Mayer, J. and Albrecht, C. Linotype, monotype and like machines; casting in mould-compartments for type, logotypes, ornaments, etc.
3458 Addressograph Co. Rubber-type interlocking with holder. Addressograph.
5092 Pulsometer Engineering Co. and Adcock, E. A. Typesetting and distributing machines; Pulsometer.
5212 Wicks, F. Linotype and like machines. Casting logotypes with mould-ends.
5619 Galwey, J. de B., and Schreier, E. Paging- and numbering-apparatus.
5744 Clark, E. B. Linotype machines; trimming-mechanism.
5797 Brooks, B. A. Typecasting and composing machine. Casts a new type to replace each type used; casts equal spaces and sets between each two words of the line.
6439 Simpson, H., and Walker, E. W. H. Quoins and side- and foot-sticks.
6543 Dey, A. and Dey, J. Date- and time-printing stamps.
7314 Wicks, F. Punch-cutting machine with ball-and-socket joint.
7394 Foster, R. J. and Buckle, J. W. Linotype machines; shifter-mechanism.
7826 Perry Time Stamp Co. Date- and time-printing stamps.
7960 Foster, J. and Foster, J. Y. Mounting type, stereotypes, etc., on cylinders.
8117 Albert, E. Making thin lead matrices for electrotypes.
9013 Cottrell & Sons Co., C. B. Process for levelling stereotypes; making-ready on flong-mould.
9081 Waite, F. and Waite & Saville. Paging-types mounted in a chain.
10032 Corey, J. A. Mounting-blocks of wood with a protective metal casing cast on with key-grooves.
10338 Pierpont, F. H. and Duncan, H. M. Monotype machines; matrices.
11501 Brown, S. Printing-cylinders with grooves and rods for securing notched type.
11633 Wagner, P. Typesetting and distributing; electro-magnetic control.
11633A Wagner, P. Typesetting machine.
11761 Dodge, P. T. Linotype machines; matrix-magazines.
12007 Lock, W. H. and North, T. M. Improvements in machines for casting and finishing curved stereotypes; Autoplate.
13007 Rudolphy, G. Monotype, linotype and like machines; distributing, matrix-composing, typecasting and matrix-distributing.
13012 Cowper-Coles & Co. and Cowper-Coles, S. O. Production of copper electrotypes.
13789 Huggins, S. A. Casting curved stereotypes for fudge or late-news.
14050 Gray, J. G. and Redpath, R. Linotype machines; cleaning face of mould.
14693 Mergenthaler Linotype Co. Linotype machines; matrix-distributing apparatus.
14964 Tympalyn Co. Mounting-blocks for stereotypes with first-action clamping and subsequent movement.
15058 Albrecht, C. Linotype machines; double-magazines.
15536 Hoe, R. Mould for curved stereotypes with water-cooling to core.
15861 Hopkins, C. E. Casting-apparatus for curved stereotypes.
17038 Meadows, C. A. Casting alloys in small ingots.

No. **1904** (*continued*).

18139 Dow Composing Machiue Co. and Dow, A. Typesetting, composing and line-justifying machine.

18140 Dow Composing Machine Co. and Dow, A. Line-justifying mechanism.

18334 Oldfield, F. F. W. Mounting-block for clamping stereotypes with multiple serration of supporting portion.

18500 Lock, W. H. and Speechley, W. R. Linotype machines; recessed slugs for tabular serrated rule. Linotype.

19417 Waters, E. T. Linotype machines; tabulating-mechanism.

19589 Mayer, J. and Albrecht, C. Linotype machines; distributing-mechanism for double-magazine machine.

20286 Pfitzer, F. Mounting-block faces of rectangular form with plastic cement.

20398 Blanz, E. Dry-flong stereotype-matrices.

21064 Murray, D. Operating keyboards of linotype machines, etc., by means of a perforated strip obtained by telegraphic means.

21466 Bellows, B. F. Linotype machines; transferring matrices from casting-mechanism to distributing rail; Electric Compositor.

21467 Bellows, B. F. Linotype machines; casting-mechanism for logotypes or type-slugs; Electric Compositor.

21468 Bellows, B. F. Linotype and like machines; assembling-mechanism; Electric Compositor.

21673 Tuch, O. Stereotype-matrix machines; line-justification of strip.

21971 Bhisey, S. A. Typesetting and typecasting apparatus; making and supplying compressible spaces.

22331 Corey, J. A. Clips for mounting stereotypes.

22972 Schreiner, F. Machine for impressing and drying stereotype-matrices.

22994 Bellows, B. F. Linotype and like machines; matrix-distributing mechanism; Electric Compositor.

22995 Bellows, B. F. Linotype machines; matrix, or type line-justifying mechanism; Electric Compositor.

23849 Eves, A. J. F. Stereotypers' casting-box; for use also in impressing matrices.

23929 Torrance, R. G. Construction of and means for securing wood-type on rotary printing machines.

25058 Smith, M. Stereotype-matrices from formes containing half-tone blocks.

25099 Corey, J. A. Clips for use in mounting stereotypes, etc.

25392 Lock, W. H. and Sutcliffe, F. W. Linotype machines; casting slugs of different lengths from the same line of matrices.

25431, 25432 Schaaff, J. T. Linotype and stereotype-matrix machines; operating electrically or direct from the keyboard.

26271 Goetz, G. Type-carrying wheels for automatic weighing-machine.

26542 Hoe, R. Automatic ejector for curved-stereotype shaving machine.

26572 Dove, W. and La Sor, W. A. Mounting-block for stereotypes and other plates.

26824 Ward, W. Gauge for casting stereotype-plates without superfluous metal at sides.

26899 Annand, R. C. Corrugated-paper backing for dry-flong matrices.

27106 Taplin, W. J. Gauge for registering printers' formes.

27277 Bancroft, J. S. Measuring-mechanism of record-strip perforators; keyboard of Monotype.

27278 Bancroft, J. S. Mould-adjusting device; Monotype.

28180 Herrmann, C. B. Dies for stereotype-matrix machines.

28439 American Type Founders Co. Engraving machine for cutting type-matrices or punches. Matrix-engraving with independent adjustment of one set of gimbal-bearings for producing condensed or extended type from the same former.

28440 American Type Founders Co. Pantograph and tracing-microscope for use in producing formers.

No.

28573 Reintanz, M. and Rothe, A. Hand-stamps for receipting, provided with means for adding all amounts receipted.

28767 Osborn, H. C. and Gammeter, H. C. Machine for use in composing and distributing short grooved type for printing imitation of type-written documents; Multigraph.

28849, 28850 Llewellin, W. M. Date- and time-printing stamps.

29195 Howard, F. M. Time-printing stamps.

29239 Stockall, J. J. Time-printing stamps.

1905.

1418 Andrieu, R. Clips for securing printing-plates in formes.

1424 Toronto Type Foundry Co. Linotype machines; oscillating assembler-mechanism, with movable wiper; Linotype.

1424A Toronto Type Foundry Co. Linotype machines; line-justifying-bar mechanism; Linotype.

1424B Toronto Type Foundry Co. Linotype machines; oscillating-assembler and automatic mechanism; Linotype.

1597 Albert, E. Matrices for electrotyping formed of sheet lead by successive pressing operations.

2155 Baker, C. and Bower, W. M. Linotype and like machines; electric work-computator.

2238 Fischer, G. Matrices for electrotyping pressed in sheet-lead having one or more series of grooves on the back.

2852 Aix, F. C. L. d'. Linotype machines; matrices with different body characters.

2853 Aix, F. C. L. d'. Linotype and like machines; radial magazines for different founts.

2915 Warnock, W. S. Composite mounting-block of several hollow, square blocks with ruled tops, clamped together.

2949 Dove, J. M., Bancroft, J. S. and Indahl, M. C. Interchangeable die-cases for Monotype.

2950 Bancroft, J. S. Centring-mechanism for type-caster. Monotype.

3761 Swift, E. S. Date-printing stamps.

4081 Reiter, J. Producing stereotype-matrices in hydraulic press with a sliding table.

4178 Bates, E. G. Numbering-apparatus; consecutive, duplicate or repeated; hand-stamp.

4289 Follett, W. I. Time-printing stamps.

4668 Cowper-Coles, S. O. Electrotypes deposited with forced circulation through holes in the anodes.

4726 Bancroft, J. S. Die- or matrix-carriers for Monotype caster.

5252 Toronto Type Foundry Co. Linotype machines; mould-jaws; Linotype.

5344 Bellows, B. F. Linotype and like machines; assembly-mechanism; Electric Compositor.

5859 Rogers, J. R. Linotype machines; slugs with slots to receive rules; Linotype.

6450 Wesel, F. Machine for drilling and nailing electrotype-plates to mounting-blocks.

6675 Addressograph Co. Addressing-machine printing-plate with raised printing-surface.

6932 Brown, C., Chance, H. G. and Bland, G. H. Mounting-process for zincographic-blocks within stereotype-plates on cylinders.

7270 Roberts, A. L. Linotype machines; metal-feed.

7271 Roberts, A. L. Chase with all its furniture and parts permanently attached.

7505 Dodge, P. T. Linotype machines; removable magazines; Linotype.

7506 Poe, D. A. Linotype machines; line-transferring and distributing-mechanism; Linotype.

8551 Kennedy, D. S. Linotype machines; sliding magazines; Linotype.

8566 Hoe, R. Casting curved stereotype-plates; horizontal axis.

8733 Rogers, J. R. Linotype machines; multiple-magazines; Linotype.

10232 Duncan, J. Time-printing stamps; type-wheel mechanism.

11527 Albert, E. Making matrices for electrotyping.

11856 Lanston Monotype Machine Co. Die-case centring-mechanism; Monotype.

12131 Mackay, W. K. and Hardisty, C. Linotype machines; repeat work mechanism; Linotype.

No. **1905** (*continued*).

12362 Pinel, J. A strip-controlled typecasting and setting machine, capable of casting two or more of the characters at once. Dyotype.

12524 Corey, J. A. Clips for mounting stereotypes, etc.

12915 Bright, F. E. Linotype machines; escapements of magazines; Linotype.

13105 Elektrizitats Akt.-Ges. vorm. Schuckert & Co. Producing high or low spaces in a typecasting machine.

13938 Wood, H. A. W. Casting and trimming curved stereotype-plates; Autoplate Junior.

14156 Schimmel, F. Linotype and like machines. Composes a line of polyhedral matrices, line-justifies with wedge-spacers and distributes matrices.

14467 Nelson, I. T. and Murray, J. Apparatus for backing up electrotypes.

14906 Law, J. C. Type for printing braille characters for the blind with six dots of which those not required are removed.

15314 Hopkins, C. E. Machines for casting and trimming curved stereotypes.

15329 Langen, F. A. Time-printing stamps with electrically controlled typewheels.

15654 Ray, D. B. Compressible non-resilient spaces.

15876 Dyson, H. Time-printing stamps; positioning the identifying number-printing wheel.

16440 Charlottenburger Farbwerke Akt.-Ges. Apparatus for cleaning matrices for stereotypes.

16510 Charlottenburger Farbwerke Akt.-Ges. Apparatus for finishing curved stereotypes.

16646 Sennett, S. J. Typecasting, nicking and finishing machine.

17077 International Time Recording Co. Date- and time-printing stamps with automatically moving typewheels.

17727 Lewis, I. E. and Corey, J. A. Making electrotypes.

17778 Crabtree, C. H. and Crabtree, A. E. Fudge-boxes.

18766 Monoline Composing Co. Composing-box and line-carriage mechanism; Monoline.

18871 Snowdon, T. W. and Rostron, J. Forming stereotype-plates to facilitate insertion of illustration-plates.

19016 Toronto Type Foundry Co. Linotype machines; escapements operated directly by the keys; Linotype.

19017 Toronto Type Foundry Co. Linotype machines; escapement-pawls pivoted to an extension of the matrix-delivery mouth; Linotype.

19333 Hopkins, C. E. Machine for trimming the longitudinal and curved edges of curved stereotypes.

20677 Laycock, W. Hand-stamps for rubber-type.

21174 Hedderwick, P. D. Fudge-box with radial ribs in ends to separate type-slugs.

21589 MacConnell, H. C. Machine for trimming straight and curved edges and for shaving curved stereotypes.

22689 Hoe, R. Machine for making stereotype-matrices by alternately pressing and drying.

24227 Hay, J. M. Time-printing stamps for speed-indicators.

24242 Böttger, C. G. Moulds for typecasting machines; body-slide.

24358 Pew, J. D., de Wagenen, E. van and Burton, J. J. Hand-stamp for dating and cancelling, with characters on four chains.

24489 Baldwin, R. S. Monotype and like machines. A modified monotype.

24516 Mayer, J. and Muehleisen, C. Linotype machines; two or more identical characters on each matrix.

25397 Hoeft, M. Record-printing stamps; clock-driven speed-indicator disks printing when speed varies above and below certain limits.

25861 Creed, F. G., Coulsen, W. A., Brown, H. T. and Brown, N. P. Typesetting; a Jacquard-operated typesetting machine.

26074 Schiepe, A. and Schütte, C. Rotary typecasting machine; mould-wheel rotates about a horizontal axis.

26251 Albrecht, C. A. Linotype machines; double-magazine distributing-mechanism.

26387 Schütte, C. and Schiepe, A. Typesetting machines; means of line-justification.

No.

26449 Harris, C. G. Numbering-apparatus; duplicate or repeat.

26651 Whitehead, A. and Porteus, G. Machine for heating or moulding stereotype-matrices.

27044 Wood, H. A. W. Machines for casting curved stereotypes; Autoplate Junior.

27259 Annand, R. C. and Peel, F. Stereotype-casting machines.

1906.

301 Annand, R. C. Metal-pump carried on vertical pivots axial with metal-pot, for filling a succession of stereotype-moulds.

987 Lock, W. H., Caine, F. J. and Mitton, G. H. Linotype machines; means for adjusting trimming-knives; Linotype.

996 Neue Photographische Ges. Inkless printing from relief surfaces of photomechanical plates.

2131 Scotford, L. K. Numbering-apparatus; consecutive, duplicate, triplicate, or indefinite repetition.

2258 Webster, C. C. Machine for manufacturing printers' leads.

2342 Kotyra, M. Machine for perforating strips for controlling typecasting machines operated electromagnetically.

2421 Wood, H. A. W. Machines for casting curved stereotypes; Autoplate class.

3551 Goss Printing Press Co. Pivotally mounted stereotype-moulds connected to a ladling device.

3568 Goss Printing Press Co. Multiple-mould for curved stereotype-plates with single opening- and closing-apparatus; three sets of casting-apparatus to one pot.

3679 Pearce, Sir W. G. and Reeves, W. R. Time-printing stamp for recording railway-signals.

4300 Hopkins, C. E. Apparatus for casting curved stereotypes; see 12850/1903.

4668 Wood, W. A. Date- and time-printing stamps.

4684 Cowper-Coles, S. O. Pressing electrotype-moulds from a composite sheet of two thicknesses of lead with an intermediate sheet of rubber.

5249 Studer, C. Means for accurately mounting the successive plates for multi-colour printing.

5640 Clause, J. J. Securing linotype-slugs or type in fudge-boxes.

6277 Hopkins, C. E. and Bennison, W. E. Apparatus for casting and trimming curved stereotypes.

7201 Shepherd, T., Baker, W. J. and Lockett, J. Printing-type of linoleum.

7206 Duncan, H. M. and Pierpont, F. H. Machines for cutting punches and matrices; Monotype punch-cutter.

7309 Lock, W. H. and Lawless, P. C. Linotype machines; trimming-knives.

7417 Homans, T. S. Linotype machines; changing magazines.

7582 Elektrizitäts Akt.-Ges. vorm. Schuckert & Co. Monotype and like machines; selecting devices for types and line-justification for casting from the strip in the direction composed.

8467 McCrum, J. Linotype machines; pump-stop mechanism.

8470 Müller, F. J. Typesetting and distributing machines.

8665 Schilla, O. Composing-sticks.

8843 Schimansky, H. Flong-matrices faced with three sheets of thin lead

8874 Kennedy, W. R. Double-magazine machines; Linotype.

8880 Dow, W. S. and Smith, E. J. Apparatus for casting a number of stereotype-plates in moulds arranged concentrically with the melting-pot.

9587 Dow, W. S. and Smith, E. J. Fudge-boxes with saw-shaped teeth for securing linotype-slugs.

9972 Dethleffs, M. Composition for mounting-blocks for printing-surfaces.

10258 Peczenik, C. E. Flong for stereotype-moulds.

10417 Fanslow, B. O. Type-holder for printing letters, circulars, maps, etc.

No. **1906** (*continued*).

10687 Mayer, J. and Albrecht, C. A. Matrix-releasing and guiding from two or more superposed magazines; Linotype.
10898 Addressograph Co. Metal-type with skeleton bodies for use in typeholders; Addressograph.
10988 Defauw, T. Date- and time-printing stamps for race-timing.
11237 Thomas, W. Hand-stamps.
11599 Thomson, A. C. Hand-stamps.
11650 Bryan, J. P. Production of stereotypes suitable for use in addressing-machines.
11914 Nuernberger, P. G. and Rettig, G. Type-casting machines; type-moulds.
11915 Nuernberger, P. G. and Rettig, G. Type-casting machines; matrix-holders and adjustment of moulds.
12672 Lock, W. H., Holbourns, J. G. and Longhurst, H. A. Linotype machines; escapement-mechanism; Linotype.
12801 Brown, S. Type with grooves to engage with a special case and with a composing-stick or fork.
13096 Duncan, H. M. and Pierpont, F. H. Machine for grinding cutters for punch-cutting. Monotype punch-cutter.
13227 Taylor, W. Date- and time-printing stamps.
13854 Tillmanns, E. Hand-stamps; for recording vehicles entering railway-stations.
13997 Jacobs, R. F. and Walther, C. F. Machine for cutting linotype-slugs to length.
14035 Drummond, R. Casting low-quads and -spaces. Monotype.
14619 Trama, E. Linotype machines; automatically supplying metal to pot by means of inclined plane and metal balls automatically-delivered as required.
14621 Blackmore, L. R. Hand-stamp with flexible backing for type.
14786 Safford, O. D. Hand-stamp for printing columns, names, addresses, etc.
14933 Kristensen, S. A. C. Liquid compound for use in preparing flong stereotype-matrices.
15270 Allam, G. and Byles, A. R. Mounting half-tone process plates in stereotype-plates of rotary presses.
15468 Druitt, P. W. and Baines, E. R. Starting, vice-justifying and matrix-separating mechanism; Stringertype.
15545 Lanston Monotype Machine Co. Line-measuring and indicating mechanism; Monotype.
15650 Lanston Monotype Machine Co. Line-measuring mechanism for keyboard; Monotype.
15987 Aix, F. C. L. d'. Linotype machines; casting, trimming and ejecting mechanism; line of matrices conveyed by rotating carrier.
16363 Brown, T. Linotype machines; cleaning matrix-faces.
16586 Weeks, F. W. Chase with holders for separate lines of type particularly adapted to type with a printing-character at one end and a proof-character at the other.
16592 Dow, W. S. and Smith, E. J. Casting curved stereotype-plates.
17546 Hewitt, T. P. and Hewitt, C. J. Time-printing stamps for recording the time of railway-signals.
17726 Redington, F. B. Mounting-block for electrotypes, stereotypes, etc.
17912 Laudenbach, H. Linotype machines; distinguishing characteristics for groups of keys.
18054 Brown, W. and Weber, A. Composite backing-block for mounting half-tone plates.
18230 Lanston Monotype Machine Co. Detachable and interchangeable stop-bar and coupling arrangements for change of fount in record-strip perforators; Monotype.
18231 Lanston Monotype Machine Co. Casting low quads or -spaces; Monotype.
18331 Lock, W. H., Holbourns, J. G. and Longhurst, H. A. Linotype machines; simultaneously adjusting mould and trimming-knives and also length of mould.
19243 Macdonald, R. G. A. Perforated type for typewriters.
20213 Annand, R. C. Apparatus for casting and trimming stereotype-plates.

No.
20617 Butlin, G. L. Rotary numbering-machine for printing longitudinally or circumferentially; consecutive.
20681 Homans, T. S. Linotype machines; moulds adjustable for length and width; Linotype.
20731 Annand, R. C. Machine with collapsible core for casting and trimming curved stereotype-plates.
20731A Annand, R. C. Machine for casting and trimming curved stereotype-plates; matrix-stripping gear without collapsible core.
21809 Thompson, A. C. Hand-stamps.
22239 Albert, E. Making soft-metal matrices for electrotypes.
22419 } 22420 } Wood, H. A. W. Machine for trimming and cooling curved stereotype-plates; Autoshaver.
22912 Hopkins, C. E. Apparatus for finishing curved stereotypes.
22974 Stamm, J. Monotype machines. Templets equal or proportional to set widths of type are composed and line-justified by wedge-spaces; the casting operations are then controlled by the templets and the wedge position.
22995 James, R. L. and Braun, H. C. Printing-block for weather-charts in newspapers.
23508 Pollen, A. H. Assembling-mechanism and line-delivery carriage; Linotype.
23528 Baker, A. G. Typesetting and distributing.
23847 Pollen, A. H., Holbourns, J. G. and Longhurst, H. A. Linotype machines; mechanism for effecting change of magazine.
24064 Patent-Industrie-Ges. Linotype machines; automatic safety device; Monoline.
25213 American Type Founders Co. Machine for cutting and smoothing the ends of printers' leads.
25310 Chambonnaud, L. Typesetting; adaptation of typewriter-mechanism.
25454 Jackson, H. O. Date- and time-printing stamps for coin-freed apparatus for issuing insurance tickets.
25484 Kempe, C. Keeping surface of stereotype-metal from oxidizing by floating iron balls or plates.
26595 Gottschling, A. Type with curved lines and clubbed ends to strokes.
27060 Drewell, H. Monotype, linotype, and like machines; strip-controlled electro-mechanical actuation of composing and typesetting machines.
27130 Lebeis, M. Printing, numbering, dating and issuing railway-tickets using a chain of printing-plates.
27678 Knorr, W. Adjustable frame for holding together standing type.
27946 Brauchlin, G. Printing measurement-marks on fabrics.
28683 Toronto Type Foundry Co. Linotype machines, assembly space-carrier, trimming and galley mechanism; Linotype.
29194 Maurer, F. Machine for beating flong stereotype-matrices.
29195 Pearce, Sir W. G. and Reeves, W. R. Time-printing stamp for recording electrically-transmitted signals sent between signal-cabins.
29398 Hewitt, T. P. Keyboard typewheel mechanism for recording railway-signal times on a record-tape.

1907.

116 Brown, S. Flexible type-forme of chain and bars of I-section engaging grooves in short type.
709 Harrison, A. W. Wood mounting-block of several lateral sections.
1286 Aix, F. C. L. d'. Linotype machines; varying the length and width of mould.
1560 Ray, D. B. Type-distributing.
1818 Lock, W. H. and Pearce, H. Double-magazines, facilitating removal; Linotype.
1819 Lock, W. H., Holbourns, J. G. and Longhurst, H. A. Means for justifying tabular matter; Linotype.
1821 Drewell, H. Monotype and like machines; strip perforator.

No. **1907** (*continued*).

1916 Gammeter, H. C. Machine for use in composing cylinders for imitation typewriting circulars; limiting the advance of the line and storing frequently-used characters.

2897 Savarèse, A. Typesetting; bifurcated type.

3002 Buigné, F. de, and Schreiner, J. Type of hard-metal locally softened by heat and pressed into soft negative-dies.

3585 Lock, W. H. and Pearce, H. Keyboard-mechanism; Linotype.

3670 Mergenthaler Setzmaschinen Fabrik. Protecting matrices in magazine-channels; Linotype.

4051 Cowper-Coles, S. O. Electrotyping on moving moulds.

4584 Foote, T. M., Wolfe, W. F. and Young, A. V. Date- and time-printing stamps.

4790 Lock, W. H., Gantzer, F., Pearce, H., Joy, J. H. and Billington, J. E. Divided moulds and ejectors for tabular work and short-measure; Linotype.

5011 Michaud, E., Spear, J. and Gibbs, F. H. Hand-stamp with rubber stereotype of thumb-print.

5236 Mergenthaler Setzmaschinen Fabrik. Reducing contact-area of matrices; Linotype.

5831 Thommen, P. Holder for alining detached rubber type.

5851 Hotel Security Checking Co. Means for automatically numbering and accurately counting printed-sheets.

6016 Gogel, F. Lines of type mounted in wedge-shaped holders and secured by bands to a cylinder.

6273 Lock, W. H., Woodroffe, C. S., Pearce, H. and Billington, J. E. Quadding-apparatus for short-measure; Linotype.

6430 Mirus, E. Typesetting and distributing.

7706 Rogers, J. R. Improvements in distribution escapement for multiple-magazines; Linotype.

7825 Klug, F. W. and Klug, R. Coating the printing-machine bed with a resinous compound to prevent spaces from rising.

7884 Lock, W. H., Holbourns, J. G. and Longhurst, H. A. Assembling and distributing reversible-matrices; Linotype.

7940 Hanigan, A. W. Forming slugs from loose-type with locking-strips.

8606 Lock, W. H. and Harris, J. J. B. Manually operated apparatus for casting, cooling and trimming curved stereotypes.

9032 Tihon, J. P. Double-magazine distribution; Linotype.

9185 Geiser, K. and Schatzmann, A. Printing-blocks formed of magnesite, starch and talc mixed with magnesium chloride.

9565 Cheffins, S. H. Printing-plates formed with relief surfaces to avoid use of underlays.

9797 Burg, H. and Jaunez, M. von. Typesetting machine and line-justifying by substituting spaces cut from lead-strip for temporary spaces.

9798 Burg, H. and Jaunez, M. von. Typesetting and distributing.

9799 Burg, H. and Jaunez, M. von. Apparatus for distributing nicked type.

9932 Druitt, P. W. Monotype and like machines; producing low-spaces; Stringertype.

10010 Eschinger, E. A. Casting low-quads; Monotype.

10011 Bancroft, J. S. Melting-pot nozzles; Monotype.

10012 Bancroft, W. Improvements in control-strip; Monotype.

10013 Benton, A. J. Adjustment of unit-wheel; Monotype.

10039 Linke, E. F. Linotype and like machines; improvements in assembly-wheel.

10047 Carleton, S. Etching process for preparing half-tone blocks.

10061 Rogers, J. R. Ejector-blades; Linotype.

10145 Duplex Printing Press Co. Machine for casting curved stereotypes.

10147 Duplex Printing Press Co. Stereotype metal-pot nozzle with hinged joint to allow it to turn back into the metal-pot; preventing freezing.

No.

10503 Dow, A. and Dow Composing Machine Co. Type-cases with pusher mechanism assisting hand.

10504 Dow, A. and Dow Composing Machine Co. Type-distributing.

10740 Sigurdsson, O. V. Monotype and like machines; typecasting, keyboard-operated machine with multiple-moulds; line-justifying with corrugated, compressible spaces.

10951 Soc. Anon. Internazionale per i Clichés in Celluloide Bacigalupi. Printing-surfaces of celluloid.

11075 Duplex Printing Press Co. Means for keeping metal-level constant in stereotype-casters; hinged displacer.

11140 Elliott, R. C. Monotype and like machines; a typecasting and composing machine resembling the Stringertype, but using selector-mechanism.

11467 Hanigan, A. W. Linotype and monotype machines; casting type and locking by strip in grooves to form slugs.

12134 Bannerman, R. P. Casting hollow quotations and furniture.

12194 Rockstroh, C. F. Clamps and spacers for printing-plates.

12209 Grant, S. Casting type from four L-shaped mould-members.

12476 Tachytype Manufacturing Co. Monotype and like machines; record-strip perforators; Tachytype.

12477 Tachytype Manufacturing Co. Monotype and like machines; Tachytype.

12610 Hodson, G. Griffin-. Type or hand-stamps with two holes each and capable of being connected by dowels.

12658 Ludlow Co. Linotype and like machines; casting from full-fount matrix-bars.

12911 Elliott, W. E. Mechanism for effecting change of fount, change of mould and for distributing to proper magazines; Linotype.

13018 Stockall, J. J. Date- and time-printing stamps.

13076, 13077 Pierpont, F. H. and Lanston Monotype Corporation. Monotype machines; casting low-quads or -spaces by means of a divided mould-blade; Monotype.

13505 Dodge, P. T. Facilitating removal of magazines; Linotype.

13778 Lock, W. H. and Wich, F. J. Assembling-mechanism for double-fount matrices. Linotype.

13803 Elektrizitats Akt.-Ges. vorm. Schuckert & Co. Monotype and like machines; rotary adjustment of matrix-disks in strip-controlled typecasting and composing machines.

13829 Mercier, C. A. Date- and time-printing stamps.

14088 Koske, O. Linotype machines; conveying matrices with deep slots.

14388 Coles, S. O. Cowper-. Soft-lead matrix of electro-deposited lead on a lead-sheet.

15508 Hodula, K. Hand-stamp for plane-tabling with polygonal and revolving-cylindrical stamps for railway-points, buildings, rail-signs, etc.

15547 Lanston Monotype Machine Co. Monotype machines; preventing delivery of defective lines; Monotype.

15548 Lanston Monotype Machine Co. Hydraulic means for retarding the motion of the die-case; Monotype.

16417 Foster, J., Foster, J. Y., Dow, W. S. and Smith, E. J. Casting stereotypes in several moulds from a pot with swivelling nozzles.

16860 Typograph Setzmaschinen Fabrik. Adjusting line of matrices and using two-letter matrices; Typograph.

17125 Evans, G. Making type-metal alloys direct from ores, etc.

17758 Foster, J., Foster, J. Y., Dow, W. S. and Smith, E. J. Machine for casting curved stereotype-plates.

17864 Monoman Typesetter Co. Monotype machines; machine with combined keyboard and casting-mechanism.

18172 Butcher, A. D. Special-sign types for representing sound values, printed between the lines of type.

No. **1907** (*continued*).

18201 Bellows, B. F. Linotype and like machines; matrix-distribution improvements; Electric Compositor.

18317 Toronto Type Foundry Co. Improvements in magazine adjustment; Linotype.

18382 Electric Compositor Co. Linotype and like machines; various improvements in line-justifying mechanism and in transferring and starting casting; Electric Compositor.

18383 Bellows, B. F. Linotype and like machines; improvements in moulds, trimming and ejecting mechanisms; Electric Compositor.

18405 Green, J. Preventing warping of mounting-blocks by inserting dovetailed strips inclined to the grain.

18579 Lock, W. H., Pearce, H. and Billington, J. E. Improvements in assembly; Linotype.

18627 Lock, W. H., Billington, J. E. and Holliwell, C. Assembly-mechanism; Linotype.

18962 Lock, W. H., Billington, J. E. and Holliwell, C. Trimming two-line letter slugs; Linotype.

19026 Toronto Type Foundry Co. Storage magazines; Linotype.

19567 Toronto Type Foundry Co. Assembly-mechanism; Linotype.

20934 Lanston Monotype Machine Co. Improvements in punching record-strip; Monotype.

20935 Lanston Monotype Machine Co. Making record-strips; Monotype keyboard.

21013 Lanston Monotype Machine Co. Arrangement of keys actuating punches; Monotype keyboard.

21014 Lanston Monotype Machine Co. Monotype machines; machine adapted as a sorts-caster; Monotype.

21350 Stockall, J. J. Date- and time-printing stamps; preventing the minutes-wheel from jumping forward.

21409 Lanston Monotype Machine Co. Mould improvements in casting low-spaces.

21718 Lock, W. H., Pearce, H., Joy, J. H. and Billington, J. E. Linotype and like machines; galley provided with adjustable shelves for short-measures.

22065 Pautze, H. Printing-plates for addresses of vulcanized fibre with stamped raised characters.

22358 Marinoni et Cie. Casting-box for producing curved stereotypes.

22406 Lanston Monotype Machine Co. Monotype machines; record-strips; Monotype.

22553 Lanston Monotype Machine Co. Typesetting; producing record-strips for automatic type-casters; Monotype.

22554 Lanston Monotype Machine Co. Typesetting; making record-strips; Monotype.

22846 Kutschbach, W. Funnels with guides to prevent type from twisting in hand-distribution.

23000 Lock, W. H., Pearce, H., and Billington, J. E. Linotype machines; changing magazines; Linotype.

23114 Burris, H., and Burris, E. Linotype machines; automatically feeding metal-pot.

23455 Haydock, W. Type with grooves for engaging in hand-stamp holders.

24109 Degener, H. Linotype and like machines; matrices produced by compression; Monoline.

24110 Degener, H. Linotype and like machines; wedge-spaces; Monoline.

24377 General Composing Co. and Degener, H. Linotype machines; means for composing characters of different styles; Monoline.

24682 Bunau-Varilla, P. Cooling the core in machines for casting curved stereotypes.

24777 Terrell, E. Typesetting; assembling L-shaped types for use on cylinder-machines.

24803 Elliott, R. C. Monotype and like machines; justifying-mechanism.

25046 Mergenthaler Setzmaschinen Fabrik. Linotype machines; alinement-device.

25053 } Wood, H. A. W. Moulding and drying stereo-
25054 } type-matrices.

25057 Wood, H. A. W. Machine for casting curved stereotypes; means for holding the matrix and stripping it from the plate.

No.

25058 Wood, H. A. W. Apparatus for casting curved stereotypes; securing the matrix by flexible strips.

25059 } Wood, H. A. W. Machine for casting curved stereotypes; means for holding the matrix
25060 } and stripping it from the plate.

25529 Welsh, W. H., Royal, C. H. and Gounley, J. F. Making matrices for electrotypes of thin metal foil.

26306 Regina Maschinen Fabrik and Friedlein, H. Printing and registering railway-tickets; magazine of loose type-plates, numbering-device and dating-stamp.

26729 Cottrell and Sons, Co., C. B. Depressing the edges of electrotype and stereotype-plates.

26998 Reid, R. B. Automatic machine for casting and trimming curved stereotype-plates.

27118 Taylor, W. Date- and time-printing stamps.

27190 Barclay, J. C. Typesetting; machines for perforating paper control-strip.

27799 Elektrizitäts Akt.-Ges. vorm Schuckert and Co. Typesetting; machines for making perforated control-strip.

1908.

85 Sigurdsson, O. V. Monotype and like machines; key-operated typecasting machine with matrices on bars.

280 Pulsometer Engineering Co. and Adcock, E. A. Typesetting machine; Pulsometer.

281 Pulsometer Engineering Co. and Adcock, E. A. Typesetting and distributing; key-mechanism; Pulsometer.

405 Morris, E. T. Routing machine for trimming curved electrotypes and stereotypes.

934 General Composing Co. and Degener, H. Linotype and like machines; improvements in Monoline machines.

970 Stockall, J. J. Date- and time-printing stamps; bringing extra type into position.

1167 Bland, J. P. Machine for dressing the backs of stereotype-matrices.

1459 Derriey, C. J. Press for moulding dry-flong stereotype-matrices.

1605 Pulsometer Engineering Co. and Adcock, E. A. Type-distributing; Pulsometer.

2336 Cottrell and Sons, Co., C. B. Making stereotypes with higher elevation for darkest parts of plates.

2781 International Multigraph Co. Typesetting and distributing; hand-operated. Short-type grooved and wedge-shaped at foot. Gammeter Multigraph.

3776 Lohmann, H. Plates for half-tone of thin copper film soldered to zinc.

4107 Rogers, J. R. Linotype machines; improvements in the Typograph.

4196 Hulton and Co., E., Mackay, W. K., Jeremiah, J. D. and Hardisty, C. Linotype and like machines; late-news slugs with end-recesses.

4207 Miller, H. G. Leads; apparatus for sawing metal-stock and linotype-slugs.

4248 Typograph Setzmaschinen Fabrik. Linotype and like machines; improvements in matrix-distribution; Typograph.

4872 Schooling, W. and Randall, F. W. Machine for recording cash amounts, totalizing, and recording totals.

4873 Schooling, W. and Randall, F. W. Machine for recording with provision for correcting.

4874 Schooling, W. and Randall, F. W. Machine for recording gross, tare and net weights of coal on wagons, totalizing, and recording totals.

5403 Pilz, O. Machines for casting curved stereo-type-plates.

5587 Schimansky, H. Electrotype-matrices of several sheets of lead-foil cemented together.

5906 Cleathero, E. T. Linotype attachment for printing an impression of the slug after it leaves the machine.

6027 Pollen, A. H., Holbourns, J. G., and Fletcher, W. Linotype and like machines; quick-change mechanism for the magazines.

6073 Huggins, S. A. Fudge-box for racing-news to receive names and numbers, previously prepared, separately; dovetail slots.

1908 (*continued*).

No.

6274 Ellis, H. Linotype and like machines; separating sorts-matrices.

6427 Read, G. F., and Lougee, F. G. Means for trimming stereotype-plates, type-slugs, etc.

6523 Thompson Type Machine Co. Typecasting machine; Thompson typecaster.

7009 Drewell, H. Typesetting; improvements in electric typesetting machine.

7042 Richford, E. M., Webb, C. S., and Garrod G. Hand-stamp; printing in more than one colour, from sectional type-blocks dowelled together.

7135 Pollen, A. H., and Bland, J. P. Improvements in means for cooling cylindrical core of curved stereotype-casting apparatus.

7495 Schwahn, K. Type; impressing internal surface of hollow articles.

7636 Castle, T. R. Linotype machines; composing tabular matter.

7684 Bannerman, R. P., and Bhisey, S. A. Typecasting machine; cooling type in process of casting.

8085 General Composing Co. and Degener, H. Linotype and like machines; improvements in distributing-mechanism and magazine; Monoline.

8911 Knudsen, H., and Barta, H. Linotype and like machines; typesetting; operating linotype machines by wireless means.

9695 Cowper-Coles, S. O. Facilitating inspection of electrotyping work.

9736 Wood, H. A W. Means for drying stereotype-matrices.

10064 Sutcliffe, J., and Taylor, Garnett, Evans and Co. Monotype machines; improvements in strip-perforating apparatus.

10704 Mergenthaler Setzmaschinen Fabrik. Linotype and like machines; vertical magazines; Linotype.

11245 Bhisey, S. A. Typecasting machine; for types and logotypes conveyed to a series of composing-machines; Bhisotype.

11442 Bates. A. H. Linotype and like machines; matrices with characters on opposite sides or at ends.

11443 Bates, A. H. Linotype or stereotype-matrix machines, assembling and distributing matrices.

11581 Lock, W. H., Pearce, H., and Billington, J. E. Linotype and like machines; adjustable moulds.

11696 Miller Saw Trimmer Co. Type; cutting and trimming type-slugs.

11799 Typograph Setzmaschinen Fabrik. Linotype and like machines; improvements in matrix-basket; increased number of bars; Typograph.

12327 Hoberg, A. Linotype, stereotype matrix, and like machines; type, typesetting and distributing.

12459 Kukla, J., and Probaska, L. Monotype and like machines; improvements in moulds.

12657 Margonari, V. Flong for stereotype-matrices.

12675 General Composing Co. and Degener, H. linotype and like machines; improvements in casting-mechanism and in alining matrices for distribution; Monoline.

12769 Huff, C., Carter, J. T., and White, E. B. Type; adjustable type-moulds.

12771 General Composing Co. and Degener, H. Linotype and like machines; improvements in Monoline matrix-bar alinement.

12776 Schnellsetzmaschinen Ges. Typesetting; line-justifying and strip-perforating.

12815 Hall, F. A. L. Monotype machines; casting low-quads by means of a divided mould-blade; Monotype.

12901 Carter-Crume Co. Printing-cylinders for carrying and actuating numbering-devices.

12903 Carter-Crume Co. Plunger-operated repeat numbering-apparatus.

13313 Mergenthaler Setzmaschinen Fabrik. Linotype and like machines; circular wedge-spaces; Typograph.

13346 Koske, O. Linotype and like machines. Improvements in matrix-slide wires.

13749 Toronto Type Foundry Co. Linotype and like machines; improvements in magazines.

13983 Chambonnaud, L. Typesetting.

No.

14531 Muller, W. and Ermbter, J. Machine for measuring and attaching measurement-marks to fabrics.

14591 Warnock, W. S. Key-operated quoins.

14780 Vogtländische Maschinen Fabrik vorm. J. C. & H. Dietrich Akt.-Ges. Automatic machines for casting curved stereotypes.

15114 McDade, C. Printing measurement-marks on fabric.

15331 Lück, F. Machine for beating, rolling, backing and drying stereotype-matrices.

15334 Quillacq, A. L. G. de and Soc. des Etablissements A. Foucher. Type; improvements in the body-slide casting-machine. Foucher.

15738 Schnellsetzmaschinen Ges. Typesetting machines; cancelling incorrect groups of holes in perforated strip.

16161 Schnellsetzmaschinen Ges. Typesetting; cancelling incorrect groups of holes in perforated strip.

16999 Stromberg Electric Manufacturing Co. Date- and time-printing stamps; locked movements.

17163 Alexander, H. Typesetting for rotary machines. Improvements in type-carrier rings.

17197 Pierpoint, F. H., and Lanston Monotype Corporation. Type-composing and casting machines; improvements in unit-counting mechanism; Monotype keyboard.

17198 Reymond, A. du Bois. Monotype machines; proportional dividers for ascertaining the quotient of two variable quantities; Monotype.

17199 Bancroft, J. S. and Indahl, M. C. Monotype and like machines; improvements in line-justification indicator drums; Monotype keyboard.

17375 Weiniger, H. and Progress Typewriter Supply Co. Typesetting.

17868 Lock, W. H., Pearce, H., Billington, J. E. Holliwell, C. and Burgess, J. R. Linotype and like machines; quadding and short-line arrangements.

17869 Lock, W. H., Pearce, H. and Billington, J. E. Linotype and like machines; improvements in automatic pump stop-mechanism.

18343 Hart, C. F. Machine for making stereotype-flongs.

18518 Burlingame Telegraphing Typewriter Co. Linotype and like machines; electro-magnetic control from a distance.

18658 Schimmel, F. Linotype and like machines; composing-frames supporting arms.

19934 Novi, G. Stereotype-matrix machines; obtaining uniform depth of impression.

20090 Lock, W. H., Pearce, H. and Billington, J. E. Quick-change mechanism for single magazines; Linotype.

20282 Aders, M. L. C. F. Typesetting; pneumatically or hydraulically actuated adjusting-mechanism.

20527 Hulton & Co., E. and Hulton, E. Apparatus for casting stereotype-plates for late-news.

20731 Aders, M. L. C. F. Typesetting; keyboard mechanism.

21047 Miller, H. G. Machine for grooving, trimming, mortising, routing and drilling slugs, electrotypes, etc.

21268 Bancroft, W. Typecasting and setting machines; simultaneously composing two or more copies of matter in line-justified lines of different lengths; Monotype.

21641 Read, G. F. Use of air-blast for stripping stereotype-matrices from the plate.

21953 Cohn, H. Protective coating for stereotype-matrices to prevent metal from penetrating.

22374 Bancroft, J. S. and Indahl, M. C. Typecasting and setting machines; automatic line-justifying mechanism; Monotype.

22802 Riley, F. and Riley & Co., J. H. Apparatus for printing numbers or other measurement-marks on cloth.

22861 Haddan, R. Apparatus for casting curved stereotype-plates.

22866 Bannerman, R. P. Type; automatically withdrawing cores in casting hollow type.

23271 Typograph Setzmaschinen Fabrik. Type; removing fins from set-up type surfaces; uses rotary brushes.

No. **1908** (*continued*).

23808 Dacheux, R. Compressible spaces formed from creased soft-metal tube.

23885 Lock, W. H., Pearce, H. and Billington, J. E. Linotype and like machines; improvements in magazine-mechanism; triple magazine; Linotype.

24010 Southgate Machinery Co. Preventing elongation in curving flat plates by first curving in the opposite direction while backed with fusible alloy; removing alloy, flattening, rebacking and recurving.

24011 Southgate Machinery Co. Duplicate flat and cylindrical plates for use on the same machine.

24629 Draper, T. and Draper, J. M. Composing-stick; notches to facilitate adjustment.

25043 Hyde, A. G. and Link, R. P. Short shouldered-type and spring-clip holders or type-bars, for lines of short-type; Uni-Typebar.

25824 Grasso, N. Quoins with ratchet-toothed ribs; key-operated.

26021 Neidich, S. A. Channels for grooved-type.

26022 Neidich, S. A. Composing-sticks for picking up grooved-type.

26676 Lock, W. H., Pearce, H. and Billington, J. E. Type-slug machines; matrix-feed from multiple magazines; Linotype.

27128 Degener, H. and General Composing Co. Ensuring entry of matrices into proper magazine channels; Linotype.

27129 Degener, H. and General Composing Co. Protecting matrices from injury; Linotype.

27130 Degener, H. and General Composing Co. Close-fitting matrices; Linotype.

27231 Huggins, S. A. Interlocking fudge-box type with head opposite to nick.

27399 Dutton, A. Stereotype-blocks; securing accuracy.

27400 Dutton, A. Asbestos stereotype-matrices.

27401 Dutton, A. Stereotype-casting apparatus.

27762 Typograph Setzmaschinen Fabrik. Improvements in matrix-basket; Typograph.

27770 Wiessler, E. Mounting-blocks for printing-surfaces.

27891 Bland, J. P. Typecasting and composing machines; galleys for type cast in reverse order.

28007 General Composing Co. and Degener, H. Water-cooling of moulds; Linotype.

28533 Derriey, C. J. Machine for making stereotype-matrices by beating and rolling.

1909.

223 Lock, W. H. and Goulding, B. J. J. Machines for trimming curved stereotypes; adjusting shaving-knife.

1214 Schriftgiesserei, E. Gursch. Casting type from matrices without lateral cheeks.

1618 Droitcour, M. A. Printing-surfaces of celluloid, hard rubber, etc.

1646 Wesel Manufacturing Co., F. Securing printing-surfaces by means of adjustable clamps.

1702 Williams, W. S. Hand-stamp comprising lines of fixed type and bands of adjustable type.

1707 Schimmel, F. Typecasting and composing machine; casts a slug or line of loose-type letter by letter; Rototype.

1822 Degener, H. and General Composing Co. Improvements in magazine-changing mechanism; Linotype.

1992 Quiggan, J. P. Mounting-block of L-shaped sections with a series of holes.

4229 Degener, H. and General Composing Co. Adjusting star-wheel to cause multiple-character matrices to assume different levels; Linotype.

4347 Fishburn, T. H. Apparatus for cleaning formes of type.

5348 Jackson, W. H. Fixing type on thin metal barrels which can be used interchangeably on a printing-cylinder.

5674 Morris, E. T. Fudge-boxes with both ends movable.

5780 Degener. H. and General Composing Co. Typecasting machines; preventing burring on type.

No.

5948 Bancroft, J. S. and Indahl, M. C. Monotype and like machines; line-justification; improvements in line-deficiency and space-number signals in record-strip; Monotype keyboard.

6384 Hoe, R. Machine for boring and trimming curved stereotype-plates.

6617 Chanonhouse, J. F. S. Low-quad signal in record-strip; moulds for casting low-quads; casting and keyboard machines; Monotype.

6633 Ehrlich, M. Strip-perforating machines; strip-controlled pneumatic type-action embossing braille characters.

6755 Link, R. P. and Morgan, A. C. Single-type composing and casting machines; magazine-mechanism; Uni-Typebar.

6756 Link, R. P. and Morgan, A. C. Single-type composing and casting machines; distributing matrices; Uni-Typebar.

6793 Harnett, J. Photographic method for producing relief surfaces.

6873 Link, R. P. and Woodroffe, C. H. Single-type composing and casting machines; matrix-selecting mechanism; Uni-Typebar.

6942 Link, R. P. and Woodroffe, C. H. Single-type composing and casting machines; clutch-driving mechanism for matrix selection; Uni-Typebar.

6955 Slater, J. W. Hand-stamp; two or more portions of the printing-surface relatively movable.

6990 Gestetner, D. Setting and distributing short-type with a non-circular cross-hole; type cases and composing-sticks.

7170 Bancroft, J. S. and Indahl, M. C. Monotype machines; power-transmitting mechanism; varying the dwell-period proportionately to set of type; Monotype.

7192 Pollen, A. H., Pearce, H. and Billington, J. E. Automatic quadding-apparatus; Linotype.

7401 Link, R. P. and Hyde, A. G. Single-type casting machines; metal-pots, pumps and moulds; creates a partial vacuum in mould; Uni-Typebar.

7402 Link, R. P. and Hyde, A. G. Single-type casting machines; transmission of matrices to and from mould; Uni-Typebar.

7421 Boorne, W. H. Making half-tone rubber-stamps from photographs.

7924 Grant, J. C. Typecasting, line-justifying and composing machines; casting a line of individual type from a line of previously assembled and line-justified matrices at a single operation. Grantype.

8259 Barr, M. and Clarke, E. R. Calculating machine; summation of partial products; reducing number of carrying operations; use of 'slaves'; multiplication in various scales of notation and of fractions with or without recording gear.

8295 Degener, H. and General Composing Co. Typecasting machines; prevention of burrs.

8527 Chipperfield, W. Printing-surfaces; flexible carriers for type or stereotype-plates.

8591 Duplex Printing Press Co. Machine for boring and trimming tubular stereotype-plates.

8871 Mergenthaler Setzmaschinen Fabrik. Type-composing machines; matrix-bar mechanism; Typograph.

8872 Mergenthaler Setzmaschinen Fabrik. Type-composing machines; improvements in matrix-bar suspension; Typograph.

8873 Mergenthaler Setzmaschinen Fabrik. Type-composing machines; improvements in matrix-bar assembling pins, guides, and alinement; Typograph.

8874 Mergenthaler Setzmaschinen Fabrik. Adjustable-moulds for type-slug casting machines; Linotype.

8983 Duplex Printing Press Co. Apparatus for casting tubular stereotype-plates.

9555 / 9556 Mergenthaler Setzmaschinen Fabrik. Linotype and like machines; obtaining proof-strips from dies or matrices; Linotype.

9851 Pierpont, F. H. and Lanston Monotype Corporation. Typecasting and composing machines; leading-mechanism; Monotype.

No. **1909** (*continued*).

11276 Hoe & Co., R. Machine for trimming and cooling curved stereotype-plates.
11549 Vogtlandische Maschinen Fabrik, vorm. J. C. & H. Dietrich Akt.-Ges. Apparatus for trimming curved stereotype-plates.
11708 Bancroft, J. S. and Indahl, M. C. Making type-matrices; avoiding pressure in die-carrying frames in stamp presses.
12023 Mergenthaler Setzmaschinen Fabrik. Hardening metal matrices by hammering; Linotype.
12024 Mergenthaler Setzmaschinen Fabrik. Escapements for double magazines; Linotype.
12025 Mergenthaler Setzmaschinen Fabrik. Alining matrices, maintaining central position on type-slug of type of varying body-thickness; Linotype.
12130 Goss Printing Press Co. Apparatus for casting curved stereotype-plates.
12319 Orsoni, P. Making-ready by hammering the under surface of stereotype-plates supported against thick plate-glass.
12453 Mergenthaler Setzmaschinen Fabrik. Apparatus for assembling and distributing matrices having three or more cavities; Linotype.
12617 Pierpont, F. H. and Lanston Monotype Corporation. Casting low-quads with divided mould-blade; Monotype.
12995 Leethem, F. C. Mounting-block for stereotype-plates.
12996 Leethem, F. C. Means for operating clamps for securing stereotypes, etc.
12997 Leethem, F. C. Mounting-block for stereotype-plates, etc.
13061 Mergenthaler Setzmaschinen Fabrik. Levelling multiple-face matrices between the casting and distributing mechanisms; Linotype.
13201 Mergenthaler Setzmaschinen Fabrik. Levelling multiple-face matrices between the casting and distributing mechanisms; Linotype.
13209 Pierpont, F. H. and Lanston Monotype Corporation. Single type-composing and casting machines enabling matrices of various sizes to be used; Monotype.
14054 Pierpont, F. H. and Lanston Monotype Corporation. Gauging type-matrices and similar bodies.
14121 Mergenthaler Linotype Co. Multiple superposed magazines and escapements; Linotype.
14263 Degener, H. and General Composing Co. Distributing matrices; fount separation prior to general distribution; Linotype.
14289 Mergenthaler Setzmaschinen Fabrik. Assembling multiple-fount linotype matrices.
14723 Dacheux, R. Distributing type; nicked type fed by oscillatory slide across feelers.
14971 Carlsen, H. Making printing-plates of celluloid and the like.
15522 Chipperfield, W. Cases for type for use with flexible type-carriers.
15648 Mettler, H. W. Number-printing apparatus for measuring-machines for length of woven fabrics.
16214 Schnellsetzmaschinen Ges. Type-composing machines; setting and line-justifying type; record-strip controlled; provision for spaces to follow each character to fill out lines with line-justifying spaces between the words; electro-magnetic control.
16361 General Composing Co. and Degener, H. Improvements in matrices, for distribution; Linotype.
17086 Wood, H. A. W. Apparatus for casting curved stereotype-plates.
17193 Novi, G. Casting type-slugs from stereotype-matrices made on a typewriter.
17303 Oliver, J. Make-ready by electro-deposition of metal on the actual printing-surfaces.
17579 } 17580 } Bancroft, J. S. and Indahl, M. C. Low-quad moulds; Monotype.
17581 Bancroft, J. S. and Knight, A. L. Improvements in securing nick-pins of type-moulds; Monotype.
17866 Claus, C. Stereotype-matrices of pulped vegetable fibre.
18367 Lambie, J. E. Composing and distributing type.
18419 Hoe, R. Continuously casting curved stereotype-plates.
18763 Davis, G. and Eisenmenger, R. Type; printing-faces of various sizes and shapes; imitation of half-tone.
19089 Goss Printing Press Co. Casting mechanism for semi-cylindrical stereotype-plates.
19742 Watkins, A. O. Type for printing in light colours on a dark ground; taking a mould from ordinary type by electrodeposition, etc., machining down to near the face and printing from the machined surface.
20209 Gilbert-Stringer, H. J. S., and Druitt, P. W. Typecasting machines; improvements in assembling matrices and in driving-mechanism; Stringertype.
20398 Grant, J. C. Type-moulds; moulds for producing self-dressed type.
20554 Indahl, M. C. and Chalfant, W. E. Die-case arranged for receiving matrices of abnormal size of strike; Monotype.
21097 Degener, H. and General Composing Co. Distributing matrices in machines producing mixed matter; Linotype.
21159 Jones, P. Mounting-blocks built up of different kinds of wood.
21246 Chipperfield, W. Composing and distributing type; flexible chases upon revolvable bodies.
21422 Lock, W. H., Pearce, H. and Billington, J. E. Magazine-entrance mechanism; Linotype.
21609 Bancroft, J. S. and Indahl, M. C. Improvements in low-quad mould-mechanism; Monotype.
21896 Wood, H. A. W. Apparatus for trimming, cooling and drying curved stereotypes.
22161 Stockall, A. H. Adjustable quoin for securing printing-type in holders.
22412 Degener, H. and General Composing Co. Assembling-apparatus for matrices bearing two or more characters; Linotype.
22546 Gander, G. J. Improvements in strip-perforating machines; Monotype keyboard.
22924 Graber, E. and Frey, O. Hand-stamp with retractable centre to permit of printing either part or both simultaneously.
23297 Elliott, R. C. Composing type; improvements in producing record-strips; Monotype keyboard.
23298 Elliott, R. C. Single-type composing and casting machines; improvements in action of record-strip; Monotype.
23360 Sigurdsson, O. V. Type-composing and casting machines; single-type composing and casting machines; keyboards; matrices; moulds; casts single short-type successively; assembles into lines and line-justifies; each line made into a solid slug by a casting process; Oddur.
23481 Mergenthaler Setzmaschinen Fabrik. Means for supporting in operative position two-fount matrices; Linotype.
23615 Mergenthaler Setzmaschinen Fabrik. Cleaning space-bands by means of rotary brushes; Linotype.
24176 Mergenthaler Setzmaschinen Fabrik. Distribution of multiple-face matrices; Linotype.
24562 Walker, A. H., Maddy, A. J. and Holbourns J. G. Type-slug casting machines; improved escapement-mechanism for space-bars; Linotype.
24933 Oddur Manufacturing Co. Single-type composing and casting machines; keyboards and matrices; Oddur.
24940 Bendixen, N. Paste for application to a surface from which a flong-matrix is to be made.
24978 Goss Printing Press Co. Curved stereotype-plate clamping-mechanism adjustable for different widths; pneumatically operated.
24987 Mergenthaler Setzmaschinen Fabrik. Means for taking up wear in escapement-mechanism; Linotype.
24990 Goss Printing Press Co. Curved stereotype-plate clamping-mechanism; pneumatically operated.

No. **1909** (*continued*).

25020 Vogtlandische Maschinen Fabrik vorm. Dietrich, J. C. & H. Akt.-Ges. Stereotype-matrices, with additional ribs.

25115 Rogers, J. R. Assembling-apparatus for two-letter matrices; Linotype.

25147 Degener, H. and General Composing Co. Assembling-apparatus for setting mixed copy; Linotype.

25616 Pierpont, F. H. and Lanston Monotype Corporation. Machine for stamping type-matrices; Monotype.

25801 Chipperfield, W. Setting and distributing type into and from flexible type-holders.

25827 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machine. Means for maintaining multiple-fount matrices in position before alinement.

25872 Cottrell & Sons Co., C. B. Make-ready; machine for shaving the backs of printing-plates.

25879 Cottrell & Sons Co., C. B. Make-ready; machine for securing plate and matrix and trimming back of plate.

25894 Cottrell & Sons Co., C. B. Make-ready process in which plate and matrix are secured to the bed of machine, trimmed and subsequently heat-treated.

25960 Mergenthaler Setzmaschinen Fabrik. Distributing apparatus; driving-mechanism; and matrices; Linotype.

26119 Mergenthaler Setzmaschinen Fabrik. Matrices having one or more faces upon opposite edges and capable of being inverted; Linotype.

26375 Dropiowski, T. Single-type composing and casting machines; a separate mould for each character in which a type is cast for each used; galley-mechanism.

26481 Obermiller, M. W. Date- and time-stamps electromagnetically operated from a distant clock.

26555 Printing Machinery Co., Pearce, H. and Wood, H. A. W. Means for trimming and cooling curved stereotype-plates; (see 21896/1909).

26564 Lambie, J. E. Printing-plates for addressing machines with inclined flanges struck up for engaging short dovetail-ended type.

26923 Goss Printing Press Co. Machine for trimming and cooling curved stereotype-plates.

27216 Cox, A. Composite mounting-block of fusible-alloy cast on to wooden blocks.

27743 Tonkin, J. O. Printing time-records; hour, minute and an identification number on a vehicle-driven strip.

28219 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machines; driving-mechanism; improvements in clutches; Linotype.

28259 Stockall, J. J. and Ireland, W. E. Date- and time-printing apparatus recording autographs on a record strip.

28273 Goss Printing Press Co. Apparatus for casting curved stereotype-plates without head or tail.

28484 Degener, H. and General Composing Co. Bringing matrices assembled at different levels to same level prior to distribution; Linotype.

28595 Mergenthaler Linotype Co. Distributing matrices; preliminary fount-selection; Linotype.

28639 Droitcour, M. A. Printing-plate of celluloid, etc., with thinned and beaded edges for clamping under tension, flat or on a cylinder.

28640 Droitcour, M. A. Stereotyper's paste for flong stereotype-matrices.

28642 Droitcour, M. A. Production of stereotypes having a graduated face to obviate make-ready; use of underlays.

28841 Brigode, A. G. Casting machines; moulds; machine for making lead-seals.

28912 Pulsometer Engineering Co. and Adcock E. A. Type-line-justifying machines; Pulsometer.

29202 Typograph Setzmaschinen Fabrik. Line-justifying wire-strung matrices; Typograph.

29231 Mergenthaler Linotype Co. Arrangement of multiple-character matrices; selecting-device for matrix-releasing; Monoline.

No.

29252 McNamara, J. Magazine arrangement of multiple-character matrices; selecting-device for matrix-releasing and locking-arrangement for releasing-devices; Monoline.

29340 Rogers, J. R. Distributing thick and thin matrices; Linotype.

29341 Mergenthaler Linotype Co. Magazines and escapements for machines with two superposed magazines; Linotype.

29379 Suretios, C. Paste for stereotype-matrices.

29526 Stockall, A. H. Typecasting machines; galleys with hinged end.

29673 Pudan, H. W. Date- and time-printing stamps for receiving signatures.

29844 Rogers, J. R. Ejecting type-slugs; driving-mechanism; moulds; Linotype.

29850 Converse, F. B. Distributing-mechanism for thick and thin matrices; Linotype.

29940 Stockall, J. J. Date- and time-printing stamps; operating typewheels.

29997 Pneumatic Rubber Stamp Co. (Buck's patent), and Garland, E. S. Hand-stamps; securing cellular printing-surfaces.

30332 Bates Machine Co. Number-printing apparatus; repeats indefinitely or any desired number of times.

1910.

557 Grant, J. C. and Legros, L. A. Casting type; nozzles for typecasting machines heated by circulation of molten metal through them.

961 Rushworth, G. A. W. Multicolour hand-stamp.

1266 Pierpont, F. H. Type-moulds; improvements in casting low-quads and -spaces; Monotype.

1772 Hoe & Co., R. Numbering-apparatus; repeats in duplicate.

1776 General Composing Co. and Degener, H. Type-slug casting machine; large-body matrices for saving spacers; Linotype.

2742 Degener, H. and General Composing Co. Type slug casting machine; magazines, keyboards, distributing-apparatus.

2845 Wilson, G.A. Clamping-devices for stereotype-plates; preventing from slacking.

3308 Typograph Setzmaschinen Fabrik. Type-slug casting machine; assembling wire-strung two-letter matrices.

3309 Typograph Setzmaschinen Fabrik. Type-slug casting machine; wire-strung matrices struck on back and front similarly for interchange or with different faces for change of fount.

3325 Dacheux, R. Distributing nicked type.

3406 Underwood Typewriter Co. Strip-perforating machines for preparing controlling-strip.

3714 Grant, J. C., Legros, L. A. and Maw, T. F. Line-justifying type; justifying lines of overset type by mechanically reducing the individual spaces.

4101 Sensenschmidt, M. and Kaiser, E. Machine for dating railway-tickets; preventing operation unless correct central-type are inserted.

4818 Aix, F. C. L. d'. Printers' composing-machines; type-slug casting machine; deals with assembling matrices, moulds, trimming and ejecting slugs, galleys and galley-mechanism, metal-pots and pumps, and driving-mechanism.

5340 Michaelis, W. Type-channels of grooved bars secured radially in a rotatable disk, for short-type for duplicating machines.

5434 Wood, H. A. W. Apparatus for cutting off tails or risers of curved stereotypes.

5712 Schoop, M. U. Applying metal-coating as a spray by means of steam or hot gas under pressure for matrix-making.

5999 Corfe, W. Alining and transferring the numbering-wheels of paging and numbering-machines.

6043 Degener, H. and General Composing Co. Type-slug casting machine; improvements in mechanism for quick-change magazines; Linotype.

6295 Hollingsworth, S. Numbering-machines for manifold sales-books; consecutive.

No. **1910** *(continued)*.

6331 Lanston Monotype Corporation and Pierpont, F. H. Typesetting and casting machines; improvements in Monotype machines.

6346 Friedmann, H. Type-composing machines; improvements in keyboards and driving-mechanism for multiple-magazine single-type machines, including line-justifying and galley mechanisms.

6347 Hamacher, H. Hand-stamp for marking letters with value of postage stamps to be affixed.

6617 Dacheux, R. Type-composing machines; setting type; keyboards, line-justifying, galley and driving mechanisms.

6718 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machine; levelling multiple-face matrices; Linotype.

6773 Mettler, H. W. Machine for measuring continuous lengths and recording by type-wheels printing numbers.

7014 Barr, M. and Clarke, R. E. Machine for calculating and recording the value of a quality expressed in a non-decimal system at a price per unit expressed in a non-decimal system.

7091 Grant, J. C. and Legros, L. A. Punch-cutting; methods of producing models or patterns for punch-cutting and like machines.

7121 Mergenthaler Linotype Co. Linotype machines; improvements in distributing-apparatus for machines carrying two or more magazines; Linotype.

7330 Crisp, C. Making type; matrix-setting apparatus for composing and casting single-types.

7949 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machine; water circulation in mould-wheels.

8952 Mergenthaler Linotype Co. Type-slug casting machine; cooling-arrangements for moulds.

9096 Campbell Printing Press and Manufacturing Co. Apparatus for cooling curved stereotypes.

9332 Smith, W. H. Number-printing apparatus with two series of numbering heads; adjusting one series circumferentially or longitudinally independently of the other series.

9492 Degener, H. and General Composing Co. Type-slug casting machine; improvements in assembling multiple letter matrices; Linotype.

9860 Rogers, J. R. Distributing two founts of matrices; Linotype.

10187 Oddur Manufacturing Co. Typecasting machines; improvements in machines. having matrices in sides of rotatable disks; Oddur.

10670 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machine assembling, line-justifying and clamping matrices; moulds, type-slug ejecting, and galley mechanisms; Linotype.

11226 Rogers, J. R. Type-slug casting machine; improvements in magazines and escapements for superposed magazines; Linotype.

11603 Grant, J. C. and Legros, L. A. Improvements in punch-cutting machines.

11902 Stubbs, G. O. J. Type-making; improvements in pumps for typecasting machines; Monotype.

12398 Drewell, H. and Schnellsetzmaschinen Ges. Improvements in keyboards and driving-mechanism for composing and type-slug casting machines; Linotype.

12507 Degener, H. and General Composing Co. Type slug casting machines; improvements in composing from multi-face matrices; Linotype.

12632 Degener, H. Type-slug casting machine; improvements in ejector-slides for ejecting type-slugs; Linotype.

12971 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machine. Improvements in quick-change mechanism for magazines; Linotype.

12972 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machines; improvements in assembling matrices and driving-mechanism; Linotype.

No.

12973 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machine; improvements in magazines and distributing-apparatus; Linotype.

13032 Degener, H. and General Composing Co. Type-slug casting machine; improvements in water-cooled mould-wheels; Linotype.

13110 Michaelis, W. Flat type-duplicator with short grooved-type carried in slotted type-bars.

13205 Walker, A. H. and Holbourns, J. G. Composing type; assembling and distributing-mechanism for extra-long lines of type.

13444 Levy, A. Type-holders; type with wedge-shaped shanks for stamping on golf-balls.

13499 Degener, H. and General Composing Co. Type-slug casting machine; improvements in metal-pots and pumps; Linotype.

13500 Degener, H. and General Composing Co. Type-slug casting machine; improvements in trimming-apparatus; Linotype.

13501 Degener, H. and General Composing Co. Type-slug casting machine; improvements in driving-mechanism.

14070 Schreier, E. F. Number-printing apparatus for repeating, or indefinitely repeating, or consecutive numbering.

14484 Jones, C. K. Electric selecting-system, for operating type-printing telegraph; may be used to operate a typesetting machine.

14503 Walker, A. H., Pearce, H. and Billington, J. E. Type-slug casting machine; improvements in escapements and magazines; Linotype.

14518 Aix, F. C. L. d'. Type-slug casting machine; improvements in adjustable moulds.

14818 Degener, H. and General Composing Co. Type-slug casting machine; distributing matrices; Linotype.

14903 Hammalian, P. M. Stereotype-moulds of a refractory material.

15042 Schriftgiesserei, D. Stempel, Akt.-Ges. Type-casting machines; arrangements of driving-shafts.

15062 Upham, B. F. Method of bending printing-plates, faced temporarily so that the actual printing-surface is on the neutral axis.

15144 Degener, H. and General Composing Co. Type-slug casting machine; water circulation in mould-wheels (see 28007/1908); Linotype.

15171 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machine; distributing matrices; Linotype.

15372 Nicholas, W. and Ackermann, W. Making type; single-type composing and casting machine, with line-justifying, galley-mechanism, and metal-pump; Graphotype.

15399 Degener, H. and General Composing Co. Type-slug casting machine; improvements in fount-distinguishing notches of matrices; Linotype.

15526 Druitt, P. W. Typecasting machines; improvements in moulds; Stringertype.

15542 Degener, H. and General Composing Co. Type-slug casting machine; improvements in matrix-distribution; Linotype.

15626 Schnellsetzmaschinen Ges. and Drewell, H. Composing type; improvements in strip-perforating machines and keyboards.

16545 Stevenson, A. G. Triangular printers' rules for use with type-slugs for tabular work.

16622 Mergenthaler Linotype Co. Type-slug casting machine; improvements in ejecting type-slugs; Linotype.

16789 Pierpont, F. H. and Lanston Monotype Corporation. Type-casting machines; improvements in producing low-quads or -spaces; Monotype.

16829 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machine; matrices with tilting-recess for hand adjustment; Linotype.

17113 Degener, H. and General Composing Co. Type-slug casting machines; distributing matrices; improvement in second elevator; Linotype.

17391 Bancroft, J. S. and Indahl, M. C. Automatic machine for stamping distinguishing marks on type-matrices; Monotype.

No. **1910** (*continued*).

17666 Homans, T. S. Type-slug casting machine; improvements in moulds; Linotype.

18189 Eichengrun, A. Printing-surfaces, which can be worked when cold, of mixture of fibrous matter and acetyl-cellulose and camphor in solution.

18544 Rogers Addresser Co. Typesetting machines; machines for setting grooved-type in a holder for addressing-machines.

18883 Bowman, T. Typecasting machines; feeding metal to metal-pots.

18917 Underwood Typewriter Co. Strip-perforating machines.

18941 Typograph Ges. Type-slug casting machine; improvements in moulds.

19187 Reed, S. Hand-stamp with segmental face and dovetailed grooves to receive lines of type.

19206 Drewell, H. and Schnellsetzmaschinen Ges. Type-slug casting machine; moulds, driving-mechanism and trimming type-slugs; Linotype.

19358 Wright, J. S. Types for blank-letter poster-printing of pieces cut-away for the white parts of the letters.

19503 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machine; trimming type-slugs. (See 26676/1908); Linotype.

19544 Duncan, H. M. Single-type composing and casting machines; type adapted for Semitic languages. (See 8633/1899); Monotype.

19615 Buigné, F. de. Typecasting from closed crucible by gas pressure.

19693 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machine; assembling matrices; Linotype.

19702 Quertier, H. Apparatus for recording weights, quantity and quality of carcasses by means of typewheels.

20223 Degener, H. and General Composing Co. Type-slug casting machine; adjusting length of mould-slot to fractions of a typographical unit.

20244 Walker, A. H., Pearce, H. and Billington, J. E. Type-slug casting machine; assembling, line-justifying, clamping and distributing matrices; Linotype.

20505 Typograph Setzmaschinen Fabrik. Type-slug casting machine; keys, keyboards and escapements. (See 11799/1908); Typograph.

20959 Degener, H. and General Composing Co. Type-slug casting machine; distributing matrices; Linotype.

20960 Degener, H. and General Composing Co. Type-slug casting machine; cleaning spacers; Linotype.

20961 Degener, H. and General Composing Co. Type-slug casting machine; improvements in metal-pots and pumps; Linotype.

21228 Degener, H. and General Composing Co. Type-slug casting machine; distributing matrices; Linotype.

21787 Ransmayer, A. Making metal type-cylinders or typewheels by expanding the cylinder in a die.

21898 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machine; assembling and distributing matrices; Linotype.

21971 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machine; assembling multi-face matrices (see 21898/1910); Linotype.

22114 Palmedo, D. Petri-. Type-slug casting machine; moulds for production of hollow type-slugs; Linotype.

22422 Electric Compositor Co. Line-justifying matrices and type; setting type; escapements; Electric Compositor.

22521 Aix, F. C. L. d'. Type-slug casting machine; assembling matrices; moulds; trimming type-slugs; ejecting type-slugs; galleys and galley-mechanism; metal-pots and pumps; driving-mechanism.

22613 Droitcour, M. A. Printing-surfaces graduated to avoid make-ready by pressing the matrix, when only a thin deposit has been made, against the overlay.

No.

22770 Grant, J. C. Type-slug casting machine; special matrices and spacers for casting type-slugs or logotypes on single-type machine. Grantype slug-caster.

22976 Degener, H. Type-slug casting-machine; means for supporting two-letter matrices during assembly; Linotype.

23061 Boyer, A., and Godeau, P. L. M. Printing-apparatus partly operated by travelling-poise of weighing-apparatus; for indicating weight, price per unit, and total cost, using typewheels.

23414 Gyles, E. J. Type-slugs or stereotype-plates for use on duplicating- and addressing-machines.

23474 Electric Compositor Co. Type-slug casting machine; improvements in mould-mechanism; Electric Compositor.

23840 Bancroft, J. S., and Indahl, M. C. Strip-perforating machines. Monotype keyboard.

23970 Felten & Guilleaume Lahmeyerwerke Akt.-Ges. Numbering-device with locking-means to prevent fraudulent alteration and ensure positive advance at each operation.

24253 Droitcour, M. A. Printing-surfaces with gradations to obviate the use of an overlay.

24474 Goss Printing Press Co. Plate-clamping mechanism for printing-presses.

24581 Hughes, D. C. Sheet-metal type-plate for addressing-machines.

24695 Bunau-Varilla, P. Cooling stereotype-plates.

25018 Barr, M., Bell, R. A. and Beeton, H. R. Calculating machine for multiplication of rates, percentages, measures, values and fractions; storage of products; conversion of foreign and English measures and expressions.

25202 Pattle, C. Composite mounting-blocks of wooden blocks let into a metal grid; both ends of wood exposed.

25228 Kennedy, D. S. Type-slug casting machine; improvements in magazine-entrances; Linotype.

25229 Kennedy, D. S. Type-slug casting machines; improvements in matrix-assembly and driving-mechanism; Linotype.

25365 Rogers, J. R. Type-slug casting machines; improvements in straight matrix-magazines for multiple-magazine machines; Linotype.

25664 Gilbert-Stringer, H. J. S., and Druitt, P. W. Composing and casting type; line-justifying type; assembling, clamping and alining matrices in single-type composing and casting machines; Stringertype.

26259 Duncan, J. S. Printing-plates of sheet-metal for addressing-machines.

26289 Degener, H., and General Composing Co. Type-slug casting machines; magazines, escapement, and matrix-distribution; Linotype.

26355 Linotype & Machinery, Ltd., and Burgess, J. R. Type-slug casting machines; assembling matrices; Linotype.

26504 Bancroft, J. S., and Indahl, M. C. Single-type casting and composing machines; casting sorts; Monotype.

26590 Stockall, A., and Stockall, A. H. Steel hollow-furniture constructed of steel bars separated by stays.

26901 Stockall, A., and Stockall, A. H. Galleys with a loose or interchangeable end for typecasting machines.

27670 Grant, J. C., and Davis, H. Typecasting machines; pivotal typecaster delivering finished type into race or galley.

28357 Taylor, A. S. Adjustable mould for casting duplicates from type.

28692 Lanston Monotype Corporation, and Pierpont, F. H. Single-type casting; composing-galleys and galley-mechanism for Semitic characters; Monotype.

28887 Sorg, W. A. Type-line holders for shouldered type.

29007 Castle, T. R. Type-slug casting machines. Securing rules in type-slugs for tabular work.

1910 (*continued*).

No.

29058 Ludlow Co. Type-slug casting machines; metal-pots and pumps; moulds; trimming and ejecting type-slugs; galleys; driving-mechanism.

29273 Bacigalupi, A. E. Incombustible cellulose composition for printing-plates; 70 per cent nitro-cellulose, 25 per cent camphor, 5 per cent castor oil, etc.

29388 Hollingsworth, S. Numbering-machines, for printing manifolding books, with numbering-heads removably carried on cylinder segments.

29472 Vogtländische Maschinen Fabrik vorm., J. C., and H. Dietrich Akt.-Ges. Matrix-clamps for stereotype-casting apparatus.

29482 Ludlow Co. Type-slug casting machines; improvements in matrix-bars; assembling; line-justifying; clamping and alining matrices.

29580 Bacigalupi, A. E. Celluloid composition for printing-surfaces.

29999 Bancroft, J. S., and Indahl, M. C. Single-type casting and composing machines; adjusting centring pins; Monotype.

30000 Bancroft, J. S., and Indahl, M. C. Single-type composing-machines; strip-perforating machines; Monotype keyboard.

30036 Pierpont, F. H., and Lanston Monotype Corporation. Improvements in strip-perforating machines; Monotype keyboard.

30037 Pierpont, F. H., and Lanston Monotype Corporation. Single-type composing and casting machine moulds; casting spaces integral with type; Monotype.

1911.

783 Le Boeuf, A. W. Type-slug casting machines; trimming type-slugs.

1142 Druitt, P. W. Single-type casting machines; improvements in body-slide moulds; Stringertype.

1171 Lowe, A., Seger, A. J., and Lowe, J. Hand-stamp with ball-head and socket-handle.

1635 Pollak, A. Perforating-machines for paper; for rapid automatic telegraphy and like purposes.

1811 Schimmel, F. Single-type composing and casting machine; matrices forming a prismatic block; moulds; Rototype.

2182 Edmondson, T. J., Edmondson, W. B. Edmondson, G., and Edmondson, A. W. Holder for two lines of loose-type for dating tickets.

2380 Typograph Setzmaschinen Fabrik. Type-slug casting machines; assembling matrices; Typograph.

2825 Typograph Setzmaschinen Fabrik. Type-slug casting machines; assembling and alining matrices; driving-mechanism; Typograph.

3108 Hanrahan, J. E. Type-slug making and typecasting machines; metal-pots; matrices; moulds; casting single-type and slugs simultaneously.

3497 Aylsworth, J. W. Use of products of phenol or cresol and formaldehyde for negative-matrices for engraving or printing; stereotyping.

3612 Gilbert-Stringer, H. J. S., and Druitt, P. W. Single-type composing and casting machines; moulds; metal-pots and pumps; Stringertype.

3613 Gilbert-Stringer, H. J. S., and Druitt, P. W. Single-type composing and casting machines; galleys and galley-mechanism; Stringertype.

4251 Schriftgiesserei, D. Stempel, Akt.-Ges. Typecasting machines; improvements in moulds for Foucher class of machines.

4813 General Composing Co. Type-slug casting machines; improvements in keyboards; Linotype.

5285 British Automatic Co., and Savage, A. C. Type-holder for ticket-printing and like machines.

5293 Droitcour, M. A. Casting printing plates to do without making-ready.

No.

5299 Hunt, J. E. Single-type composing and casting machines; strip-perforating machines for duplicating perforated strip.

5926 Rushworth, G. A. W. Flexible formes for rotary, etc., duplicators with removable type-plates for names and addresses.

6304, 6305 Typograph Setzmaschinen Fabrik. Type-slug casting machines; improvements in distributing matrices for Typograph machines.

6404 Chaix, H. A. L., and Bourgeaux. M. C. A. Use of two or more formes successively for printing music: 1. Staff lines, bars, phrasing marks and signs outside the staff; 2. The signs or notes to be printed on the staff and all signs that pass through the bar lines.

6423 General Composing Co., and Degener, H. Assembling and distributing multi-character matrices; guiding-ledges of transport-channels; Linotype.

7064 Schlueter, K. M., and Schlueter, F. Plate-clamping devices, with bevel-gear and screws.

7193 Schimmel, F. Type-slug casting machine; assembling matrices; escapements.

7236 Hipkins, W. E. Printing-mechanism in conjunction with a steelyard poise for recording in several weight-standards (English, Indian, Metric) uses three type-disks, one for each standard.

7385 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machines; improvements in magazines and distributing matrices; automatic cut-out for distributor; Linotype.

7652 Linotype & Machinery, Ltd., and Holliwell C. Type-slug casting machines; providing type-slugs with identification marks; Linotype.

7967 Smith, W. H. Number-printing apparatus; simultaneously moving all wheels for preliminary inking without altering their relative arrangement.

8417 Bancroft, J. S., and Indahl, M. C. Single-type casting and composing-machines; improvements in metal-pumps; Monotype.

8594 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machines. Keyboards; alternate release of matrices from two magazine-channels by successive operations of the same key; Linotype.

8673 Carlsen, H. H. Means for attaching printing-plates to base-blocks.

9435 Elson, R. Hand-stamps for postmarking or numbering; automatically-locking frame and typewheels after making a given number of impressions.

9559 Aylsworth, J. W. Printing-plates and stereotyping; use of infusible phenol formaldehyde resins with a halogen-substituted phenol or naphthol.

9696 Thornton, J. G. Printers' furniture; interlocking-blank frames.

10336 Duncan, J. S. Printing-plate with recessed panel for addressing-machines.

10359, 10360 Typograph Setzmaschinen Fabrik. Type-slug casting machines; changing matrices in machines having matrices guided on wires; Typograph.

10670 Droitcour, M. A. Make-ready arrangements for toning printing-surfaces

10832 Druitt, P. W., and Gilpin, W. R. Single-type composing and casting machines; improvements in multiple magazines; Stringertype.

10928 Rawson, F. L., and Knight & Co., A. Producing a matrix on a wax-coated glass-plate to the other side of which the print to be copied is secured.

11225 Droitcour, M. A. Make-ready arrangement for celluloid printing-plates.

11235 Henkle, E. A. Recording-apparatus for ship engine-room telegraphs for time and nature of signal sent and acknowledged.

11256 Richter, J. Moulds for printing-surfaces of acetone-soluble acetyl-cellulose treated with camphor and rolled.

11258 Schreier, E. F. Number-printing apparatus for multiple groups of number-wheels with means for actuating operating-pawls, constructed for adjustment axially.

No. **1911** (*continued*).

11627 Bertram, W. E. Type-slug casting machines; magazines; escapements, and matrix-ejecting apparatus; keyboards; driving-mechanism; Monoline.

11628 Bertram, W. E. Type-slug casting machines; magazines; escapements and matrix ejecting apparatus; keyboards and driving-mechanism; matrices of Monoline pattern; spacers; assembling matrices; distributing matrices; Monoline.

11902 Dodge, P. T. Single-type composing and casting machines; assembling, clamping, and line-justifying matrices to produce lines of separate types without change of matrices; moulds; metal-pots and pumps; galley and galley-mechanism; driving-mechanism; Linotype.

11984 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machines; escapements for releasing matrices from two magazine-channels alternately; Linotype.

12288 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machines; distributing matrices; Linotype.

12491 Stevenson, A. G. Type with a step on the body for supporting shallow-depth rules.

12556 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machines; Keyboards and escapements; Linotype.

12659 Aylsworth, J. W. Producing printing-surfaces; uses infusible but plastic product of phenol and formaldehyde.

12827 Wride, G. S. Hand-stamps; roller with removable type.

12940 Duplex Printing Press Co., and Bechman, H. F. Casting tubular stereotype-plates.

13515 Cottrell & Sons Co., C. B. Backing-arrangements for electrotype printing-plates to avoid making-ready.

13542 Cottrell & Sons Co., C. B. Backing-arrangements for electrotype printing-plates to avoid making-ready.

13554 Cottrell & Sons Co., C. B. Casting stereotype-plates; holding matrix in mould by suction.

13557 Cottrell & Sons Co., C. B. Casting stereotypes; matrix held in mould by suction.

13560 Cottrell & Sons Co., C. B. Casting stereotype-plates with gradated surfaces, using a reverse overlay held in mould by suction.

13791 Goss Printing Press Co. Machine for trimming curved stereotype-plates.

13876 Mergenthaler Setzmaschinen Fabrik. Slug-casting machines; improvements in changing magazines.

14321 Barber, E. B. Single-type casting and composing-machine; a complete keyboard-machine for composing and casting line-justified type and bonding together the line-justified type into lines by means of metal-strips, flattened from an originally-curved trough; the wedge-spacers co-operate with inclined recesses in the type.

14533 Drewell, H., and Schnellsetzmaschinen Ges. Composing type; strip-perforating machines; line-justifying.

14580 Freeston, H., Freeston, R., and Harris, J. C. Furniture with mortices or tongued and grooved ends.

15023 Martin, P. Means for securing curved stereotypes to cylinders.

15426 Drewell, H., and Schnellsetzmaschinen Ges. Single-type casting and setting or slug-casting machines; galleys and galley mechanism.

15767 Blume, M. E. Strip-perforating machines controlled from a typewriter for controlling typographic machines; stamping characters of various widths.

16516 Mergenthaler Linotype Co. Type-slug casting machines; magazines; assembling, clamping and distributing matrices; galleys; Linotype.

16517 Mergenthaler Linotype Co. Type slug casting machines; trimming type-slugs; Linotype.

17101 Crabtree, C. H., and Crabtree, A. E. Fudge-boxes; cage of radial tapered-bars for holding type-slugs.

No.

17417 Bhisey, S. A. Casting type; typecasting machines; moulds; nicking and trimming type; galley-mechanism.

17521 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machines; moulds; Linotype.

17782 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machines; assembling matrices at two different levels; Linotype.

17992 Rogers, A. H. Hand-stamp with detachably-secured printing-surface.

18315 Kohnle, F., and Hunter, G. S. Holders for loose-type with gripping-device.

18398 Benzing, F. E. Apparatus for recording time of operating bolts and the position occupied at the time.

18945 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machines. Assembling matrices at two levels; Linotype.

18946 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machines. Restoring two-character matrices to a common level before distribution; Linotype.

18947 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machines. Controlling shifter-fingers and supporting line in elevator; Linotype.

18965 Lucas, E. G. H. Producing a typographic printing-surface from an ordinary gelatino-bromide print.

19112 Linotype & Machinery Ltd., and Whittaker, M. H. Type-slugs with short rule-sections having one end of rule high-to-paper and depressed by a tool when locked up so as to render the rule continuous; Linotype.

19350 Hughes, D. C. Forming stops in sheet-metal type-holders for shallow-type.

19374, 19375 Linotype & Machinery, Ltd., Pearce, H., and Billington, J. E. Type-slug casting machines. Keyboards and keyboard-mechanism, with light-touch shift-keys for double magazines; Linotype.

19827 Mergenthaler Linotype Co. Type-slug casting machines. Distributing matrices and improving magazine-entrances; Linotype.

20012 Marino, P. Types of compressed paper-pulp silver-coated; may be subsequently electro-plated.

20448 Linotype & Machinery Ltd., and Holbourns, J. G. Type-slug casting machines. Escapements; removing escapement-actuating mechanism readily; Linotype.

20541 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machines. Trimming type-slugs; Linotype.

20873 Bacigalupi, A. E. Printing-surfaces. Dies for making celluloid or similar printing-plates of a hard, plastic composition, hydrated silicate of magnesia, etc.

21066 Schoop, M. U. Obtaining metal-coatings by spraying, against the surface, metal under very high pressure.

21171 Dement, I. S. Typewheel formed from two disks, one with radial lugs in which the characters are impressed, subsequently bent to a cylindrical surface, and the other stamped to fit inside the first.

21217 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machines. Moulds; trimming type-slugs; driving-mechanism; Linotype.

21218 Mergenthaler Setzmaschinen Fabrik. Type-slug casting machine. Assembly-mechanism for mixed matter.

21241 Longee, F. G. Matrix drying-press with automatic timing-device.

21514 McCulloch, W. B. Type-slug casting machines; adjustable moulds; one liner consists of two parts.

21582 Pierpont, F. H., and Lanston Monotype Corporation. Delivery spouts; pumps for molten metals; nozzle of a typecasting pump, provided with one or more channels through which part of the metal being pumped is circulated.

21884 Vogtlandische Maschinen Fabrik, vorm., J. C., and H. Dietrich, Akt.-Ges. Milling devices for trimming stereotype-plates.

21974 Vogtlandische Maschinen Fabrik, vorm., J. C., and H. Dietrich, Akt.-Ges. Apparatus for casting curved stereotype-plates; holding the plate to the core when the mould is opened.

No. **1911** (*continued*).

21978 Vogtlandische Maschinen Fabrik, vorm., J. C., and H. Dietrich, Akt.-Ges. Machine for casting curved stereotype-plates.

21983 Vogtlandische Maschinen Fabrik, vorm., J. C., and H. Dietrich, Akt.-Ges. Machine for casting and finishing curved stereotype-plates.

22048 Bancroft, J. S., and Indahl, M. C. Single-type casting and composing-machines. Stop-bars of die-cases; Monotype.

22068 Siemens & Halske Akt.-Ges. Record-strip perforating machine making typewritten record simultaneously; applicable to type-setting, and to casting and composing machines, but specially to telegraphic transmission.

22380 Brown, A. W., and Hipkins, W. E. Printing a record from a type-drum in conjunction with weighing-apparatus.

22484 Denison, S. Printing-apparatus for weighing-machines using typewheels.

22730 Dean, A. A. Mounting-block for electrotypes, stereotypes, etc.

23395 Dacheux, R. Type-distributing. Distributing ordinary and italic type.

23396 Dacheux, R. Type-composing machines. Changing magazine-channels; improving type-setting rails and composing two kinds of type.

23558 Burgess, W. H. Date- and time-printing stamps for recording the movements of watchmen.

23810 Cade, B., and Heldrich, A. A. Type-slug machines; matrices; keyboards.

24178 International Time Recording Co. Date- and time-printing; the first operation prints time and punches corresponding holes in the card; the second operation not only prints and punches, but also calculates and prints the working-hours from the two sets of perforations by means of typewheels.

24326 Foxton, J. Number-printing apparatus; holder for loose-type.

24459 Grant, J. C., and Davis, H. Single-type casting machines; moulds; finishing type.

24523 Druitt, P. W., and Gilpin, W. R. Single-type composing and casting machines; improvements in multiple magazine; see 10832/1911; Stringertype.

26113 Dacheux, R. Distributing type; galleys and galley-mechanism.

26549 Cooper, C. Rules for printing, perforating, etc., with flanges.

26718 Bancroft, S. S., and Indahl, M. C. Single-type casting and composing-machines; guiding and supporting types from the type carrier to the galley; Monotype.

27395 Typograph Setzmaschinen Fabrik. Magazines for type-slug casting machines; Typograph.

27399 Pershke, F. F., Rudd, E. H., and Matthews, W. Moulds for electrotypes of blotting-paper, paper-pulp, etc., impregnated with wax.

27553 Allan, G., Byles, A. R., and Byles & Sons, W. Providing raised square projections arranged diagonally on the back of half-tone plates for incorporation in stereotypes to facilitate the flow of stereotype-metal.

27917 Goss Printing Press Co., and Pettigrew, C. H. Apparatus for casting curved stereotype-plates.

27919 Castleman, S. T. Coin-freed printing-apparatus combined with weighing-apparatus rendering it inoperative beyond a predetermined weight; for insurance tickets.

27922 Castleman, S. T. Coin-freed printing-apparatus combined with weighing-apparatus and time-recording apparatus.

27926 Goss Printing Press Co., and Pettigrew, C. H. Apparatus for casting curved stereotype-plates.

27994 Baldock, R. Building up designs for reproduction by photography as printing-surfaces.

28274 Swale, J. Type-slug casting machines; assembling matrices.

28477 Barton, J. T. Frame for securing standing-matter.

28484 Schlueter, K. M., and Schlueter, F. Gauge for alining and adjusting printing-plates on base-blocks.

No.

28714 Huebner-Bleistein Patents Co. Means for accurately positioning a machine-part for impression-mechanism of electrotype-matrix machines.

28939 Mergenthaler Linotype Co. Type-slug machines; assembling matrices; driving-mechanism; Linotype.

29212 Münchener-Zeitungs Verlag Ges. Machines for trimming curved stereotype-plates.

29223 Weigert-Sterne, L. Automatically controlling temperature of stereotype-metal by a thermostatic arrangement.

29272 Collin, C. Setting and distributing type; galleys.

29281 Bacigalupi, A. E. Mould for making celluloid clichés or stereotypes.

1912.

1 Burroughs Adding Machine Co. Adding-apparatus with operating means; two counter-mechanisms arranged for use as two machines or for accumulating separate or partial totals on the second counter.

249 Hall, C. I. Date- and time-printing apparatus combined with electric meters.

270 Typograph Setzmaschinen Fabrik. Moulds and spacers for casting reglets; Typograph.

442 Burroughs Adding Machine Co. Adding and subtracting apparatus; performing operation of subtraction and recording for over-drawn accounts.

701 Typograph Setzmaschinen Fabrik and Doineth, J. Magazines; V-shaped matrix-basket; see 27395/1911; Typograph.

946 Automatic Vending Machine Co. Transfer and zeroizing mechanism; permits setting by hand of time- and date-wheels of coin-freed apparatus.

1187 Booth, J. B. S., and Lanston Monotype Corporation. Record-strip perforating machines; multiple line-justifying of type for tabular work; Monotype.

1213 Crook, C. E. Rotary hand-stamp for printing on eggs; holders for loose-types.

1346 Buigné, F. de. Types cast from alloys free from zinc, but containing aluminium, copper, tungsten, etc.

1946 Goss Printing Press Co. Machine for trimming curved stereotype-plates.

2453 Klaczko, M. Autographic cash-recorder; with type-fingers for printing on vouchers and record-strip.

2518 Mergenthaler Setzmaschinen Fabrik. Line-justifying and alining matrices; Linotype.

2690 Denison, G. H. Printing-apparatus for weighing-machines; for gross and tare weights.

2730 Mergenthaler Setzmaschinen Fabrik. Means for changing magazines for multiple-magazine slug-casting machines; Linotype.

3063 National Cash Register Co. Cash-register; zeroizing mechanism.

3390 Underwood, J. T. Adding-apparatus; numeral-keys which set up pins in rack-bars, for subsequently setting the computing-wheel.

3725 Dick Co., A. B. Adding-apparatus; zeroizing and error-correcting mechanism.

4178 Dick Co., A. B. Adding-apparatus; transfer mechanism; multiplying by repetition.

4380 Pierpont, F. H., and Lanston Monotype Corporation. Record-strip perforating machines; multiple line-justifying of type; Monotype.

4584 Etienne, P. Type-printing telegraph; type-wheel positioning-apparatus.

4672 Hopkins, C. E. Casting, trimming and cooling curved stereotype-plates.

4767 Johnson, J. L. Machine for affixing and dating adhesive stamps.

4771 Gompf, R. Numbering small tickets consecutively by distributing the work over ten numbering-devices on the printing-cylinders.

5327 Stigell, R. V. Recording-apparatus combined with weighing- and measuring-apparatus for granular or liquid material; typewheels.

No. **1912** (*continued*).

6483 Linotype and Machinery, Ltd., and Field, J. G. W. Distributing matrices; alternate lifter-strokes for thick sorts; Linotype.
7028 Jones, R. Assembling matrices; hinged finger for left-hand shifter-arm.
7136 Trinks, F. Calculating machine; uses the recording-wheels for printing the totals by means of racks.
7222 Rogers, J. R. Magazines and escapements for multiple-magazine machines; Linotype.
7280 Mortier, P. Printing process; decomposition of pictures, designs, etc., into small areas the tone-values of which are transmitted telegraphically or telephonically; composing-stick and rules for special type.
7376 Linotype and Machinery, Ltd., Parker, T. R. G., and Bennison, W. E. Machines for boring and trimming tubular stereotype-plates.
7519 Rogers Addresser Co. Addressing-machines for circular letters in imitation of type-writing characters; salutation controlled from address-plate; printing-mechanism controlled from address-plate for omitting.
7522 Rogers Addresser Co. Addressing-machines for circulars in imitation type writing characters; dating-device with type-holder arranged to print at alternate revolutions.
7979 Pierpont, F. H. and Lanston Monotype Corporation. Single-type composing and casting machines; positioning-mechanism for matrices of abnormal size; Monotype.
7980 Lanston Monotype Machine Co. Single-type composing and casting machines; positioning-mechanism for matrices of abnormal size; Monotype.
7981 Lanston Monotype Machine Co. Type-moulds; adapted to produce short-body grooved-type; Monotype.
8261 Burroughs Adding Machine Co. and Terry, G. Adding-apparatus for avoirdupois measure; transfer-mechanism.
8746 Murray, J. Electrotype; backing-up electrolytically with lead before removal from wax-mould.
8960 Kleinschmidt, E. E. Perforating-machines for telegraph transmitting tapes.
9013 Akt.-Ges. vorm Seidel & Naumann. Adding-apparatus; transfer-mechanism; zeroizing mechanism.
9075 Leuchter, A. Electrotypes of an alloy of iron and nickel.
9159 Bannerman, R. P., and Bannerman, R. P., Jr. Type-moulds; break.
9405 Druitt, P. W., and Gilpin, W. R. Distributing matrices from a single distributor to two or more magazines; Stringertype.
9471 Niederreuther, E. Locking-devices for stereotypes; clamp.
9663 Ingrey, C. Indicating and registering mechanism; recording-apparatus for weights.
9741 Druitt, P. W., and Gilpin, W. R. Assembling and clamping matrices; multiple line-justification; Stringertype.
9827 Howard, H. M., and Tanner, A. J. Printing-apparatus for fare registering-apparatus, effecting automatic change in part of registering-surface.
9838 Borchers, H. Setting and distributing short-body, grooved, Multigraph type.
10148 Piscicelli, R. T. Multiplying and dividing apparatus; transfer-mechanism; zeroizing-mechanism; keyboard-interlock.
10174 Schimmel, F. Single-type composing and casting machines; continuously-rotating and reciprocating cylindrical matrix-block arrested by key-depression and casting-mechanism engaged; Rototype.
10527 Pierpont, F. H., and Lanston Monotype Corporation. Moulds and galley-mechanism for casting and composing short-body grooved-type in the holders for addressing-machines; Monotype.
11059 Savarese, A. Typecasting machine and mould for short-body bifurcated type.
11076 Bannehr, L. W., Delton, J. H., Gilbert, J. B., and Watson, G. Calculating apparatus; gross and tare items set and recorded from which net items are automatically calculated and recorded; control of printing of zeros; totalizing mechanism; overthrow-preventing mechanism.
11109 Brown, G. M., and Murray, J. Securing thin electrotypes to printing-cylinders; circumferential and longitudinal adjustable clamp-strips.
11139 Printing Machinery Co., and Bennison, W. E. Machine for trimming curved stereotype-plates.
11140 Mergenthaler Setzmaschinen Fabrik. Assembling multiple-strike matrices; Linotype.
11156 Carlisle, A. H., and Tanner, A. J. Apparatus for issuing and checking zone tickets.
11330 Webner, F. E. Calculating apparatus; records time elapsed between two given times; multiplies this by a wages-rate; sums time-intervals and wage-equivalents; records totals; interlocking-mechanism.
11364 Moss, E. Postmarking machines, with printing-surface formed in two sliding parts.
11401 Allgemeine Elektricitäts Ges. Ticket-printing and issuing machine; preventing actuation when type-plate magazine is empty.
11402 Allegemeine Elektricitäts Ges. Ticket-printing and issuing machine; safety-device controlling type-plate lifting-mechanism.
11449 Lanston Monotype Machine Co. Record-strip perforating machine; guides for punches and punch-bars; Monotype.
11480 McCabe, H. B. Date- and time-printing machine for workmen's cards; prints numbers also to facilitate finding net time.
11487 Typograph Setzmaschinen Fabrik. Securing and releasing moulds for type-slug casting machines; Typograph.
11604, 11605 Pope, E. Type-printing telegraph; uses a flexible type-plate adjusted in x and y.
12024 Typograph Setzmaschinen Fabrik. Trimming type-slugs; Typograph.
12040 Kuhn, M. Combined fare-registering and time-printing apparatus. Taximeter provided with record-strip and detachable ticket.
12107 Stewart, W. Machines for affixing and cancelling adhesive stamps by dating.
12216 Printing Machinery Co., and Harris, J. J. B. Casting stereotypes in vertical moulds; means for preventing creeping and buckling of the matrix.
12313 Siemens & Halske Akt.-Ges. Type-printing telegraph; clutch-mechanism.
12342 Norman, J. F., and Norman Type Casting Syndicate. Typecasting machine and mould using a matrix similar to the Wicks.
12850 Mergenthaler Setzmaschinen Fabrik. Quick-change magazines for type-slug casting machines; Linotype.
12868 Bhisey, S. A. Multiple-mould rotary type-casting machine with axis horizontal.
13183 Upright Grain Printing Base Co. Mounting-blocks of fibrous material with fibres vertical.
13187 Chapple, W. A. Apparatus for dating and marking insurance cards.
13490 Siemens & Halske Akt.-Ges. Type-printing telegraph; selecting and printing-mechanism.
14011 National Cash Register Co. Calculating apparatus; permits lateral movement of type-carriers for recording in other columns simultaneously printing two columns; transfer-mechanism.
14057 Ferguson, O. Hand-stamp with holder for loose-type for marking dates on eggs.
14094 Scholz, H. Type-slug casting machine; mechanism for assembling matrices comprising two telescopic parts; adjusting matrices for height.
14220 Krause, G. Hand-stamp for marking repetition signs in books; revolving printing-wheel.
14471 Lutz, C. A. Printers' quoins; two parallel faces separated by nut and screw.
14777 Burroughs Adding Machine Co. Adding-apparatus; preventing overthrow of registering-wheel.
14831 Hiltz, G. S. Type-printing telegraph; setting typewheel; uses two electromagnets in series with polarized typewheel escapement.

No. **1912** (*continued*)

14837 Hiltz, G. S. Type-printing telegraph; uses either of two printing-wheels.

15591 Knudsen, H. Electric telegraph; perforated strip and de-coding apparatus.

15936 Black, H. D. Ticket-dating press.

15962 Marchthal, E. M. von. Control-strip perforating machine; forms a loop and punches line-justification symbols after completion of the line; for use in forward direction.

15993 Chicago Lino-Tabler Co. Type-slugs perforated by punching to receive and support column-rules.

16072 Mergenthaler Linotype Co. Distributing matrices and type; permitting change of fount to be made without adjusting the magazine-channel entrance; Linotype.

16297 Standley, M. G. Recording hand-stamp; for simultaneous impression outside and record inside.

16327 Douard, A. Hand-stamp for dating, post-marking, etc.; uses typewheels.

16800 Hall, C. I. Time-printing apparatus for electric meters; records position of type-wheels.

17199 Gibbs, F. I. Hand-stamp with rubber-blocks for printing on glass, china, earthenware, enamelled iron, metal-plates, etc.

17240 Duncan, J. S. Stamping characters closely in sheet-metal address-printing plates; Addressograph.

17242 Duncan, J. S. Flattening sheet-metal address-plates; Addressograph.

17248 Duncan, J. S. Imitation type-writing printing-forme sections; facilitating assembling; Addressograph.

17252 Duncan, J. S. Dies for embossing address-plates; enabling characters to be set close together; Addressograph.

17304 Mergenthaler Setzmaschinen Fabrik. Escapements for type-slug casting machines; operating escapements of two different channels alternately; Linotype.

17319 Annand, R. C. Machine for casting and trimming curved stereotype-plates; uses a collapsible water-cooled core.

17885 Gibbs, R. R., and Brown, A. W. Apparatus for giving printed-records of weights.

17926 Paul, A. F. Machine for printing and issuing tickets for zone services.

17928 Tanner, A. J. Apparatus for printing and issuing tickets for zone services.

17990 Linotype & Machinery Ltd., Pearce, H., and Billington, J. E. Metal-pots; detachable mouthpiece; Linotype.

18519 Smith, E. J. Stereotype-matrix mangle-press with bed operated hydraulically.

18797 Stockall, J. J. Workmen's time-recorders; printing mixed arrivals and departures. Alining the minute-printing wheel.

18837 Typograph Setzmaschinen Fabrik. Distributing matrices; buffer arranged to receive the bottom ends of the matrices being distributed; Typograph.

18985 Jensen, H. O. A. Printing-telegraph with typewheels; selection of character on type-wheel determined by time-interval.

19180 Diestelhorst (*née* Wenzel), T. Machines for recording and registering cheque-values etc.; controlled by means of Jacquard cards.

19273 to 19276 Wanderer-Werke vorm Winklhofer and Jaenicke Akt.-Ges., and Greve, J. E. W. Key-set, lever-operated, calculating apparatus; prints totals and sub-totals of separate columns independently; error-key; repeat-key; means for printing serial numbers.

19313 Harvey, J. B. Affixing and cancelling insurance-card stamps.

19428 Stein, R. Affixing and cancelling insurance-card stamps; hand-stamp positioning-device.

19560 Betteley, J. H. Apparatus for printing distinguishing marks on zone tram-tickets.

19739 Engelke, W. Hand-stamp for printing admission-tickets.

20160 Smith, E. J. Longitudinally-movable dogs for securing curved printing-plates to cylinders.

20388 Dunn, W. Producing lines in stereotype-matrices; roller with ruling-disks.

No.

20434 Ranger, A. W. Setting and distributing type; keyboards; galley-mechanism.

20745 Stiles, N. R. Affixing adhesive stamps and cancelling by dating-wheels.

20843 National Cash Register Co. Checking and recording receipts; duplicate retained in machine.

20844 National Cash Register Co. Time-printing stamp for use with cash-register.

20872 Keats, H. D. Metal mounting-blocks with wooden strips laid in diagonal grooves.

21165 Siedle, A. J. and Yardley, J. H. R. Hand-stamp for affixing and cancelling stamps.

21242 Link, R. P. Type-bar making machines; short-type cast in order of composition clamped in a clip (see 25043/1908).

21277 Binns, M., and Binns, W. Measuring and marking fabrics by means of a typewheel.

21332 Kessels, E. J. Type-printing telegraph; positioning type-cylinders step-by-step.

21339 Mergenthaler Setzmaschinen Fabrik. Slug-casting machine; mould; Linotype.

21601 Ottino, G. P. Printing and issuing tickets and totalizing the fares.

21662 Earle, H. A., and Druitt, P. W. Typographical composing-machines; distributing matrices at every half-revolution of distributor-shaft; oscillating magazine-mouths; Stringertype.

21668 Denison, S. Apparatus for giving printed-records of weight.

21928 Ridsdale, J. W., and Pendlebury, H. Apparatus for recording the giving of orders and making of observations on ships; time-printing apparatus.

22106 Pierpont, F. H., and Lanston Monotype Corporation. Milling automatically type-matrices to correct length and depth of matrix-cavity; Monotype.

22218 Manufacture d'Horlogerie de Bethune. Weighing and recording apparatus; type-disks locked till the steelyard sinks.

22234 J. R. Rogers: Type-slug casting machine; delivering thick matrices to the distributor at alternate operations of lifter; Linotype.

22920 Wright, A. H. Index-type machine with printing-surfaces for franking.

23355 Brill, W. Fischer-. Type-printing telegraph.

23658 Bylicki, S. von, and Parenski, J. Affixing and printing on postage stamps, labels, etc.

23836 Linotype and Machinery Ltd., Whittaker, M. H., and Holliwell, C. Type-slug with printing-edges overhanging the feet; for Christmas-card printing, etc.; Linotype.

23873 Blackmore, P. R. Compound wood and metal mounting-blocks.

23874 Typograph Setzmaschinen Fabrik. Type-slug casting machines; matrices of cranked form; preventing damage in assembling; Typograph.

24134 Smith, E. J. Plate-clamps for engaging the inside edges of the plates on printing-cylinders.

24497 Hatch, A. C. Type-slug casting machine; matrices are carried by pivoted rods and fall into the assembling-position by gravity; two series of wedge-shaped line justifying bars used to form double-wedge spacers; mould; pump; type-slug ejector; driving-mechanism.

24652 Kristensen, S. A. C. Composition for making printing-surfaces of resin, sulphur and infusorial earth.

24692 Decker, A. G. Setting and distributing short-body, grooved type.

24758 Ellero, U. Facsimile telegraph; the picture is split up into elements of black and white squares to which symbols corresponding to the degree of shade are assigned; the symbols are telegraphed and the picture built up of type-elements of corresponding intensity.

24965 American Cash Register Manufacturing Co., and Wells, B. B. Cash-register with check-slip recording and issuing mechanism.

25114 Bancroft, J. S. and Indahl, M. C. Single-type composing and casting machine; die-case positioning and mould adjusting mechanism; Monotype.

No. **1912** (*continued*).

25361 Linotype & Machinery, Ltd., Pearce, H., Parker, T. R. G., and Carverhill, R. H Retractable clamps for fixing tubular stereotype-plates on printing-cylinders.

25382 Western Electric Co. Type-printing telegraph; two line-wires; typewheel control-mechanism.

25432 Brown, A. M. Holder for loose-types for insurance-stamp cancelling.

25525 Daniels, O. Postmarking machine; printing-surface of an outer portion for value of stamp, and inner portion of adjustable-types for date, etc.

25869 Post, T. R. Dating-stamp for railway-tickets, etc.

25951 St. Louis Cash Register Co. Cash-registers; lever-operated; separate lever for setting higher amounts; totalizer and recording-mechanism.

25959 Kolar, N. Counters with recording-apparatus; for monetary value of gas, electricity, etc.

26168 Schnellsetzmaschinen Ges., and Drewell, H. Type-slug casting machine; automatic change of mould during composition.

26306 Siemens & Halske Akt.-Ges. Punching machines; electro-magnetically operated for perforating strip for telegraphic or similar purposes.

26386 National Cash Register Co. Cash-register; accumulating and recording totals.

26448 Mergenthaler Linotype Co. Casting sorts from matrices not normally carried by the matrix-carrier of single-type casting machines such as described in 13297/1897 and 24933/1909.

26588 Wadewitz, A. H. Securing printing-chases.

26802 Leinweber, A. Casting stereotypes; supplying several moulds from one pump.

No.

27346 Universal Machine Co. Typesetting and distributing machine; keyboards: galleys and galley-mechanism.

27911 Nelson, I. T., and Murray, J. Electrotype from moulds made up of intaglio metal-type.

28214 Leskow, E. Composing-machine; type are contained in a series of stationary radial-channels and are set up in a rotatable composing-channel.

28335 Nelson, I. T. and Murray, J. Printing-surfaces of celluloid heated and impressed on a matrix set up of intaglio-type.

28378 Goss Printing Press Co., Raabe, O. L., and Terry, A. Printing-surfaces; means for clamping the printing-plates on cylinders adapted for more than two plates end-to-end.

28626 Denison, S. Weighing-apparatus with recording-mechanism.

28700 Pocock, J. Printing-surfaces; clip for holding.

28976 Schumann, K. Counter with recording-apparatus; for marking upon a bill the quantity of material consumed as shown by a meter.

29057 General Engineering and Construction Co. Type-printing telegraph; letters made up of combinations of four elementary types.

29245 Hurcum, G. A., and Lawrence, E. C. Mounting-board for stereotype-plates.

29416 Baronio, A. C. Electric printing-telegraphs.

29574 Clarke, E. R., and Debenham, E. R. Selective setting-mechanism applicable to strip-controlled typecasting machines having *x* and *y* co-ordination for determining characters; reducing number of perforations.

29798 Avery, W. & T., and Johnson, S. H. Counting and recording-apparatus; printing tickets.

29950 McClure, J. A. Hand-stamp; facilitating setting of rubber-bands.

AMERICAN PATENTS.

LIST OF SPECIFICATIONS OF UNITED STATES PATENTS RELATING TO THE PREPARATION OF THE TYPOGRAPHICAL PRINTING-SURFACE.

The priority of American Patents up to 1837 is distinguished by date; after 1837 by the Specification Number. Numbers preceded by R are Reissues.

Year.	Date.	Name. Subject.
1791	Jan. 29	F. Baily; Punches for types, etc.
1805	Aug. 28	W. Wing; Machine for casting types.
1811	Jan. 29	A Binney; Printers' type-mould.
1811	Feb. 4	A. Binney; Smoothing or rubbing printers' types.
1812	Feb. 7	U. K. Hill; Music types.
1814	May 17	A. Binney; Moulds for casting printers' types.
1816	Feb. 28	G. Webster; Casting movable types.
1816	Oct. 9	F. Bailey; Ornamenting gildings, etc., with types.
1816	Dec. 18	B. Lothian; Type-moulds.
1819	Jan. 20	M. Smith; Stereotype printing-block.
1820	April 4	G. Bruce; Making shaded letters.
1827	Oct. 23	J. Sturdevant and E. Starr; Mechanical typecaster.
1828	Aug. 21	W. M. Johnson; Process of casting printers' types.
1828	Oct. 11	S. G. Goodrich; Stereotype-block.
1828	Oct. 13	G. F. Peterson; Machine for casting printing-type.
1829	Nov. 20	N. Hale; Stereotype-plate.
1830	Feb. 9	W. R. Collier; Casting and setting types.
1830	Mar. 12	L. Blake; Making and using types.
1830	Aug. 11	G. B. Lothian; Cutting and casting music types.
1830	Nov. 27	G. Bruce; Music types by combinating printers' types.
1831	Jan. 7	G. W. Grater; Extendible stereotype-block.
1831	Jan. 7	M. D. Mann and S. Sturdevant; Vertical typecaster.
1831	Jan. 7	S. Sturdevant; Type rubber or machine for smoothing the bodies of type.
1831	Mar. 8	B. Haskett; Stereotype-plate block.
1832	May 21	B. Haskett; Moving forward the "hooker" of stereotype-blocks.
1832	May 28	S. Sawyer; Stereotype-block.
1832	July 13	A. Chandler; Cam and spring block for fastening stereotype-plates.
1833	Feb. 15	E. Hale; Stereotype-block.

Year.	No.	Name. Subject.
1838	631	D. Bruce, Jr.; Type-smoothing machine.
1838	632	D. Bruce, Jr.; Machine for casting printing-type.
1841	2139	J. H. Young and A. Delcambre; Typesetting machine.
1843	3013	J. Stewart; Casting type.
1843	3257	F. Rosenborg; Type-distributing and setting up machine.
1843	3324	D. Bruce; Typecasting machine
1844	3835	C. Davison; Stereotyping.
1845	4072	D. Bruce; Typecasting machine.
1845	4130	T. W. Starr; Preparing matrices for type by the electrotyping process.
1845	4239	C. F. Baldamus and F. W. Siemens; Anastatic printing.
1845	4315	R. Hemming; Cylindrical type-setting.
1846	4479	J. Warren; Composition for stereotype-plates.
1847	5049	J. C. Petyt; Machinery for making type.
1847	5278	W. P. Barr; Casting type.
1848	5420	J. L. Duncan; Type-rubbing machine.
1848	5483	D. Bruce, Jr.; Type-smoothing machine.
1848	5846	H. W. Day; Type-moulder.
1849	6243	J. J. Sturgis; Typecasting machine.
1849	6604	J. Bachelder and S. D. Dyer; Casting type.
1850	7581	L. V. Newton; Preparing the face of metallic type, engraved plate, etc.
1850	7669	J. M. Mahan; Casting stereotype-plates.
1851	8333	C. Hobbs; Moulding and casting stereotype-plates.
1851	8349	J. J. Sturgis; Typecasting machine.
1852	9166	H. P. Cook; Casting stereotype-plates.
1852	9177	W. P. Barr; Casting type
1852	9418	E. C. Harmon; Spaces for setting type.
1852	9454	J. McCreary; Manufacturing wooden type.
1853	9548	J. L. Kingsley; Compound for stereotype-plates.
1853	9787	J. J. Sturgis; Typecasting machine.
1853	9790	J. L. Kingsley; Moulding gutta-percha stereotype-plates.
1853	9870	L. Westbrook; Gutta-percha stereotype composition.
1853	9911	J. Herriet; Elastic type for printing on irregular forms.
1853	9964	S. Magoun; Machine for cutting and bevelling pointed rules.
1853	9974	W. H. Mitchel; Type-distributing and composing-machine.
1853	R 246	J. Warren; Orig. No. 4479. Composition for stereotype-plates (shellac, tar, and sand).

1854.

No.	Name. Subject.
10377	C. Muller; Typecasting machine.
10656	V. Beaumont; Type-distributing machine.
10659	D. Moore; Type-rubbing machine.
10704	R. D. Mott; Stereotype pan.
10929	W. H. Mitchel; Type-composing machinery.
11831	J. Herriet; Gutta-percha stereotype composition.
11955	G. Bruce; Casting type.

No.

1855.

12157 W. Cowles; Stereotyping apparatus.
13197 W. McDonald; Machine for mitring printers' rules.
13609 S. S. Weed; Machine for making printers' type.
13710 W. S. Loughborough; Type-composing and setting machine.
13935 D. Moore; Type-rubbing machine.

1856.

15340 J. J. Koenig; Type-composing and distributing machine.
15358 O. F. Grover; Printers' composing-stick.
15386 E. Pelouze, Jr.; Valve for typecasting machines (back seating of jobber).
R 339 W. S. Loughborough; Orig. No. 13710; Type-composing and setting machine.

1857.

16500 W. T. Tillinghast; Printers' composing-stick.
16743 W. H. Mitchel; Type-composing machine.
16947 W. H. Houston; Type-composing and distributing machine.
17007 D. Winder; Printers' composing-stick.
17457 J. W. Tidgewell; Printers' composing-stick.
18175 T. Alden; Typesetting and distributing machine.
18264 W. H. Mitchel; Type-distributing machine.

1858.

19797 G. Schaub; Casting type for printing.
20081 J. McElheran; Method of preparing stereotype-plates (impressing letter-dies on softer material).
21208 J. McElheran; Feed-motion for cerotypography (printing by type on plastic surfaces).
21321 A. Calhoun; Printers' composing-stick.
22423 H. Harger; Mechanical typographer (impression-device).

1859.

22634 R. Doble and M. A. Starr; Machine for making printers' rules.
23009 W. Blanchard; Casting stereotype-plates.
23236 W. H. Elliott; Mode of obtaining curved printing-surfaces (by flexible matrix for cylindrical plates).
24662 D. B. Ray; Improved apparatus for punching stereotype-plates.
25533 J. J. C. Smith; Mode of constructing matrices, etc.
26149 J. B. Gilmer; Typesetter and distributor.

1860.

28436 S. W. Brown; Printers' composing-stick.
28463 C. W. Felt; Typesetting machine.
28472 O. F. Grover and H. S. Pelouze; Tool for mitring printers' rules.
28702 J. Villet-Collignon and L. George; Typography (logotypes; ordinary types combined with solder).
28857 H. Harger; Typesetting (feeding type to assist hand).
28899 J. G. Pavyer; Type-scouring machine.
29091 S. H. Mix; Process for making stereotype-plates.
29144 J. Corduan; Mode of coating type-metal with brass.
30211 D. B. Dorsey and E. Mathers; Typesetting (avoiding risk of pieing).
30293 I. C. Bryant; Casting embossed type.
30630 D. C. Hitchcock and E. B. and E. M. Larcher; Relief printing-plate, etc. (liquid silex to harden lines, the whites being rubbed away).
R 943 J. J. C. Smith; Orig. No. 25533; Mode of constructing matrices (alloy of copper and tin).

1861.

31292 G. H. Babcock; Apparatus for mitring printers' rules.
31333 J. J. C. Smith; Type-cutting machine.

No.

1862.

34265 D. B. Ray; Typesetting machine.
35986 M. S. Beach; Stereotype-plate.
36991 O. L. Brown; Typesetting machine.
37078 P. Schulze; Process of obtaining printing-surfaces.

1863.

38955 C. W. Felt; Typesetting machine.
39946 W. Moore; Type-rubbing apparatus.
40076 R. W. and D. Davis; Mould for casting printing-type.

1864.

42274 J. C. Clapp; Numbering-machine (with lever gear for printing consecutive numbers).
42530 B. Day; Relief printing-plate.
43071 C. F. Cosfeldt, Jr., and T. T. Pears; Apparatus for melting metals for casting stereotype-plates.
43323 J. D. McLean; Apparatus for forming stereotype-moulds.
43648 J. J. C. Smith; Making printers' type (casting a slug and sawing into individual type).
43649 J. J. C. Smith; Machine for cutting printers' type (see 43648).
45353 J. J. C. Smith; Making printers' type (soldering electrotype-heads to rolled-strip and sawing into separate type).

1865.

47262 H. Tubesing; Flexible type and apparatus for printing on uneven surfaces.
48479 L. Bradley; Telegraph paper-perforating apparatus.
48488 G. J. Hill; Numbering and paging machine (vertical slide).
50245 H. J. Hewitt; Script-printing type.
51437 W. F. Draper; Device for stereotype-plates.

1866.

52073 J. Paulding; Mechanism for setting type in making stereotype-plates.
52254 H. W. Alden and W. Mackay; Typesetting and distributing machine.
53587 J. Donlevy; Typographic printing (combination with intaglio).
54110 A. Case; Stereotype-block.
55299 T. S. Hudson; Construction and manufacture of printing-type.
57034 C. Baer; Typesetting machine.
59522 P. Flamm; Typography (successive impressions from type carried on a wheel).
59675 S. W. Soulé and C. L. Sholes; Numbering-machine (numbers on parallel bars for printing tickets).
59786 E. Van Gieson; Type-separator.
60450 P. Welch; Type-dressing machine.

1867.

62058 W. Nelson; Construction of *papier mâché* matrices for stereotype-plates.
62826 A. T. De Puy; Stereotype-plate holder.
63611 D. H. Chamberlain; Method of casting type on printing-wheels.
64200 A. Corey and J. M. Harper; Typesetting machine.
64410 D. A. Draper; Device for forming letters on type-blocks (by pressure on edge of block).
65000 M. Nelson; Machine for making type-mould.
65501 W. Nelson; Machine for forming moulds for stereotype- or electrotype-plates.
65839 S. W. Soulé; Numbering-machine (numbered disks connected to move serially and automatically).
66562 N. L. Chamberlain; Die for raising letters on typewheels.
71104 J. M. Willbur; Stereotype-casting.
71610 J. M. Harper; Device for arranging type in rows.
71668 R. Walker; Machine for cutting and mitring printers' rules.
72515 J. MacNair; Machine for producing stereotype-moulds.

No.

1868.

75681 W. H. Houston; Typesetting and distributing machine.
75700 J. Ramage and T. Nelson; Production of plates for printing (obtains relief stereotype from photograph on gelatine).
76440 F. T. M. A. Guyon; Printers' furniture (extensible).
76460 T. S. Hudson; Die for forming letters, etc., on the edges of type-blocks.
77232 W. B. Woodbury; Producing surfaces, for printing, from photographs (metallic intaglio from gelatine relief).
78033 J. L. Wait; Composing-stick.
80245 W. W. Ustick; Apparatus for cutting and mitring printers' rules.
80448 D. Bruce; Type-machine (automatically breaking-off jets).
81140 W. E. Clark; Cutting printers' leads.
81476 J. W. H. Cheney; Cutting printers' leads.
82463 J. M. Willbur; Machine for forming stereotype-plates.
82464 J. M. Willbur; Stereotypers' putty.
83828 D. Bruce; Typecasting machine.
84273 F. G. Foster; Typesetting machine.
85251 J. T. Slingerland; Typesetting and distributing machine.
R 2899 W. McDonald; Orig. No. 13197; Machine for mitring printers' rules.

1869.

86257 R. W. Thing; Composing-stick.
86968 C. Baer; Type-breaker (breaking-off jets).
87941 C. F. Johnson, Jr.; Mechanical typographer (successive-impression matrix).
88180 A. N. Kellogg; Block for holding stereotype-plates.
88800 F. W. Murray; Composing-stick.
89183 S. D. Tucker; Machine for making printers' rules.
89421 T. H. Mead; Machine for mitring printers' rules.
89715 C. and C. Vogt; Producing from printed-paper new plates for reprinting (anastatic).
90318 J. J. C. Smith; Casting metals under pressure (rotating wheel of moulds with guard-plate and continuous stream of metal for articles up to 4 oz. weight).
91240 G. Little; Telegraph paper-perforating apparatus.
91988 M. Umstadter; Typesetting and distributing machine.
93331 C. N. Morris; Printers' rule.
93426 J. M. Eaton; Composing-stick.
95053 L. L. Smith; Nickel-faced type.
95193 W. E. Cameron and A. A. Detlaff; Machine for mitring printers' rules.
95282 H. Sutcliffe; Numbering-machine (for loose sheets).
95344 B. B. Hill; Method of manufacturing type-wheels.
95405 R. A. Adams; Composition for making type for printing wall-paper, oilcloth, etc.
95853 J. Thorne; Typesetting machine.
96330 } G. Little; Telegraph paper-perforating
96331 } apparatus.
97426 R. S. Merrill; Printing-type (hollow, open at the foot).
97891 I. Delcambre; Type-composing and distributing machine.
98799 C. Reuter; Printers' rule (joining by notching).
R 3442 D. A. Draper; Orig. No. 64410; Device for forming letters and figures on type-blocks.
R 3572 T. Alden; Orig. No. 18175; Typesetting and distributing machine.

1870.

100366 O. L. Brown; Type-distributing machine.
100368 W. Bullock; Machine for planing and squaring the ends of segmental stereotype-plates.
101555 H. Stephenson, W. Thompson, and W. G. Blake; Ornamental-scroll type.
102013 A. N. Kellogg and J. J. Schock; Printers' furniture (block-bridge for headings).
102183 D. B. Thompson; Type-distributing machine.

No.
102304 M. Nelson; Stereotype-mould.
104236 C. S. Westcott and A. K. Rider; Type-distributing machine.
105463 K. M. Klees; Machine for making printers' leads.
105855 J. T. Slingerland; Typesetting machine.
106641 W. H. Wilkinson; Logotype (metal-types united with rubber).
107202 J. D. Smith; Numbering-machine (hand-stamp).
107992 W. S. Wright; Type-planer.
108451 A. F. Cloudman and G. W. Coffin; Composing-stick.
108549 R. C. Young; Composing-stick.
108813 W. T. Morgan; Machine for preparing stereotype-matrices.
108879 A. Chase; Stereotyping.
108980 M. de la Peña; Typesetting machine.
110077 W. S. Shipley; Typesetting machine.
110303 W. Spang; Typecasting machine.

1871.

110752 W. Donald; Quadrat (bevelled ends).
111111 W. W. Dunn; Typecasting machine.
111896 F. H. Aiken; Machine for cutting and mitring printers' rules.
112292 A. C. Sine; Numbering and paging machine (lever gear).
112384 I. Schoenberg, Jr.; Machine for making printers' leads.
112562 D. A. Draper; Process of manufacturing type-blocks (impression on heated metal).
113912 F. M. Neff and J. E. Scruggs; Typesetting and distributing machine.
114773 H. J. Davies; Elastic-type.
114786 J. Fish; Stereotype-block.
114850 T. G. Plunket; Typesetting machine.
115287 R. E. Draper; Machine for producing stereotype-matrices.
115777 J. T. Slingerland; Type-distributing machine.
115796 C. S. Westcott; Combined type-composing and casting machine.
115934 J. M. Conner; Machine for ornamenting printers' rules.
116304 L. Guex; Stereotype-mould.
118420 J. A. Adams; Treating formes of type, engraved-blocks, etc.
118425 B. B. Blackwell; Printers' furniture (for use with stereotypes and bases).
118439 A. J. H. Duganne; Printers' column rule (grooved for stereotype).
118978 C. L. Sholes; Numbering-machine (clutching number-wheels).
119537 A. Shiland; Machine for producing stereotype-matrices.
120096 H. D. Perky; Making rubber-stereotype.
120398 D. B. Ray; Typesetting and distributing machine.
121036 F. H. Aiken; Stereotype (casting upon a wooden back with key-grooves).

1872.

122531 T. Miner and J. G. Moody; Manufacturing pointed-type.
122744 D. B. Thompson; Type-distributing machine.
124295 F. C. Smith and H. McCollum; Machine for bending printers' leads and rules.
126262 O. L. Brown; Typesetting machine.
126944 J. M. Farnham; Typesetting machine.
127512 W. A. Pinnell; Stereotype-block.
128285 A. Chase; Making stereotype-moulds of *papier mâché*.
128826 R. P. Tickle; Stereotype-block.
129106 J. M. Conner; Typecasting machine.
129331 } M. Gally; Combined stereotyping and tele-
129725 } graphing machine.
130170 J. Wilson; Composing-stick.
130485 }
130982 } A. Corey; Typesetting machine.
132184 G. and C. R. Scott; Metal-types (a printing-face supported by ribs or flanges for poster-printing).
132253 O. Churchill; Rubber-type.
132456 T. A. Edison; Telegraph paper-perforating apparatus.
132722 P. S. Hoe; Printers' composing-stick.

No. **1872** (*continued*).

133678 H. Stephenson, W. Thompson, and W. G. Blake; Scroll-corner type.
134196 S. Crump; Paste for making stereotype-moulds.

1873.

135384 J. I. Sturgis; Printers' lead-casting machine.
136018 W. H. Baldwin; Typesetting machine.
136091 J. A. T. Overend; Typecasting machine.
136204 H. Barth; Machine for planing stereotype-plates.
136244 M. J. Hughes; Stereotype-block holder.
136442 J. A. Marquez; Machine for making matrices for stereotype-plates.
136769 W. Schnauffer; Stereotype-plate holder.
136815 A. C. Converse; Apparatus for casting type.
137466 C. T. Moore; Typesetting machine.
138006 G. K. Cooke; Making rubber-stereotype.
138241 M. Gally; Type-distributing machine.
138290 F. Scholefield; Stereotype-plate holder.
138922 S. H. Orwig; Typesetting machine.
139365 D. W. Bruce; Printing-type (figures on 2/3 em, fractions without diagonal line).
139393 C. Hurst; Stereotype-plate holder.
139640 E. R. Whitney; Type (of glass; for poster printing).
140278 C. Kastenbein; Type-distributing machine.
140279 C. Kastenbein; Type-composing machine.
140436 W. Shaw; Type (reduced at the top and notched to facilitate removal for correction).
140542 J. L. Ringwalt; Typographical printing-plate (typographic etching).
140899 C. W. Dickinson; Numbering-heads (for numbering bank-notes, bonds, etc.).
140921 R. A. Hill; Machine for making stereotype-moulds.
141450 H. P. Montague; Printers' furniture (slotted to tooth together).
142512 C. Reuter; Printers' rule (adjustable clamps for).
142652 D. B. Ray; Apparatus for arranging type for typesetting machines.
142783 W. Filmer; Apparatus for casting printers' leads.
143875 L. Buschmann; Composing-stick.
144066 J. M. Conner; Typecasting machine.
144196 R. M. Evans; Consecutive-number printer (case with type-high numbering-wheels; automatic).
144571 J. Silversmith; Manufacture of printing-type.
145179 M. J. Hughes; Blocking stereotype-plates in casting.
145549 J. B. Bancroft; Machine for preparing printers' rules.
145598 J. D. Smith; Numbering-machine (automatic type-head for notes, etc.).
146163 J. Bryson; Stereotype-block holder (making-ready).

1874.

146454 M. J. Hughes; Stereotype-plate.
148624 D. B. Ray; Space for type (double wedges).
149239 F. J. Ott; Stereotype-machine.
149647 F. G. Foster; Typesetting machine.
150234 J. M. Farnham; Typesetting machine regulator.
151509 D. H. Perkins; Machine for cutting printers' rules.
152868 J. A. Reynolds; Typesetting machine.
152869 J. A. Reynolds; Type-distributing machine.
153084 M. Joyce; Producing relief-line metal-plates for printing (engraving through plaster-coated plate and stereotyping).
153095 W. Macrone and W. Mackenzie; Composition for stereotyping (for plaster-moulds).
154230 J. Dickson; Printing-plate or die (hard-rubber relief from intaglio).
155609 J. Goodale; Machine for casting printers' leads.
155765 J. D. Smith; Numbering-machine (for bank-notes, certificates, etc.).
156247 T. H. Winchester; Line-curver for type.
157694 J. W. Paige; Typesetting machine (29 claims).
157853 T. J. Mayall and R. W. Hartnett; Drier for matrices of stereotype-plates.

No. **1875.**

159696 T. J. Mayall and R. W. Hartnett; Stretcher for stereotype-matrices.
159946 T. J. Mayall and R. W. Hartnett; Machine for shaving the backs of curved stereotype-plates.
160423 G. Greene; Making typecasting matrices.
161473 L. C. Bodie, J. Masse and W. Webster; Machine for numbering, embossing, and inking bonds, etc. (successive stamping and inking).
161542 A. J. O'Shea; Registering-device for stereotype-blocks.
163540 J. A. Stanion; Printers' lead and rule cutter.
163872 A. N. Kellogg; Stereotype-plate holder.
163873 A. N. Kellogg; Stereotype-block.
163874 A. N. Kellogg; Stereotype-plate.
163998 W. Hawkins and W. F. Dodge; Printers' lead-cutting machine.
164037 A. C. Richards; Typesetting machine.
165387 L. W. Tracy; Device for manufacturing printers' leads.
165859 J. A. T. Overend; Printers' lead-cutting machine.
165871 T. Richards; Numbering printing-plate (using type-bars, or slugs, to print numbers on bond-coupons, etc.).
166205 A. M. Howard; Type (for typewriters; removing the fin formed by swaging).
166549 W. D. C. Pattyson; Typesetting machine.
166681 T. S. Bowman; Consecutive-numbering machine (type-high, platen-actuated).
166702 A. N. Kellogg and J. J. Schock; Stereotype-plate holder (securing by grooves in column rules).
167726 R. T. P. Allen; Typesetting machine.
168044 A. Millar; Typesetting machine.
168591 D. B. Thompson; Typesetting machine.
168977 J. L. Firm; Stereotype-block.
169215 } C. S. Westcott; Typecasting and setting
169216 } machine.
169638 H. W. Henley; Machine for mitring printers' leads and rules.
169701 A. M. Howard; Type machine.
170372 J. Hooker; Typesetting machine.
170593 A. C. Richards; Typesetting machine.
171248 H. J. Stone; Printers' lead-cutting machine.
171408 G. H. Morgan; Typewheel for printing-telegraphs.

1876.

172325 J. W. Kellberg; Machine for planing stereotype-plates.
173373 W. H. Thomas; Composing-stick.
173648 A. N. Kellogg; Stereotype-plate holder.
173729 E. T. Jameson; Machine for shaving stereotype- and electrotype-plates.
174899 } C. W. Dickinson; Type-distributing machine.
174900 }
174901 C. W. Dickinson; Typesetting machine.
174915 W. A. Lorenz; Type-distributing machine.
174916 W. A. Lorenz; Typesetting machine.
175009 J. H. Banks; Producing printing-surfaces (typographic etching).
175119 J. Lindsay; Printing-type.
175147 W. D. C. Pattyson; Type-distributing machine.
175393 S. D. Tucker; Mould for casting stereotype-plates.
175910 W. H. Bell; Movable locking-type.
175938 A. Corey; Typesetting and distributing machine.
178843 S. V. Essick; Stereotyping machine.
178910 J. M. Conner; Typecasting machine.
184115 H. J. Stone; Machine for casting printers' leads.
184738 H. J. Stone; Machine for shaving metal for printers' rules and leads.
R 7342 H. Stephenson, W. Thompson and W. G. Blake; Original No. 101535; Printing-type (for printing an imitation of ribbon-scroll).

1877.

187278 A. M. Howard; Type-machine (swaging).
187880 T. Mason; Type-mould (pivotal).
188232 T. S. Bowman; Printers' rule (mitred).
190434 J. M. Howe; Type-distributing machine (by selecting nicks).

1877 (*continued*).

No.

192281 D. Reynolds; Type-distributing machine (by selecting nicks).

193315 C. G. and O. N. Blomgren and A. Hawkinson; Printers' lead-shaving machine.

193628 C. S. Westcott; Typecasting matrix (electrotyping method).

193805 G. W. Caslear; Hard-metal type (impression by rolling; whites routed out).

194524 W. A. Lorenz and C. D. Hughes; Distributor type-carrier (for selecting nicks).

195072 R. T. P. Allen; Type-distributing machine (for selecting nicks).

196826 D. Reynolds and J. Thorne; Typesetting machine.

198237 G. P. Drummond; Process and apparatus for producing printing-surfaces (typewritten on elastic material, stretched to justify and photographed automatically line-by-line).

198238 to 198241 G. P. Drummond; Machine for obtaining printing-surfaces for reading matter (cuts letters from printed-ribbons and sticks them, overlapping the whites, on an elastic band, which is stretched to justify; see 198237).

1878.

198847 J. P. Jamison; Producing printing-surfaces (rolling for printing on wood, ivory, etc.).

198913 H. C. Fenton; Printers' composing-stick.

200020 J. R. Bettis; Type (portions of characters).

201401 C. Ewing; Numbering-machine (controlled by ratchet-bars; simultaneously-numbering the coupons of bonds).

201436 C. T. Moore; Methods of preparing transfer-sheets or matrices for printing (justifying matter and spacing words on transfer-sheets and matrices).

201632 R 8401 A. H. Rogers; Elastic-faced printing-type.

201718 L. P. Taylor; Type-holder (hand, for names, dates, etc.).

202716 G. W. Glazier; Manufacture of logotypes (set close and cemented in grooves).

204432 O. F. Grover; Printers' composing-stick.

204795 J. Brown; Composition for supporting metallic plates for the formation of printing-surfaces (drawing made in thin metal and electrotyped from either side for relief or intaglio respectively).

205268 A. Henning; Stereotype-block (base and clamps).

205988 C. S. Westcott; Type (rounding vertical edges).

206781 W. H. Golding; Machine for cutting printers' rules and leads.

206924 T. S. Bowman; Numbering-machine (type-high; see 166681).

207429 T. Mason; Machine for dressing printing-type.

208181 A. N. Kellogg; Means for holding stereotype-plates.

211038 J. North; Type-distributing machine (by selecting-wards).

1879.

211865 J. J. Schock; Cleaning type (by the use of live steam).

212228 M. J. Hughes; Apparatus for casting stereotypes (flat).

212503 A. C. Richards; Type-distributing machine (see 115777).

212504 A. C. Richards; Typesetting machine (see 164037 disclaimed).

212937 M. J. Hughes; Stereotype-cast (on wooden cores).

213427 B. B. Huntoon; Casting stereotype-plates (negative to support matrix and positive using this backing).

215259 F. L. Bailey; Engraving machine (for printing-surfaces).

216046 J. Macdonough; Numbering-machine. (Simultaneously-numbering several columns of coupons of bonds.)

217607 P. Gfroerer; Printing-type (wood with rubber printing-face).

218572 W. H. Price; Printers' composing-stick.

No.

219861 S. J. Hoggson; Fountain type (hollow-type charged with ink).

219887 G. F. White; Wooden printing-type (see 210229, Manufacturing articles of wood).

220039 T. W. Smith; Type-matrix (non-rubbing with hard-metal sides).

220942 C. D. Reppy; Printers' composing-stick (gauge).

220999 R. Smith; Curved-bodied printing-type (for setting up curved lines, ornaments, etc.).

221366 W. Scott; Machine for shaving and trimming stereotype-plates (curved).

221685 J. B. R. Lespinasse; Stereotype-plate (grooved edge; see 118425 and 166702).

221825 L. E. Jannin; Composition for stereotype-moulds (protoxide of lead and glycerine).

221853 J. North; Typesetting machine (loose-type).

222642 J. W. Schuckers; Machine for making stereotype-matrices (impression from line of justified type dies).

222910 M. J. Hughes; Stereotype casting-box (flat).

1880.

223584 B. Duncan and J. E. Leyden; Type-forme for electrotyping (filling in above trade-height spaces).

224166 A. Fraser; Type-composing apparatus (loose-type).

224167 A. Fraser; Type-distributing apparatus (key-operated).

224372 W. J. Adams; Type-clamp (metal bands to replace string).

224755 W. A. Wright; Machine for shaving and cutting stereotype and other plates (flat).

225457 M. Bradley; Engraving printing-surfaces (in relief, using ruling machine).

225468 P. Dillon; Typesetting and distributing machine (assisting hand-setting; automatic distributor).

226297 A. Fraser; Type-composing machine (see 224166).

226377 C. C. Webster; Type-rubbing machine.

226383 G. C. Bell; Photo-relief-engraving (uses raised sensitized points for obtaining dots).

226623 J. North; Type-distributing machine (automatic by wards).

227017 R. L. Kimberly; Matrix-forming machine (successive impression; justification by scale).

229291 F. Wesel; Stereotype-plate holder (base and spring-clip).

229861 E. P. Brown; Stereotype (oblique tongues for securing).

229862 E. P. Brown; Block for interchangeable stereotype-plates.

229869 E. D. Chamberlain; Elastic-faced printing-type (rubber on wooden line-core).

230021 G. E. Jones; Stereotype-block (cast direct from female type).

230784 L. K. Johnson; Type- and space-holder (assisting hand).

231427 W. J. Johnson; Machine for trimming stereotype-plates (curved).

232157 J. Thorne; Typesetting and distributing machine (two grooved cylinders; step-by-step movement).

232786 W. C. Walter; Printing-surface (of sand, or powdered rock, glued to a block).

232983 G. Lautenschlager; Numbering or paging machine (improvements in ratchet carrying gears).

233608 J. Fleming; Machine for casting printers' leads.

233704 F. Schley; Printers' rule (brass with inserted steel edge).

233749 W. E. Gump; Stereotype casting-box (flat).

233894 F. S. Taft; Machine for cutting printers' leads.

234480 W. J. Johnson; Drying stereotype-matrices.

1881.

236768 J. Breakey; Type-case (for setting and distributing machines).

237202 J. D. Parker; Composing-stick gange (for setting-stick).

237706 G. Scott; Manufacture of printers' metal furniture. (Gang-milling mild steel, etc., in a jig.)

No. **1881** (*continued*).

239942 P. Dillon; Mechanism for making, finishing and packing type (duplex caster).
240173 J. G. Pavyer and J. Whitelaw; Typecasting machine (pivotal).
240809 E. P. Brown; Stereotype-casting apparatus. (Repetition of flat plates.)
241128 C. W. E. Eberhard; Stereotype-block (securing to base).
241759 G. Trimble; Column-rule and printing-forme (rule with line of type stereotyped).
242244 H. E. Allen; Stereotype-plate holder (for permitting insertion of dashes and leads between paragraphs).
242989 F. Schley; Stereotype-block (clip).
243044 J. M. Hepburn; Apparatus for manufacturing types. (Shanks machine.)
243981 W. Scott; Mould for casting stereotype-plates (semi-cylindrical).
244634 W. A. Lorenz; Typesetting machine (ejecting single type to assist hand-composition)
244636 W. A. Lorenz; Mechanism for cutting off and elevating lines of quadrats. (Type slicer.)
244721 L. K. Johnson; Type-distributing machine (see 174899).
244723 W. A. Lorenz and L. K. Johnson; Machine for arranging type in lines.
244724 W. A. Lorenz, E. G. Parkhurst and L. K. Johnson; Carrier for type-distributing machines.
244725 W. A. Lorenz and L. K. Johnson; Type-distributing machine (see 174899).
245064 J. P. Ellacott and T. K. Tracy; Stereotype-block (securing to base).
245220 W. Robinson; Numbering-machine (printing a dash or other sign in front of single units).
245523 A. A. Low; Type-distributing machine (see 212503).
245562 T. Reeve; Type-distributing machine (see 212503; Alden).
247418 J. J. Sachs; Producing printing and other surfaces (typographic etching).
248047 W. A. Lorenz; Typesetting machine (see 174899).
248233 H. H. Thorp; Type (multiple-unit set and multiple-unit position of line).
250052 E. P. Brown; Stereotype locking-device (for facilitating changes of column).
250238 C. H. Hansen; Printing-plate (relief).
250239 C. H. Hansen; Preparing matrices for producing printing-plates (relief).
250555 W. A. Lorenz and L. K. Johnson; Type-justifying machine (slicing and inserting leads in columns of hand-justifying matter).
251380 D. Reynolds; Typesetting and distributing machine (avoiding turning of thin sorts in automatic distributing by selecting nicks).
251425 E. Farrar; Type-marking machine (marking wheel composed of loose-type).
R 9560 D. Reynolds; Orig. No. 192281; Type-distributing machine. (Automatic by nicks into channels on a cylinder.)
R 9720 A. A. Low; Orig. No. 233264; Type case (see 212503–4).

1882.

251804 C. V. Steinbach; Machine for bending printers' rules.
252694 A. Overend; Stereotype-plate holder (clamp).
253057 J. P. Hunt; Preparing type-formes (making slug by impressions).
253153 E. W. Brackelsberg; Typesetting and distributing apparatus.
253386 M. J. Hughes; Combined printing-press and stereotype casting-box.
254018 L. K. Johnson; Printers' composing-rule (for stick).
254019 L. K. Johnson; Type- and space-holder (see 230784).
254792 L. B. Benton; Mould for casting printers' leads.
254827 W. P. Kidder; Numbering-machine (to print from 1 to 100 inclusive, blank preceding single figures).
255667 T. J. Porter; Typesetting machine (presenting type for hand-composition).

No.
256490 G. E. Lloyd; Stereotype-shaving machine (flat).
259578 J. North; Hand type-distributor (guiding to case compartments).
260084 J. B. Boyd; Printers' rule (for setting curved work).
261378 J. North; Typesetting machine (see 221853).
263707 L. K. Johnson; Type- and space-holder (see 230784).
264084 L. K. Johnson; Typesetting apparatus (assisting hand-composition).
264085 L. K. Johnson and A. A. Low; Type-distributing apparatus (assisting hand-distribution).
265623 V. M. Moreau; Machine or cutting wooden types (router).
265660 C. E. Curtiss; Stereotype-plate holder (clip).
265918 M. H. Dement; Preparing matrix-formes for stereotyping (strips from impression-machines).
266932 W. H. Welsh and C. W. Woodward; Type-rubbing and dressing machine.
268084 C. L. Divine; Extension composing-stick.
268409 L. K. Johnson and A. A. Low; Type-containing channel (for machines).
268513 T. McKinley; Injector for typecasting machines (corrugated diaphragm plungerless pump).
268688 F. Keefer; Sectional-block for stereotype-plates (composite with clamps).

1883.

270056 H. Hagemann; Stereotyping-machine (successive impressions).
271204 R. S. Robson; Machine for cutting printers' rules.
271349 C. Mitchell; Machinery for cutting and mitring printers' rules.
271380 S. D. Tucker; Machine for trimming stereotype-plates (curved).
271711 L. K. Johnson and A. A. Low; Typesetting apparatus (assisting hand).
271858 W. J. Johnson; Matrix drying-press (stereotype).
274918 C. H. Davids; Machine for making stereotype-matrices (successive impressions on lead-slugs).
274993 H. H. Thorp; Type (script).
275664 L. K. Johnson and A. A. Low; Typesetting and distributing machine (assisting hand).
275958 J. H. Stonemetz; Appliance for making stereotype-plates (flat).
276204 F. Wesel; Stereotype-plate holder (clamps).
276947 F. Wicks; Type-composing machinery (Wicks' composer and compressible spaces).
276986 C. L. Ware; Automatic numbering-machine (type-high with external operating-ratchet).
277740 L. K. Johnson; Type-holder and separator (facilitating hand-distribution).
278211 A. B. Auer; Type-forme furniture, etc. (roughened face).
278652 C. Baechler; Casting stereotype-plates (enveloped core).
278700 W. H. Golding; Composing-stick.
278785 G. S. Eaton; Type-rubbing machine.
279168 L. K. Johnson; Type- and space-holder (assisting hand).
279352 A. Danziger; Composing-stick (two widths in one stick).
280699 F. Wicks; Type-making and arranging machinery (rotary caster).
282174 M. H. Dement; Type-writing and printing machine (successive impression).
282175 M. H. Dement; Type-writing and printing machine (successive impression).
282176 M. H. Dement; Apparatus for justifying stereotyped line-strips, and putting and securing them in column, or page form.
282356 A. Neitsch; Type-grinding machine (rubbing).
282655 A. W. Marshall; Stereotype-plate holder (grooved back for rule).
282866 J. F. Earhart; Casting a plate for decorative printing, etc. (obtaining a decorative effect from casting made nearly cold).
282988 L. K. Johnson and A. A. Low; Type-distributing apparatus (assisting hand-distribution).

No. **1883** (*continued*).

283016 N. F. Olson; Automatic numbering-machine (for tickets, 10 to 15 sets simultaneously).

283762 R. H. Davies; Distributing printing-type (proposed type of celluloid, aluminium, etc., to be separated by difference of density).

283876 J. L. Firm; Plate-rack for stereotype-blocks.

283934 J. Thorne; Typesetting and distributing machine (see 232157).

284399 J. F. Earhart; Printing-plate (see 282866).

284757 E. E. Pratt; Stereotype-block (cast upon multiple wood-blocks).

285470 M. H. Dement and A. W. Granville; Apparatus for stereotyping matrix-strips. (Enabling cut-bars to be spaced for justification.)

285643 W. Mears; Stereotyping (use of collodion in matrix-making).

288203 T. Bradwell and S. K. White; Stereotyping outfit (casting, sawing, shaving, and drying).

290201 L. B. Benton; Printing-type (self-spacing type).

290628 J. C. Blevney; Machine for manufacturing type (of soft-iron for case-hardening).

R10385 M. H. Dement; Orig. No. 265918, Preparing matrix-formes for stereotyping (from impression devices).

1884.

292181 P. R. Shugg and G. Boyle; Making relief printing-plates or blocks (photo relief-plate).

293633 J. M. Conner; Typecasting mould (pivotal, for heavily-kerned descenders).

294355 E. C. Bell; Type-holder (locking binding-cord).

294378 W. H. Golding; Composing-stick.

294588 E. and A. H. Cowles; Stereotype-backing powder or filling (lime and glutinous substance).

294677 R. S. Robson; Composing-stick.

295596 F. K. Tracy; Stereotype-plate (facilitating transposition of columns).

295878 R. L. Kimberly; Machine for making matrices (successive impression).

296049 G. Pearce and E. Hughes; Method of and apparatus for drying matrices for stereotype-plates.

296061 E. E. Pratt; Device for locking removable stereotypes (spring-clip).

296277 C. B. Cottrell; Electrotype and stereotype casting-pan (curved plates).

296278 C. B. Cottrell; Electrotype and stereotype casting-mould (curved matrix for casting curved plates).

296974 R. L. Kimberly; Machine for making matrices (successive impression).

297023 F. J. Smith; Stereotyping-apparatus (flat).

298703 R. W. Nelson; Mounting stereotype- or electrotype-plates (inclined key-strip).

299438 G. W. Surguy; Mould for casting slugs and leads for printers' use.

300452 G. S. Eaton and J. W. Lyon; Type-rubbing machine.

300731 E. E. Pratt; Device for securing stereotype-plates in the forme (spring-clip).

300732 E. E. Pratt; Stereotype-block (base).

302653 M. H. Dement; Typewriting and type-matrix making machine (successive impression).

303026 A. H. McClure and A. Pfirsch; Device for casting printers' leads (hinged mould).

303542 J. G Pavyer; Type-matrix holder and gauge (filing jig).

304272 O. Mergenthaler; Matrix-making machine (successive impressions of typewheel).

304931 J. J. Hesselschwerdt; Numbering-machine (uses endless type-chain).

306283 D. Reynolds; Type-distributing machinery (see 192281).

306423 O. M. Peterson; Machine for setting and obtaining impressions from type (impression in wax from a line).

306784 R. H. Smith; Manufacturing elastic-faced type.

306855 J. G. Pavyer; Machine for dressing type-matrices.

No.

307417 H. H. Thorp; Type. (Furniture grooved for the binding-string.)

307446 M. H. Dement; Apparatus for putting matrix-strips in forme and preparing them for stereotyping (successive impression).

308043 W. J. Shaw; Stereotype-matrix and making the same (using non-conducting ink and electro-depositing on the spaces between).

309093 E. E. Pratt, C. S. Partridge and G. E. Lloyd; Machine for grooving stereotypes.

309596 G. R. Bacon; Type-mould (pivotal, adjustable nick-wires).

1885.

310422 W. Hendrickson; Composing-stick (knee-clamps).

310486 W. B. Woodbury; Producing gelatinous printing-plates (photographic).

311175 M. Crane and J. L. Firm; Stereotype-plate (surface with blow-holes for printing a tint).

311350 O. Mergenthaler; Method of and means for producing printing-surfaces (impression-device, casts slugs and cuts them up for justification).

311400 J. H. White; Machine for justifying matrix-strips (successive impression; National Typograph Co.).

311411 J. O. Clephane; Matrix for printing-surface (impression-device).

311412 J. O. Clephane; Type for matrix-making (for successive-impression machines).

311413 J. O. Clephane; Casting appliance for stereotype-bars (from matrix-strip).

311414 J. O. Clephane; Means for producing printing-surfaces (impression-device).

311524 E. E. Pratt; Stereotype-plate holder (spring-clip).

312145 O. Mergenthaler; Machine for producing stereotype-matrices (impression from long type-bars set automatically to justify the line; a second line can be set while the first matrix is being beaten; see 304272).

312302 A. D. Stern; Printers' rule (adjustable).

312569 A. W. Marshall; Electrotype-plate and holder.

313224 O. Mergenthaler; Machine for producing printing-bars (Linotype with long multiple-character matrices).

313812 G. W. Cummings and J. R. Cummings; Electrotype-shell and base.

314384 W. F. Klose; Machine for shaving printers' leads, slugs, etc.

314391 A. D. McLean; Machine for shaving curved stereotype-plates.

314827 R. Gnichwitz; Typecasting mould (pivotal, adjustable core).

315045 N. R. Lyman; Machine for making printers' leads (continuous).

315794 W. J. Johnson; Machine for shaving stereotype-plates (curved).

316398 E. E. Pratt and C. S. Partridge; Machine for trimming stereotype-plates (flat).

316579 J W. Smith; Stereotype-shaving machine (flat).

317828 O. Mergenthaler; Machine for producing printing-bars (Linotype; single character, or combined characters, on each matrix).

318803 J. H. Reinhardt and C. S. Ellis; Consecutive-numbering machine (platen-operated, typographic).

318893 C. M. Grow; Composing-stick (multiple gauges for separating columns).

320103 E. A. Warren; Numbering-machine (for successive or successively repeated printing).

320271 J. E. Munson; Setting type (perforated strip, ten rows of perforations; two rows determine case; two of remaining eight determine the character).

320272 J. E. Munson; Typesetting machine (operated by perforated strip).

320713 C. A. Skene; Impression-sheet for making stereotype-plates (matrix).

323557 A. Z. Boda and L. Klopsch; Stereotype-plate holder (dovetail-rib clamped between two base-sections).

324111 J. M. Hepburn; Typefounding machine (body-slide).

No. **1885** (*continued*).

324423 R. H. Smith; Manufacturing elastic-faced printing-types.
325324 J. R. Cummings; Stereotype-plate and securing it in printers' formes (means for clamping to base).
325636 G. Sutherland; Producing typographic blocks or plates from photo-negatives.
326009 I. Baas, Jr., and L. B. Benton; Type-mould (pivotal).
326376 L. H. Allen; Paper-mould for casting stereotype-plates (from impression machine strips).
326599 R. H. Smith; Elastic-faced printing-type.
326663 J. W. Maclachlan; Numbering-machine (facilitating change from successive to repeated numbering).
327079 J. F. Gabel and J. B. Guelpa; Nipple-plate for typecasting machines (water- or air-cooled).
327546 H. C. Hansen; Mould for casting printers' leads.
327648 E. R. Booth; Stereotype-plate and holder (double-sided, locked to base by column-rules).
327798 M. Joyce; Stereotype-block (wooden back grooved longitudinally).
327855 L. B. Benton; Punch-cutting machine (single column).
327856 E. A. Blake; Stereotype-plate trimming machine (flat).
327857 E. A. Blake; Stereotype-plate shaving machine (flat).
328017 A. Filly; Printers' rule mitring machine.
328600 J. E. Munson; Electrical perforator (for typesetter ribbon).
328677 E. R. and A. W. Hoffmann; Apparatus for making typewheels (for printing-telegraphs, etc.).
328960 O. Mergenthaler; Matrix-making and printing-machine (successive impression).
328961 O. Mergenthaler; Machine for dressing type-bars (made from successive impression-matrices).
329466 F. D. Maltby; Machine for making type-matrices (successive impressions).
330344 J. E. Munson; Automatic perforating-telegraph (reproduces setting at a distance, from a single ribbon).
331438 J. L. Poalk; Stereotype or matrix-making machine (single typewheel; successive impressions).
332352 F. D. Maltby; Machine for justifying matrices for producing printing-surfaces (impression-device).
332354 O. Mergenthaler; Machine for forming type-matrices (impressing justified line with spring-spaces; see 311350).
332419 J. E. Munson; Perforating machine (for typesetter ribbon).
332873 J. X. Browne; Apparatus for making stereotype-matrices (flat).
332990 L. B. Benton; Punch-cutting machine (single column).
333018 G. E. Lloyd; Stereotype-plate roughing machine (flat).
333325 J. North; Machine for mending stereotype-plates (punching slots).

1886.

333529 G. E. Lloyd; Machine for shaving stereotype-plates (flat).
333530 G. E. Lloyd; Machine for fitting stereotype-plates and their backing (T-groove).
334048 E. E. Pratt and C. S. Partridge; Stereotype-casting box (flat).
334544 G. Pepé; Apparatus for drying stereotype-matrices (rotary drum).
335276 J. H. Ferguson; Stereotype-shaving machine (flat).
336022 W. T. Smith; Stereotype-plate and block or bed for the same (half-dovetail and rule).
336483 C. Hochstadt; Typecasting mould, grooved or recessed.
336645 L. K. Johnson and A. A. Low; Type-distributing apparatus.
336646 } 336647 } L. K. Johnson; Compositor's type-case (see 230784).

No.
336719 L. K. Johnson, and A. A. Low; Compositor's type- and space-holder (see 230784).
336753 F. Schreiner; Type-case for stereotype-matrix making machines (for impression-devices).
336754 F. Schreiner; Machine for making stereotype-matrix impressions (of single lines of type).
336824 D. J. Riker; Matrix (lead, tin and mercury).
337406 L. K. Johnson and A. A. Low; Type-distributing apparatus (assisting hand).
337407 L. K. Johnson and A. A. Low; Type-distributing apparatus (assisting hand).
337743 J. R. Cummings; Clamping-tool (for fastening electro-shells to bases).
337744 J. R. Cummings; Type (spaces and quads with projection to fit nicks of type).
338259 C. Frecker; Composing-stick.
339076 H. Seger; Composing-stick.
339609 T. D. Worrall; Type or die for forming impressions in metal surfaces (for successive impressions).
339671 F. D. Maltby; Machine for producing stereotype-matrices (see 304272).
339724 T. D. Worrall; Typewriting and matrix-making machine (impression-device).
339798 J. Mayerhofl; Perforating-type and overlay (tubular, cutting-edged-type).
340104 G. Damon and E. S. Peets; Stereotype-block (tongued-plate and multiple-base).
340124 L. K. Johnson and A. A. Low; Type-distributing apparatus.
340125 L. K. Johnson and A. A. Low; Type-holder and separator (see 277740).
341332 S. H. Horgan; Printing-plate (veneer backing).
342364 R. L. Kimberly; Justifying-machine (uses serrate flanged disks).
342386 F. Russell; Type-smoothing machine.
342442 L. K. Johnson; Compositor's galley-stick (to replace composing-stick).
342916 H. C. Leland; Type-distributing machine (automatic by nicks).
343640 P. S. Kellogg; Printers' lead- and rule-cutter.
344035 F. H. Dodd; Printers' furniture (adjustable for length).
344974 O. Mergenthaler; Machine for producing type-matrices (impression of a line).
345433 M. Joyce; Stereotype-block (wooden core and base strips).
345525 O. Mergenthaler; Machine for producing type-bars and matrices for the like (long-matrix Linotype; see 313224).
345526 O. Mergenthaler; Machine for producing type-bars (linotype-slugs).
345697 R. H. Ingersoll and P. B. Henry; Rotary, hand, numbering- and printing-machine (single-wheel).
347222 } 347223 } E. A. Blake; Stereotype-shaving machine (flat).
347591 W. H. Golding; Composing-stick.
347626 J. L. McMillan; Typesetting machine.
347627 J. L. McMillan; Type-distributing machine (automatic by nicks).
347629 O. Mergenthaler; Machine for producing type-bars (linotype-slugs).
347630 O. Mergenthaler; Type-matrix and mechanism for distributing the same (see 317828).
347818 O. Mergenthaler; Machine for casting stereotypes (impression-device).
347837 E. C. Standiford; Stereotype-plate (saddle-formed plate).
348583 E. E. Pratt; Stereotype-plate and -block (cast into wood-back).
348804 H. F. Wellman; Machine for shaving printers' leads (see 314384).
348836 C. G. Fischer; Apparatus for setting type (assisting hand).
349257 N. R. Lyman and A. Morley; Stereotype-plate and base with locking-device (tongue, locking-rod and rule).
350640 J. H. Reinhardt; Consecutive-numbering machine (see 318803).
350677 M. J. Hughes; Printing-plate holder (clamping plates).
350916 L. C. Crowell; Stereotype-plate holder (for curved plates).
351040 J. Brooks; Stereotype casting machine (curved).

No. **1886** (*continued*).

351313 J. R. and G. W. Cummings; Printing-block (see 312569).
351355 T. Bigelow; Printing-type (with holes to lace for supply of ink).
352137 H. Lee; Numbering-device (enabling arbitrary characters to precede low numbers without zeros preceding).
352447 J. E. Caps; Stereotype-casting machine (flat).
352869 P. Wenzel and H. Heinebach; Typecasting mould (pivotal).
353711 J. H. Reinhardt; Consecutive-numbering machine (for ten tickets simultaneously, see 318803).
354060 P. Wenzel and H. Heinebach; Mould for casting type (pivotal).
354149 L. K. Johnson and A. A. Low; Type-distributing apparatus (assisting hand).
354586 E. L. Tarbox; Mould for casting type-wheels.
354935 G. Rettig; Typecasting machine (pivotal).
R10710 J. North; Orig. No. 333325; Machine for mending stereotype-plates (correcting, etc.).

1887.

355768 E. D. Laraway and E. Bridge; Manufacture of type (from paper-pulp).
356749 J. M. Conner; Type-mould (pivotal for hollow type).
356840 L. K. Johnson and A. A. Low; Type distributing apparatus (assisting hand; Alden).
356845 A. A. Low; Lead- and rule-holder (assisting hand; Alden).
358041 L. K. Johnson and A. A. Low; Printers' typesetting compartment (Alden).
358585 H. F. Wellman; Mould for casting printers' leads.
359021 G. F. Kimball; Mould for casting printers' leads and small furniture.
359208 W. W. Gilman; Printers' galley (operating and securing sidestick).
359625 R. B. Nicol, Attachment for stereotype-blocks (levelling screws).
359751 E. A. Warren; Numbering-machine (multiple numbering-heads).
359779 L. and A. Foucher; Machine for casting and finishing type (body-slide).
359960 J. R. Cummings; Type and leads (raised to fit nick in type; see 337744).
360096 } 360097 } L. K. Johnson and A. A. Low; Type-distributing apparatus (assisting hand; Alden).
360104 A. A. Low; Type-containing channel (see 230784; Alden).
360307 L. Klopsch; Base for (celluloid, etc.) stereotype-plates.
360355 } 360356 } A. A. Low; Type-containing channel (see 230784; Alden).
360357 A. A. Low; Type-channel (for setters; see 230784; Alden).
360358 A. A. Low; Type-containing channel (see 230784; Alden).
361306 W. P. Martin; Stereotype-plate holder (clips).
362145 W. W. Colley; Machine for numbering papers (web-ticket printing).
362496 T. G. and H. Daw; Apparatus for producing impressed and printed surfaces (impression machine).
362751 A. Lagerman; Typesetting machine (Lagerman Typotheter).
362987 C. T. Moore; Printing (making stereotype line-impressions).
363193 W. R. Bacon; Apparatus for numbering (railway) tickets.
363836 A. A. Low; Type-distributing apparatus (assisting hand; Alden).
363975 W. R. Bacon; Numbering-apparatus (consecutive; see 363193).
364521 T. Lanston; Producing justified-lines of type (by increasing set width of types and spaces proportionately).
364522 T. Lanston; Producing justified-lines of type (by increasing set widths of types and spaces equally).
364523 T. Lanston; Producing justified-lines of type (type normal, spaces increased equally).

No.
364524 T. Lanston, Type-forme (of lines of justified matter; see 364521, etc.).
364525 T. Lanston; Type-forming and composing-machine (Monotype).
368757 J. A. Dear; Fastening for printing-plates upon cylindrical surfaces.
369192 G. E. Lloyd and C. S. Partridge; Stereotype-plate finishing machine (for locking-device plates).
369580 T. J. Bickster; Manufacturing printing-plates (relief).
369720 L. K. Johnson; Type-containing channel (see 230784; Alden).
370819 G. Rettig; Type-rubbing machine.
372076 A. A. Low; Type-distributing apparatus (assisting hand; see 264085; Alden).
372186 } 372187 } J. Thorne; Typesetting and distributing machine (see 232157).
374048 W. W. Evans; Printing-surface (hollow-shell type united to flexible base).
374438 J. H. White; Machine for making stereotype-matrices (successive impression; see 304272).
374629 J. H. Reinhardt; Consecutive-numbering machine (serial number and series).
374667 W. Filmer; Clamp for securing stereotype-plates.
374993 W. H. Page; Producing dies for use in making wood-type (models for pantograph).
375008 G. C. Setchell; Die for making wood-type and method of producing the same.
375360 P. S. Kellogg; Composing-stick.

1888.

375757 } 375758 } A. A. Low; Type-line support (Alden).
376348 F. Schreiner and A. Schott; Matrix for stereotyping (dry-flong).
376541 O. Mergenthaler; Mechanism for electrically-controlling stamping machines, etc. (linotype matrices).
376743 I. D. Hurlbut; Stereotype casting-box (flat).
376765 H. Barth and E. Lietze; Typecasting and finishing machine (body-slide).
378797 O. Mergenthaler; Machine for forming type-bars (Linotype; see 317828).
378798 O. Mergenthaler; Machine for producing type-bars (Linotype).
378799 G. Mohr; Apparatus for fitting up matrices (gauge for squaring).
378880 F. Geissel; Type-rubbing machine.
379241 W. H. Nelson; Stereotyping-machine (flat).
379777 W. H. Golding; Machine for cutting printers' rules.
379778 W. H. Golding; Machine for mitring printers' rules.
380004 W. H. Welsh; Machine for dressing and grooving type (see 266932).
380558 } 380559 } G. S. Eaton and J. C. Birch; Type-rubbing machinery.
381105 J. M. Black; Numbering-mechanism (for consecutive-numbering and perforating).
381227 C. S. Ellis; Numbering-machine (type-high, using printing-chains).
381802 A. A. Low; Type-containing channel (see 230784; Alden).
381820 E. D. Rogers; Means for securing stereotype-plates which are cast separately from their beds (inclined ribs).
381974 S. K. White; Numbering-machine (vertically-reciprocating frame).
383221 L. Goss; Machine for planing stereotype-plates (flat).
383959 to 383962 } A. A. Low; Lead- and rule-holder (see 356845; Alden).
386783 L. K. Johnson and A. A. Low; Type-line holder (assisting hand; Alden).
387007 C. S. Partridge; Stereotype-plate finishing machine (see 369192).
387527 M. G. Merritt; Making wood-type (routed and finished by die-pressing).
387546 J. Thorne; Justifying apparatus (assisting hand).
388032 H. Fietsch, Jr.; Block for locking stereotype-plates for printing.
388088 J. Thorne; Justifying apparatus (assisting hand).

No. **1888** (*continued*).

388307 J. H. Reinhardt; Consecutive-numbering-machine (typographic, platen-operated, quick-change of distinguishing letter, etc.).
388361 J. W. Hoke; Relief-type production (steel plate coated with powder and soluble-glass and baked).
388713 J. G. Pavyer; Printers' type (side-cores).
389108 J. R. Rogers; Machine for making stereotype-matrices (line-impression Typograph).
389112 G. C. Setchell; Making wood-type (pressing counters and outline-routing remainder).
389113 G. C. Setchell; Producing dies for making wood-type (see 374993).
389135 G. Bender; Type-metal pot and furnace (flue under metal-duct).
389673 J. Thompson; Stereotype-casting-box (semi-cylindrical).
389715 A. Overend; Stereotype-plate holder (see 252694).
390680 F. Keehn; Typefounding machine (body slide).
390774 L. Goss; Stereotyping (for mailed plates; subdividing illustrations).
391289 F. W. Wicht; Numbering-head (type-high, reducing space occupied, drop-cipher).
391516 E. H. Cottrell; Apparatus for drying matrices and casting stereotypes (flat).
391798 L. K. Johnson and A. A. Low; Type-distributing apparatus (see 264085; Alden).
392188 G. Damon and E. S. Peets; Stereotype-plate (of xylonite or celluloid).
392358 J. B. Odell; Typesetting and distributing indicator (assisting hand-work).
392446 O. Mergenthaler; Matrix-delivering mechanism (Linotype escapement).
392556 J. G. Harris; Method of graining plates for surface-printing (sand and balls).
392710 H. Barth and E. Lietze; Type-casting and finishing machine (body-slide).
392806 L. K. Johnson and A. A. Low; Type-distributing apparatus (assisting hand; Alden).
393267 J. R. Risdon; Composing-stick.
393846 O. Mergenthaler; Type-bar (linotype-slug with dressing-ribs).
394255 L. Dow; Type-distributing machine (key-operated).
394346 R. D. De Little; White-letter type (for intaglio-printing from type).
394594 C. T. Murray; Stereotype-finishing machine.

1889.

395435 L. Goss; Stereotype-plate (casting columns joined only at the ends).
395728 F. Wesel; Machine for cutting printers' rules (also mitring).
395984 A. A. Low; Lead- and rule-holder for compositors' use (see 356845).
396478 L. Goss and S. W. Trew; Machine for trimming, planing, and sawing stereotype-plates (flat).
397003 L. K. Johnson and A. A. Low; Compositors' type-case (see 230784; Alden).
397232 R. B. Hastie; Matrix-impression guard for type-formes (type-high).
398624 W. Koch; Numbering-machine (consecutive, operated by vertical head-carrying rod).
398852 W. G. Slauson; Stereotype-plate holder (swivel clamps).
399911 F. J. Ludington and H. C. Leland; Composing-stick.
399945 E. L. Tarbox; Moulding typewheels and other curved surfaces (multiple radial moulds).
400000 M. G. Merritt; Making type (struck for typewriters).
400001 M. G. Merritt; Die for trimming type (struck for typewriters).
401738 G. Eastwood; Matrix for stereotype-plates.
402317 H. Freeman; Type-case (assisting hand-justifying).
402537 R. W. Nelson; Typesetting machine (see 232157).
402720 F. M. F. Cazin; Producing matrices (tissue-paper facing).
402850, 402851 W. H. Page and G. C. Setchell; Die for forming wood-type (by impression).

No.
402852 W. H. Page; Die for forming wood-type (by impression).
402863 G. C. Setchell; Die for forming wood-type (see 402850).
403075 W. Rennyson; Typewriting and matrix-making machine (impression-device).
404564 F. Schreiner and A. Schott; Matrix for stereotyping (flat; see 376348).
405273 G. D. Rogers; Typesetting and distributing machine.
405419 H. Klemm; Typecasting mould (casting and delivering mortised type).
405662 J. R. Cummings and G. E. Lloyd; Stereotyper's sawing, trimming and grooving machine (flat plates).
406371 E. D. Rogers; Means for securing stereotype-plates which are cast separately from their beds (flat; longitudinal flanges).
406398 J. G. Harris; Apparatus for graining printing-plates.
406828 H. Fietsch, Jr.; Block for stereotype- or electrotype-plates (with holes for eccentric-headed stop pins).
406862 F. D. Thomason; Stereotype-plate and base (with spring sides and dovetails).
407608 C. S. Partridge; Matrix-making machine (mechanically-operated heating-brush).
407670 E. A. Leland; Elastic-faced type (vulcanized fibre).
408195 A. D. Rood; Type (with raised points for both perforating and printing).
409518 V. Sperle; Composing-stick.
409690 A. A. Low; Type-distributing apparatus (assisting hand).
409748 L. K. Johnson and A. A. Low; Type-distributing apparatus (assisting hand; Alden).
409920 J. R. Carter; Paper-numbering machine (for simultaneously-numbering both sides of strip).
410673 J. Phillips; Apparatus for the consecutive-numbering of cheques, tickets, etc. (lever-depression).
410714 J. C. Merritt; Stereotype-block (flat, with side securing plates).
410830 J. F. Frey; Backing compound for stereotype-matrices.
410923 D. Reid; Means for securing stereotype-plates (dovetail-strips screwed to base).
410958 C. H. Davids; Numbering-device (gear for releasing and re-engaging).
411883 G. H. Benedict and P. M. Furlong; Matrix-plate clamp (for curved electrotypes; Chicago Matrix Machine Co.).
412001 J. H. Rogers; Paper-perforating machine (multiple-perforations corresponding to characters).
412299 C. Sears; Making stereotype-moulds (successive impressions in end-grain wood; see 20081).
412489 W. A. Force and W. W. Sawyer; Consecutive-numbering machine (hand-stamp).
412606 L. Dow; Typesetting machine (American Typesetter Co.).
412714 L. Dow; Typesetting machine (see 412606).
413042 A. J. Engelen; Machine for making type-bars (successive impressions of intaglio-matrices on wood).
413087 J. G. Pavyer; Type-making machine (pivotal).
413522 W. A. Kelsey and R. Atwater; Machine for cutting and mitring printers' rules.
413550 H. Popp; Typecasting machine (body-slide).
414254 W. H. Price, Jr.; Composing-stick.
414399, 414400 G. A. Goodson; Matrix-making machine.
414401 G. A. Goodson; Matrix-making machine die.
414402 G. A. Goodson; Clutch-mechanism (for successive-impression machine).
414521 G. A. Goodson; Forming matrices (by successive impressions).
414636 G. A. Goodson; Matrix-making machine die.
414637 G. A. Goodson; Device for converting motion (electro-magnetic for successive impressions).
414664 F. W. Wicht; Numbering-head (type-high, plunger-operated).
415615 J. I. C. Clarke; Interchangeable plate for stereotype-formes (semi-cylindrical).

1889 (*continued*).

No.

415821 W. Scott; Machine for bending stereotype-plates.

416568 E. O. Chase; Machine for shaving printers' leads.

416716 J.R.Cummings; Stereotype-plate separating, trimming and grooving machine (for flat plates).

416717 J. R. Cummings; Stereotype-casting apparatus (flat).

416740 C. L. Redfield; Type-die for matrix-making (for successive impressions; Chicago Matrix Machine Co.).

416741 C. L. Redfield; Impression-device for matrix-making machines (for successive impressions).

416742 C. L. Redfield; Circuit-closing device for matrix-making machines (for successive impressions).

416743 C. L. Redfield; Escapement-device for matrix-making machines (for successive impressions).

416744 C. L. Redfield; Feed-device for matrix-making machines (for successive impressions).

417057 T. J. Lumis; Typesetting machine (see 232157).

417074 R. W. Nelson; Type-distributing machine (see 232157).

417142 B. A. Brooks; Preparation of printing-surfaces (logotypes formed by impression and justified with ordinary or automatic spring-spaces).

418292 J. Manning; Machine for bevelling stereotype- and electrotype-plates (flat).

418295 C. L. Redfield; Variable-feed mechanism for matrix-making machines (for successive impressions).

418321 J. B. Odell; Typesetting machine (electrically operated).

418664 W. Dreyer; Electro-magnetic typesetting machine.

1890.

418799 G. E. Lloyd; Stereotype-shaving machine (plane).

418858 A. M. White; Composing-stick.

418985 D. Reid; Key for securing stereotype-plates (to their bases).

419119 J. Gustafson; Typesetting machine. (Lagerman Typotheter; see 362751.)

420454 B. B. Hill; Type-holder for rubber-type.

421001 L. K. Johnson and A. A. Low; Type-distributing machine (see 363836; Alden).

421972 C. L. Redfield; Impression-device for matrix-making machines (successive impressions).

422122 P. P. Craven; Typesetting machine (loose-type setter).

423332 L. S. Mack and B. Woodward; Stereotype-plate holder (clip).

423402 W. R. Wilson; Machine for washing printers' type-formes.

423688, 423689 W. J. Howell; Apparatus for producing indented type-impressions (successive in matrix).

424085 E. White; Means for inserting movable-type in stereotype-plates.

424147 H. W. Taylor and C. W. Welman; Relief-type (engraving plate with soft friable coating).

425140 O. Mergenthaler; Machine for producing type-bars (linotype-slugs; see 317828).

425580 J. H. Reinhardt; Consecutive-numbering head (type-high, platen operated).

425581 J. H. Reinhardt; Consecutive-numbering machine (type-high, alters designating-letter and repeats).

426283 H. H. E. G. Kohl; Plate-holder for mechanical printing (rotatable grid for half-tones).

427320 J. T. Hawkins; Means for securing flexible printing-plates.

427365, 427366 H. Robischung; Means for holding printing-plates, on cylindrical or flat surfaces.

427680 G. A. Goodson; Attachment for type-writing machines (for impression-matrix making).

427681 G. A. Goodson; Electro-matrix machine (successive impression).

No.

427682 G. A. Goodson, A. S. Capehart, and C. L. Travis; Forming matrices for stereotype-plates (successive impression).

427685 J. Gustafson; Typesetting machine (Lagerman Typotheter).

427716 C. L. Travis; Producing type-dies for impression machines.

427717 C. L. Travis; Matrix-machine (successive impressions of a small character to produce a large one, for advertisments).

427803 F. Schreiner and A. Schott; Stereotyping-matrix (flong).

427947 G. G. Allen; Typesetting and printing machine (sets, prints, and distributes the line).

428138 C. L. Redfield; Type-die holder for matrix-making machines (successive impressions).

428906 J. Gustafson; Typesetting apparatus (Lagerman Typotheter).

429737, 429738, 429739 C. L. Redfield; Impression-device for matrix-making machines (successive impressions).

429740 C. L. Redfield; Matrix-making machine (successive impressions).

429741 C. L. Redfield; Justifying-index for matrix-machines (successive impressions).

429742 C. L. Redfield; Impression device for matrix-making machines (successive impressions).

429754 J. W. Chadwick; Typesetting machine (Lagerman Typotheter).

429864 C. L. Redfield; Forming matrices (successive impressions).

429865, 429866 C. L. Redfield; Type-die for matrix-making machines (successive impressions).

429867 C. L. Redfield; Forming matrices (successive impressions).

430007 L. Dow and D. Powers; Type-distributing machine (key-board; see 394255).

430051 F. Wicks; Typecasting machine (Rotary).

430542 J. C. Parmerlee; Engraving-machine (for reproduction on plates coated with friable material for the production of stereotypes).

430624 R. Clay and J. E. Marchant; Feed-appliance for typesetting machines (see 362751, but continuous running; Typotheter).

430630 J. T. Denvir; Stereotype-plate locking-device.

431280 J. B. Odell; Machine for perforating strips for use in automatic-typesetting apparatus (May and Jones).

432407 C. E. Hopkins; Machine for sawing stereotype-plates.

432627 A. J. Kletzker; Matrix-making machine (successive impressions).

433030 G. P. Prescott; Typesetting machine (loose-type).

433232 J. Brooks; Fastening for printing-plates upon cylindric surfaces (bands).

433448 J. R. Cummings; Clamping-device for stereotypers' casting-boxes (plane).

433449 J. R. Cummings; Stereotypers' casting apparatus (box, plane).

434880 J. B. Odell; Recording-telegraph.

434881 J. B. Odell; Printing-telegraph (electrically-controlled typewheels).

434942 J. B. Odell; Typesetting machine (loose-type setter).

435344 F. M. F. Cazin; Matrix-making machine (successive impressions).

435564 L. K. Johnson and A. A. Low; Type-distributing apparatus (for type dropped into receivers or conduits; Alden).

435753 M. Joyce; Stereotype-block (cored cellular).

435777 R. H. St. John; Type-bar (St. John Typobar).

436028 S. D. Tucker; Stereotype-plate holder (clip).

436039 L. K. Johnson and A. A. Low; Type-distributing apparatus.

436109 C. Spielmann; Consecutive-numbering machine (hand-stamp; see 412489).

436314 J. W. Osborne; Making matrices *papier mâché* stereotype).

436372 C. T. Murray; Stereotyping-apparatus (matrix drying-press and metal-pot).

436379 L. Quanchi; Making matrices for stereotyping purposes (also drying).

436531 O. Mergenthaler; Machine for forming type-bars (linotype-slugs; see 317828).

No. **1890** (*continued*).

436532 O. Mergenthaler; Machine for producing linotype-slugs, type-matrices, etc. (see 317828).
436614 M. Schwertführer; Locking-device for printing-plates (clamp).
436703 G. A. Goodson; Matrix-making machine (successive impressions; see 414399).
436740 J. B. Odell; Printing-telegraphs (electrically controlled typewheels).
436925 C. Ostermann; Adjustable drying-frame for matrices or moulds for stereotypes (cold process).
437139 J. R. Rogers; Typograph (Rogers Typograph slug-caster; see 389108).
437141 F. E. Bright; Typograph (Rogers Typograph slug-caster; see 389108).
437374 G. H. Benedict; Mechanism for casting stereotypes (to interlock with bases).
438354 O. Mergenthaler; Linotype-machine (melting-pot and mould-wheel).
439334 G. W. Weaver; Stereotype-plate and base (detachable for mailing).
439446 W. P. Uhlinger; Governing-device for numbering-machines (hand-stamp for successive repetitions).
440086 E. Wright; Typewriting and matrix-making machine (impression-device).
441118 C. L. Redfield; Matrix-making machine (successive impressions).
441340 T. A. Thorsen; Stereotype casting-box (cylindrical).
441475 W. B. Fish; Composing-stick.
441564 M. Howard; Matrix-making machine (successive impressions).
441750 P. P. Craven; Type-distributing machine (corresponding to key-depressions).
442341 J. H. Stonemetz; Stereotype-plate casting-box (cylindrical).
442363 J. R. Cummings; Stereotype-casting apparatus (box, plane).
442364 R. J. Cummings; Stereotype-plate and device for locking (by means of grooved rule).
442515 J. R. Cummings; Stereotype-casting apparatus (box, plane).
442551 R. H. St. John; Type-bar machine (Typobar).
443085 G. Corsa; Type-making mechanism (linotype-slugs, using wedge-spaces).
443086 G. Corsa; Forme-setting and typecasting machine (slug-caster).
443517 H. C. Hadstate and S. J. Martin; Numbering-machine (for cylinder-press printing duplicate sales-slips).
443656 C. E. Strong and H. G. Lange; Stereotype-casting machine (plane with ribs).
443662 H. G. Lange; Stereotype-casting machine (plane).
R11056 J. A. Dear; Orig. No. 368757; Fastening for printing-plates upon cylindrical surfaces.
R11091 J. R. Carter; Orig. No. 409920; Paper-numbering machine.

1891.

444090 W. S. Scudder; Machine for casting linotype-slugs (curved for cylinders).
444124 }
444125 } G. Calder, Jr.; Matrix-making machine (successive impressions).
444294 P. T. Dodge; Type-composing mechanism (Linotype matrix-delivery).
444337 P. T. Dodge; Mechanism for justifying matrices, type, etc. (Linotype).
444949 H. Dalziel; Backing-block for stereotype-plates.
445040 G. Calder, Jr.; Matrix-making machine (successive impressions).
445559 F. A. Johnson and W. E. Crane; Machine for producing printing-surfaces (impression-device).
445702 A. A. Low; Type-containing channel (see 230784).
446235 J. Patten; Type-distributing machine (automatic).
446695 H. Schimansky and L. Passelt; Frame for holding stereotype-moulds (matrices).

No.
446738 E. A. Henkle and J. C. Fowler; Apparatus for the manufacture of curved linotype-bars (for cylinders, reading in direction of the length).
446930 C. Sears; Stereotype-mould (successive impressions in wood).
447124 A. B. Adams; Type-distributing holder (for hand-distribution).
447134 H. Lee and E. Lebrun; Matrix-making or typesetting machine (successive impressions).
447135 H. Lee; Matrix-making or typesetting machine (successive impressions).
447321 T. C. Hargrave; Electric matrix-making machine (successive impressions).
447449 T. C. Hargrave; Matrix-making machine (successive impressions).
448587 C. L. Redfield; Escapement-device for matrix-making machines (successive impressions; see 436703).
448735 E. C. Standiford and S. A. Hyers; Typesetting or composing machine (loose-type).
448994 C. L. Redfield; Matrix-making machine (successive impressions).
449039 H. Fietsch, Jr; Stereotype-plate holder (clamp).
449062 A. F. Allen; Typefounder's matrix (hard- and soft-metal).
449872 P. T. Dodge; Linotype machine.
450083 T. Mitchell and J. Milne; Type-mould (for double-ended type).
450665 J. J. Finke; Detachable-holder for rubber-faced type and type for the same.
450783 T. J. A. Macdonald; Numbering-machine (for consecutive numbers on both sides of sales-slips).
451276 T. I. Knight and L. Quanchi; Stereotype-casting machine.
451625 N. E. Smith; Type-frame for chases.
453257 J. Gustafson; Typesetting machine (Typotheter; see 427685).
453343 T. Mangan; Stereotype backing-powder or filling for matrices.
453584 L. K. Johnson and A. A. Low; Type-distributing apparatus (into channels; Alden).
453699 S. H. Hoggson; Type-belt (for dating-machines, etc.).
453962 J. O. Clephane; Linotype machine.
454063 J. C. Parmerlee; Engraving machine (engraving in wax-covered plate for stereotyping).
454066 C. L. Redfield; Type-die for matrix-making machines (successive impressions).
454774 C. Schraubstadter, Jr., and C. R. Schilling; Engraving machine (engraving electrotypes, stereo-casts, etc.).
454862 B. Godwin; Printers' type (for script).
455070 A. T. Thayer; Printers' furniture (tenoned corners).
455732 S. C. Beckwith and W. W. Street; Alinement-bar for matrix-making machines (successive impressions).
456014 T. S. Buck; Type-holder (for rubber-type).
456502 W. MacKay; Bed for metallic printing-plates.
456873 J. M. Williamson; Type and holder for the same.
456874 E. G. Bates; Numbering-machine (hand-stamp, consecutive, duplicate or repeat).
457182 R. Clarke; Portable type-distributor (with compartments for spaces and leads).
457481 J. B. Odell; Type-distributing apparatus (automatic).
457575 J. C. Birch and C. Dancel; Type-rubbing machinery.
457752 W. W. Street; Electrical matrix-making machine (successive impressions).
457829 O. F. Teed; Type-distributing machine (automatic).
457896 J. R. Cummings; Stereotypers' casting apparatus (metal-pot and ladle).
457897 J. R. Cummings; Stereotype-casting apparatus (type-high bases).
458050 H. C. Hansen; Typecasting machine (heating nipple).
458314 J. O. Clephane; Linotype machine.
458531 W. B. Fish; Method of and machine for making printers' rules.
459825 C. Carlton, J. E. Caps and W. J. Rose; Stereotype-plate holder (clamp).

No. **1891** (*continued*).

460035 C. Schraubstadter, Jr., and C. R. Schilling; Lead-cutter.
461141 W. B. Lewis; Stereotype-casting box.
461186 J. H. Reinhardt; Hand numbering-machine (hand-stamp, consecutive, duplicate, or triplicate).
461196 R. Hammer; Consecutive-numbering machine (hand-stamp).
461338 E. A. Henkle and J. C. Fowler; Curved linotype-bar (for cylinder, reading in direction of the length).
461408 T. F. Geary; Consecutive-numbering head (type-high; see 318803).
462764 B. F. Harris, Jr.; Stereotype-plate and base with locking-device (groove and rod).
462960 A. T. Thayer; Printers' furniture (with guide-bars type-high).
463388 F. A. Johnson; Matrix-making and stereotyping machine (Tachytype; successive impressions).
463427 T. MacKellar; Metallic slug (lead, tin, antimony and copper with aluminium).
464163 J. L. McMillan; Type-distributor (see 347627).
464477 C. H. Joslyn; Type-distributing machine (see 347627).
465316 L. Benson; Device for locking up type in galleys or chases (screw clamp).
465351 J. R. Cummings; Combined stereotype-plate trimming, bevelling and shaving machine.
465352 J. R. Cummings; Delivery-mechanism for stereotype-plate trimming, grooving, and shaving machines.
465353 J. R. Cummings; Machine for trimming, shaving, and grooving stereotype-plates.
465482 H. C. Leland; Type-distributor (automatic by special nicks).
465532 E. P. Mickel; Stereotype-plate and base retaining grooves).
465847 C. M. Gage; Matrix-board (stereotype-flong).
465876 J. L. McMillan; Typesetting machine (loose-type; see 347626).
465877 J. L. McMillan; Type-justifying machine (loose-type).
R11198 J. R. Rogers; Orig. No. 389108; Machine for making stereotype-matrices (Rogers Typograph).

1892.

466366 C. S. Partridge; Stereotype-box (for casting).
466666 P. T. Dodge; Typecasting machine (linotype melting-pot).
467087 L. Dow and D. Powers; Type-distributing machine (see 394255).
467335 W. A. Lorenz; Type-justifying apparatus (Thorne).
467355 W. A. Lorenz; Type-arranger (for loose-type; Thorne).
467631 E. J. Andrews; Typesetting and distributing machine (Thorne).
467640 T. J. Lumis; Typesetting and distributing machine (see 232157; Thorne).
468078 T. J. Lumis; Belt-driving mechanism (for Thorne typesetter).
468504 M. E. Lyon; Composing-stick.
468570 T. J. Lumis; Typesetting and distributing machine (see 232157; Thorne).
468973, 468974, 468975 } C. L. Redfield; Matrix-making machine (by successive impressions; see 429742).
468976 C. L. Redfield; Type-die (for successive impression machine).
469198 J. F. Reinhardt; Consecutive-numbering machine (type-high platen-operated).
470649 J. C. Fowler; Spacer for type-matrices (spring; for successive impression machine).
471432 D. Reid; Device for mounting and locking interchangeable stereotype- and electrotype-plates to their bases (keying).
471601 J. J. Clause; Machine for trimming segmental cylindrical stereotype-formes.
471890 J. G. Pavyer; Typecasting and dressing machine (see 413087).
472473 J. R. Cummings; Stereotype-casting apparatus (matrix).
472474 J. R. Cummings; Stereotype-plate and base (locking columns).

No.
472475 J. R. Cummings; Stereotypers' casting apparatus.
472966 M. Georgii; Means for justifying matrices (rotating helical-faced space-matrix halves).
473271 J. R. Topliss and J. A. Kay; Machine for nicking printing-type (for distributing).
473405 R. W. Nelson; Typesetting and distributing machine (see 232157).
473691 G. A. Botton; Typesetting machine (loose-type).
474306 J. W. Schuckers; Mechanism for justifying composed-lines of type (see 222642).
474809 G. Calder, Jr.; Matrix-making machine (by successive impressions; see 445040).
474964 W. Mitchell; Electrically-heated matrix press.
475517 H. S. Popp; Typecasting machine (movable body-slide).
475804, 475805, 475806 } C. Sears; Matrix-making machine (successive impressions).
475807 C. Sears; Matrix-making machine type-writing-attachment (successive impressions).
477008 L. K. Johnson; Slug for type-containing channels.
477009 L. K. Johnson; Type-distributing apparatus.
477591 H. Fietsch, Jr.; Block for stereotypes, etc. (clamp).
478241 C. H. Shaw; Numbering-machine (hand-stamp; soft-type fitted to wheels).
478257, 478258 } G. A. Goodson; Matrix-making machine (by successive impressions).
478333 F. A. Johnson; Matrix-material (successive impression; Tachytype).
478340 A. Lagerman; Type-justifying apparatus (Typotheter).
478749 S. H. Horgan; Printing-plate and block (base).
479539 C. L. Travis; Matrix-making machine (successive impressions).
479772 G. A. Goodson and A. S. Capehart; Matrix-making machine (by successive impressions).
479773 G. A. Goodson; Matrix-making machine (by successive impressions; see 414399).
480350 W. W. Street and C. L. Travis; Justifying-attachment for matrix-making machines (successive impression).
480361 S. C. Beckwith and W. W. Street; Matrix-making machine (by successive impressions).
480497 W. W. Hastings and F. D. Foster; Type-setting machine (Typotheter).
480933 G. D. Morse and M. Chase; Type-plate and blank for the same.
481286 L. K. Scotford; Type-holder (for rubber-type).
481308 C. L. Redfield; Forming matrices (impressions).
481760 T. K. Hinshillwood; Typecasting machine (movable body-slide).
481920 J. C. Fowler; Machine for producing type-bars (linotype-slugs).
482784 A. Coleman; Type (stereotype to replace wood-letter).
483023 J. Slocum; Typograph attachment (Rogers Typograph).
483252 T. T. Heath and A. N. Verdin; Typographic machine (successive impression).
483544 J. R. Cummings; Stereotype-plate and base.
483716 W. A. Force; Composition for stereotype-plates.
484082 M. Bennitt; Stereotype-plate and holder (keying).
484135 A. T. Brown; Type-making machine (automatically produced from wire).
484389 E. G. Bates; Consecutive-numbering machine (type-high).
484390 E. G. Bates; Machine for consecutively-numbering cheques, bonds, etc., in sheets (arrangement of numbers on wheels; see 484389).
484391 E. G. Bates; Consecutive-numbering machine (type-high, wheels close together, drop-cipher).
484514 J. K. Bittenbender; Composing-stick.
484588 F. Hainsworth; Printing-plate holder (clamp).
484915 T. M. Kenney; Type-finishing machine.

No. **1892** (*continued*).

485655 L. Ransom and A. W. Maynes; Type-line-forming machine (successive impression).
485702 A. J. Kletzker and J. G. Goesel; Matrix-making machine (by successive impressions).
486160 W. Filmer; Clamp for securing stereotype-plates.
486240 A. Thomson; Stereotype-plate and holder (keying).
486572 W. H. Steele; Printing-plate and making the same (matrix).
488265 J. Hooker; Typesetting machinery (see Brit. pat. 477/1874).
488577 F. Sanders; Consecutive-numbering head (type-high; see 391289).

1893.

489011 M. Joyce; Matrix and method of using matrices (for stereotyping).
489449 E. G. Bates; Numbering-machine (hand-stamp for yardage-tags).
489503 C. Sears; Linotype-making machine (from impression matrices in a cold mould).
489834 H. C. and S. D. Snoddy; Typesetting machine (loose-type, temporary spaces, automatic justification).
490263 E. V. Beals; Matrix-making machine (impression).
490739 I. McK. Chase; Type-bar (linotype-slug with compressible space-connections for justifying).
492147 G. A. Davis; Matrix-drying machine (cylindrical for stereotyping).
492164 J. A. Kay; Typesetting machinery (loose-type setter).
493270 J. Hooker; Type-distributing machinery (automatic by thickness and nicks; see Brit. pat. of W. H. Mitchel 155/1857, type nicked for distributing).
493448 A. V. Ruckmich; Typesetting machine (Lagerman-Chadwick).
494564 J. I. Haynes; Typesetting machine (loose-type).
494572 L. K. Johnson; Typesetting apparatus (Alden).
494573 L. K. Johnson; Typesetting apparatus (setting composed combinations with spaces).
494899 W. S. Scudder; Space-bar for line-casting machines (Monoline).
495588 J. Hooker; Indicator-mechanism for type-setting machines (for length of line, electrical).
495667 H. Dunning; Manufacturing types for printing and stamping, and type made by such process (in gelatinous material).
495703 J. G. Pavyer; Type-machine (discharging and dressing).
495704 J. G. Pavyer; Typecasting machine (discharging and dressing, uses compressed air).
495705 J. G. Pavyer; Type-machine mould (discharging).
495835 C. L. Redfield; Matrix-making machine (impressions made successively).
496373 C. L. Travis; Matrix-making machine (impression; see 414399).
497729 F. Sanders; Numbering-machine (one or more adjustable heads platen-operated from the side).
497914 A. C. Ferguson; Phototype machine (arranging characters, photographing and transferring).
498127 M. Levy; Screen for making photomechanical printing-plates (half-tones).
498248 T. T. Eckert and S. Bergmann; Mould for the formation of (soft-rubber) typewheels.
498396 W. Kurtz; Photomechanical printing; consists of producing half-tone negatives by subjecting the sensitized plates to one exposure through screens provided with parallel lines running in one direction only, and others in which the lines run in different directions respectively; producing printing-plates from these half-tone negatives; printing in different colours from the printing-plates.

No.
498425 J. C. Fowler; Spacer for type-matrices (compressible for impression machine).
498426 J. C. Fowler; Spacer for type-matrices (compressible for impression machine).
499278 W. Berri; Matrix and matrix-assembling mechanism (Polygonal).
499506 W. W. and J. M. Bishop; Typesetting machine (loose-type).
499507 W. W. Bishop; Type (bifurcated to set on rules or rails).
499546 A. A. Hill; Composing-stick (supported by body to leave both hands free for setting).
499911 T. T. Eckert and G. B. Scott; Typewheel (soft-rubber).
500317 L. F. Campi; Machine for engraving or sinking dies, matrices, or other objects.
500801 F. Ecaubert; Die for making typewheels (by rolling in brass, etc.).
501297 C. L. Redfield; Type-die for matrix-making (impression; see 416740).
501358 S. H. Nesbit; Type-holder (for dating, etc.).
501597 O. S. Bowman; Type-distributing machine (hand-operated).
501934 W. Grothe; Adjustable typefounding apparatus (hand-mould).
503324 A. J. Kletzker and J. G. Goesel; Matrix-making machine (impression; see 485702).
503950 G. Eastwood; Stereotyping (partially-dried flong raised after receiving the impression).
505200 J. Hooker; Indicator-mechanism for type-setting machinery.
506198 W. S. Scudder; Line-casting machine (Monoline).
506349 A. L. Thomas; Drying matrices and means for so doing (stereotypes).
507258 F. H. Bultman; Type-mould (for mortised or cored type).
507275 W. Kemp, Jr.; Type-matrix (soft metal inserted in a hard body).
507431 A. Gray; Printing-plate bending-press (for making to conform to cylindrical surface).
507485 W. B. Carr and A. G. French; Matrix-board (for stereotyping).
507610 C. C. Bruckner; Engraving machine (for relief or intaglio).
508186 C. Sears; Justifying matrix-lines (impression).
508248 C. Sears; Matrix-making machine (impression; see 475804).
509075 H. Fietsch; Base for stereotype- or electrotype-plates (clamping).
509860 E. V. Beals; Apparatus for perforating strips for actuating type-rings (for impression-matrices).
510032 V. F. Lake and I. Risley; Machine for justifying matrix-pages (produced by impression-devices).
510288 H. S. Popp; Typecasting machine (see 413550).
510305 J. A. Watson; Justifying-mechanism for matrix-making machines (for impression-devices).
510853 J. C. Fowler; Machine for producing type-bars (linotype-slugs from impressions; 481920).
510912 C. A. Haney; Numbering-head (type-high, platen-operated).
R11316 C. L. Redfield; Orig. No. 429864; Forming matrices (impression).
R11335 C. L. Redfield; Orig. No. 416740; Type-die for matrix-making machines (impression).
R11363 J. W. Hoke; Orig. No. 388361; Relief-type production (friable coating).
R11393 O. Mergenthaler; Orig. No 345525; Machine for producing type-bars and matrices for the same object (justification of impression; see 313224; Linotype).

1894.

512215 W. E. Post and S. J. Nevins; Matrix-moulding and drying-apparatus (steam-heated mangle-press).
512447 A. E. Newby; Holder-plate for type (for posters and labels).
512924 J. Vierling; Binder or tie-up for pages of type.
513007 G. A. Dubeux; Curved linotype-slug and holder (dovetailed and tapered for cylinder-press).

No. **1894** (*continued*)

513330 A. Kayser; Stereotype-b
apparatus (to make type-h
513958 C. Skatulla; Space-bar i
machines (Monoline).
515368 F. Sanders; Numbering-mac
improvements).
515623 H. A. Stall; Linotype machi
516672 E. T. Wheed; Printing-pla
tional with clamps).
516742 H. Lee; Matrix-making a
machine (impression).
517144 L. K. Johnson; Typeset
(Alden).
517340 H. Heinebach; Typecastin
type-relief at one end a
other).
517680 H. A. Chase; Engraving
printing-stamps and numb
517802 C. F. Hilder; Type-distribu
518063 M. M. Gillam; Art of an
colouring the printing-sur
(to stop glitter of linotype
518569 E. and A. E. Hall; Matrix
(cylindrical).
518632 C. Spielmann; Consecu
machine (hand-stamp, co
cate or repeat).
518826 R. J. Sachers; Manufactu
plates (hard and soft meta
519516 E. Werner; Typographic
pression-device).
519517 E. Werner; Typographic
attachment (impression-de
520140 C. Forth and H. Glenzer;
justifying matrix-lines (at
instead of equably).
520158 P. T. Dodge; Linotype mac
520238 H. W. Libbey; Typogra
device).
520311 C. F. Hilder; Typesetting m
520465 W. Weatherby; Device for
from type (uses an elastic
520642 R. H. Healey; Matrix-d
(stereotype).
520968 F. Sanders; Numbering-m
heads; modified plunger
rotary presses).
520969 F. Sanders; Numbering-m
heads operated by single
520976 F. W. Wicht; Numbering
high, automatically-repea
521000 J. H. Reinhardt; Numberin
high).
521001 J. H. Reinhardt; Nu
(type-high with drop-ciph
521039 J. L. McMillan; Method
for justifying type.
522073 O. Mergenthaler; Linotype
522714, 522715, 522716 L. K. Johnson and A. A. L
apparatus (Alden Type M
523255, 523256, 523301 G. H. Ziegler; Typecastin
523740, 523741 L. K. Johnson; Types
(Alden).
523742 to 523745 L. K. Johnson and A. A. L
apparatus (Alden Type M
523760 T. B. Caswell; Perforatin
setting machines (for ty
die-setting and distributi
524099 W. H. Welsh; Typecastin
a number of type simult
524285 O. V. Sigurdsson; Linotyp
524692 F. Praunegger; Typesettin
524693 F. Praunegger; Type-distr
525754 G. W. Weaver; Type (i
writer stipple).
526106 L. K. Johnson; Type-dist
(Empire).
526148 W. J. Egan; Stereotypi
box).
526569 A. Foucher; Typefounding
caster; see 359779).
526822 R. A. Stewart; Type-ho
type.
527371 G., J. G., and M. O. Rehfus
machine.

No. 1894 (*continued*).

513330 A. Kayser; Stereotype-block trimming-apparatus (to make type-high).

513958 C. Skatulla; Space-bar for line-casting machines (Monoline).

515368 F. Sanders; Numbering-machine (type-high, improvements).

515623 H. A. Stall; Linotype machine.

516672 E. T. Wheed; Printing-plate holder (sectional with clamps).

516742 H. Lee; Matrix-making and typesetting machine (impression).

517144 L. K. Johnson; Typesetting apparatus (Alden).

517340 H. Heinebach; Typecasting machine (for type-relief at one end and intaglio at other).

517680 H. A. Chase; Engraving machine (for printing-stamps and numbering-machines).

517802 C. F. Hilder; Type-distributing apparatus.

518063 M. M. Gillam; Art of and apparatus for colouring the printing-surface of cast type (to stop glitter of linotype slugs).

518569 E. and A. E. Hall; Matrix-drying machine (cylindrical).

518632 C. Spielmann; Consecutive-numbering machine (hand-stamp, consecutive, duplicate or repeat).

518826 R. J. Sachers; Manufacture of printing-plates (hard and soft metals).

519516 E. Werner; Typographic machine (impression-device).

519517 E. Werner; Typographic machine and attachment (impression-device).

520140 C. Forth and H. Glenzer; Mechanism for justifying matrix-lines (at two spaces only instead of equably).

520158 P. T. Dodge; Linotype machine.

520238 H. W. Libbey; Typograph (impression-device).

520311 C. F. Hilder; Typesetting machine.

520465 W. Weatherby; Device for removing leads from type (uses an elastic base).

520642 R. H. Healey; Matrix-drying apparatus (stereotype).

520968 F. Sanders; Numbering-machine (multiple-heads; modified plunger for cylinder and rotary presses).

520969 F. Sanders; Numbering-machine (multiple-heads operated by single plunger).

520976 F. W. Wicht; Numbering-machine (type-high, automatically repeating series).

521000 J. H. Reinhardt; Numbering-machine (type-high).

521001 J. H. Reinhardt; Numbering-machine (type-high with drop-cipher).

521039 J. L. McMillan; Method of and machine for justifying type.

522073 O. Mergenthaler; Linotype machine.

522714, 522715, 522716 } L. K. Johnson and A. A. Low; Typesetting apparatus (Alden Type Machine Co.).

523255, 523256, 523301 } G. H. Ziegler; Typecasting machine.

523740, 523741 } L. K. Johnson; Typesetting apparatus (Alden).

523742 to 523745 } L. K. Johnson and A. A. Low; Typesetting apparatus (Alden Type Machine Co.).

523760 T. B. Caswell; Perforating strips for typesetting machines (for type-, matrix-, and die-setting and distributing).

524099 W. H. Welsh; Typecasting machine (casts a number of type simultaneously).

524285 O. V. Sigurdsson; Linotype machine.

524692 F. Praunegger; Typesetting machine.

524693 F. Praunegger; Type-distributing machine.

525754 G. W. Weaver; Type (imitation of typewriter stipple).

526106 L. K. Johnson; Type-distributing machine (Empire).

526148 W. J. Egan; Stereotyping-press (casting-box).

526569 A. Foucher; Typefounding machine (duplex-caster; see 359779).

526822 R. A. Stewart; Type-holder for rubber-type.

527371 G., J. G., and M. O. Rehfuss; Type-dressing machine.

No.

527702 O. Mergenthaler; Linotype machine.

528308 L. K. Scotford; Method of and apparatus for making (matrices for) rubber-type.

528660 F. B. Emery; Printers' metal-furniture (with slots for curved lines).

528855, 528856 } P. F. Cox; Typesetting machine (Cox typesetter).

528857 P. F. Cox; Apparatus for automatically-justifying type (Cox typesetter).

529205 C. Skatulla; Machine for producing cast type-bars (Monoline).

529440 A. S. Capehart; Matrix-bar and making same (Monoline).

529446, 529447 } L. K. Johnson and A. A. Low; Typesetting apparatus (Alden Type Machine Co.).

529497 L. K. Johnson; Typesetting apparatus (Alden).

530279 M. Lane; Matrix-making machine (typewriting and impression-matrix making).

530371 A. G. Wade; Printing-plate and base.

530428 J. A. Keyes; Composing-stick.

530479 G. A. Goodson; Apparatus for casting molten material (electrically heating connecting-tube between pump and mould; Goodson Typecaster and setter).

530481 G. A. Goodson; Typecasting and setting machine (Goodson Typecaster and setter).

530931 P. T. Dodge; Linotype machine.

531069 L. K. Scotford; Machine for cutting rubber-type (for addressographs).

531266 O. Mergenthaler; Composing-mechanism for Linotype machines.

531531 C. F. Hilder; Type-distributing apparatus.

531586 T. G. and H. Daw; Machine for producing stereotype-matrices and typewriting (impression-device).

1895.

531786 P. T. Dodge; Linotype machine.

532368 J. C. Fowler; Typecasting and setting machine (Fowler composer).

532680 W. Merl; Engraving machine (pantograph for stamps, plates, etc.).

533285 J. C. Fowler; Machine for producing type-bars (Fowler composer).

533346 C. M. Busch; Linotype-slug for tabular work (slots in character-slugs).

533389 J. C. Fowler; Type-distributing mechanism (Fowler composer).

533848 F. A. Johnson; Typecasting and composing machine (Tachytype).

534439 L. K. Johnson; Type-containing channel (Alden).

534550 P. F. Cox; Typesetting and justifying machine (Cox typesetter).

534917 J. R. Rogers; Machine for making printing-surfaces (slug, or impression, Rogers Typograph).

535111 L. K. Johnson; Type-distributing machine carrier (Alden).

535498 W. E. Hoole; Numbering and paging machine (lever operated).

536149 F. A. Johnson; Manufacture of controllers for composing-machines (Tachytype).

536448 E. P. Teal; Numbering-machine (releasing and driving number-disks).

537183 W. Bucher; Stereotyping-machine (casting-box).

537668 R. A. Berger; Type-distributor for line-casting machines (either matrix-composing, or impression).

537905 C. Sears and F. Miller; Matrix-making machine (impression machine).

538094 C. P. Woodruff; Linotype machine.

538100 P. T. Dodge; Linotype machine.

538123 P. L. Ripsom; Linotype machine.

538133 C. Skatulla; Linotype machine.

538176 O. Mergenthaler; Means for justifying type-matrices and type (Linotype).

538902 J. A. Erkson; Linotype machine.

539221 L. Grossman; Printing-plate (securing half-tones in stereotype-plates).

539253 A. C. Ferguson; Matrix-making and stereotyping.

539544 J. H. Reinhardt; Engraving machine (pantograph for dies and stamps).

539716 F. Wicks; Type-composing machine (helically grooved races).

No. **1895** (*continued*).

539946 to 539948 L. K. Johnson; Typesetting apparatus (Alden Type Machine Co.).
539949 to 539952 L. K. Johnson and A. A. Low; Typesetting apparatus (Alden Type Machine Co.).
539983 P. T. Dodge; Type-justifying mechanism (Linotype; stepped space-matrices).
539984 to 539986 P. T. Dodge; Linotype machine.
539992 L. F. Mather; Leading-mechanism for linotype machines.
539993 O. Mergenthaler; Linotype machine.
539994 C. Muehleisen; Method and means for justifying type (Linotype; two-part wedge-space).
540000 J. Place; Separable matrix (preventing damage in assembling; Linotype).
540001 J. Place; Separable matrix (Linotype matrix with one strike on each side).
540002 J. Place; Matrix and expanding spacer for linotype machines.
540055 C. F. Hilder; Apparatus for packing type into receptacles (for loose-type setting).
540656 G. F. Giesecke; Type-finishing machine.
540743 W. Kemp, Jr.; Typecasting and setting machine.
540895 O. Bartusch; Numbering-machine (hand-stamp, consecutive, duplicate, or repeat).
540914 A. S. Hoge; Typesetting machine (loose-type).
540915 A. S. Hoge; Type-distributing machine (loose-type).
541161 T. C. Hargrave; Matrix-making machine (impression machine).
541180 J. H. Reinhardt and F. Sanders; Numbering-machine for successive numbers on strip-tickets.
541182 F. Sanders; Numbering-machine (hand-stamp).
541217 F. Q. Stuart; Typesetting machine (loose-type).
541353 A. W. Hanigan; Spacer for line-casting machines (Monoline).
541445 J. Rupertus; Machine for making stereotype-matrices (impression-device).
541758 L. K. Johnson; Type-distributing machine (Alden Type Machine Co.).
542140 L. A. Brott and G. A. Kay; Composite type-bar and making same (casting a connection between recessed-type forming a justified line).
542224 H. Lee and E. Lebrun; Matrix-making and printing-bar-casting machine (slug-caster).
542358 J. R. Carter; Numbering-machine (disk-wheels for duplicate and triplicate slips).
542368 F. Meisel; Numbering-machine (for consecutively numbering both sides of sales-slips).
542847 G. Eastwood; Manufacture of flongs for producing matrices for stereotyping.
543272 C. Skatulla; Type and matrix (Linotype).
543497 O. Mergenthaler; Linotype machine.
544317 W. S. Marder; Typecasting machine (American Type Founders Co.).
544958 L. E. Chapin; Stereotype-plate holder (back or base).
545530 A. D. Pentz; Linotype machine.
545568 L. B. Benton; Type (combination-fractions, superiors and inferiors each with part diagonal-stroke).
545635 C. F. Moore; Type-holder (for rubber-type).
545697 F. A. Johnson; Machine for making controllers for composing-machines (Tachytype).
546054 A. D. Pentz; Linotype machine.
546382 T. F. Geary and W. E. Bracewell; Numbering-machine (for use with rotary-press).
546503 H. Barth; Typecasting machine (casting distribution-nicks).
546542 J. G. Kingsbury; Engraving machine (engraving figures on counting-wheels).
546610 J. C. Fowler; Type-distributing rail (Fowler composer).
547392 W. H. Cox; Automatic type-distributor and holder (logotypes).
547448 F. Peterhansl; Unleading-machine for linotype matter.

No.
547633 P. T. Dodge; Linotype machine.
547859 J. W. Paige; Typesetting, distributing and justifying machine. [Application filed Dec. 5, 1882. 133 Drawings (31 sheets), 28 pages subject-matter and 130 claims.]
547860 J. W. Paige; Type-distributing, setting and justifying machine. [Application filed Aug. 19, 1887. 471 drawings (163 sheets), 55 pages subject-matter and 146 claims.]
547861 J. W. Paige and C. R. North; Automatic type-justifying machine. [Application filed Feb. 14, 1893. 242 drawings (81 sheets), 64 pages subject-matter and 172 claims.]
548045 C. R. Ferguson; Typesetting machine (Linotype).
548320 V. Lowendahl; Manufacture of stereotype-plates.
548432 P. T. Dodge; Linotype machine.
548654 J. M. Padgett; Numbering-machine (hand-stamp for sheets of coupons).
548802 W. A. Force; Numbering-machine (hand-stamp).
549146 B. S. Molyneux; Engraving machine (for punches, matrices, etc.).
549147 B. S. Molyneux; Engraving machine (for punches, matrices, etc.).
550137 J. H. Richards; Brush and machine for removing fins or burrs from type.
550263 F. W. Feldman; Composing-stick.
550482 L. Carr and G. Southey; Rotary numbering-machine (to work with rotary-press).
550553 P. F. Cox; Type-distributing machine (Cox typesetter).
550554 P. F. Cox; Ejecting-mechanism for typesetters (Cox typesetter).
550555 P. F. Cox; Type-distributor (Cox typesetter).
551037 A. W. Marshall; Stereotype-plate holder (back or base).
551071 J. C. Breuer; Stereotype-casting and shaving machine.
551384 551385 L. K. Johnson and A. A. Low; Typesetting apparatus (Alden Type Machine Co.).
551386 L. K. Johnson and A. A. Low; Type-containing channel (Alden).
551387 L. K. Johnson and A. A. Low; Type-holder (Alden).
551457 E. D. Tucker; Printing-plate holder (clip).
551469 H. Lee and E. Lebrun; Matrix-making and typesetting machine.
551981 O. Mergenthaler; Linotype and mechanism for producing same.

1896.

552745 V. Calendoli; Simultaneous typesetting machine (single letter or groups).
552800 W. Wells; Impression stamp for textile materials.
552830 J. C. Fowler; Line-casting machine (line-casting or indenting).
553312 J. W. Osborne; Surface-treatment of movable-type (for preventing adhesion after impression).
553575 G. H. Ziegler; Typecasting machine (pivotal straight-presentation).
553909 T. T. Heath and A. N. Verdin; Impression-device.
553983 T. T. Heath and A. N. Verdin; Friction-clutch (for cut-out).
553984 T. T. Heath and A. N. Verdin; Profiling machine (for cutting punches and type).
553985 T. T. Heath and A. N. Verdin; Type-carrier for typographic machines (impression).
553986 T. T. Heath and A. N. Verdin; Tablet-holder for typographic machines (impression).
553987 T. T. Heath; Ratchet-movement (for matrix-feed for impression machine).
553988 T. T. Heath and A. N. Verdin; Multiple-profiling machine (for cutting type or punches).
554405 J. West; Typecasting pump (carbon-composition lining).
554406 J. West; Typecasting pump (refractory lining).
554770 J. Burger; Linotype machine.
554790 554791 J. W. Phelps; Linotype machine.

1896 (*continued*).

No.

554842 S. Smith; Linotype machine.

555519 H. W. Libbey; Typograph (impression on celluloid).

555907 G. W. Sherer; Type line-justifier (thin pliable spaces).

556517 F. Peterhansl; Linotype machine.

556993 N. A. Larkin; Linotype machine.

557000 O. Mergenthaler; Linotype machine.

557039 M. H. Whittaker; Means for facilitating alterations in printing-surfaces (changing curved plates).

557184 F. E. Bright; Typograph (Linotype).

557232 J. R. Rogers; Typograph (impression-device).

557540 W. Berri; Space-bar for typesetting machines (compressible for Linotype).

557541 W. Berri; Matrix and matrix-distributing mechanism (for matrices of different lengths).

557716 H. T. Sundstrom; Mergenthaler Linotype machine.

557994 T. Lanston; Machine for making justified lines of type.

558145 W. Berri; Typecasting-device (mould-line composed of individual independent separate moulds).

558405 F. Meisel and H. Fischer; Rotary numbering-machine (multiple repetitions on paper-strip).

558406 O. Mergenthaler; Linotype machine.

558587 C. C. Keller; Adjustable stereotype-plate holder (clamp).

559707 C. F. Hilder; Type line-justifying machine.

559822 W. Spencer; Machine for engraving brass or other rules, bars, or similar articles.

560000 C. Holliwell; Knife for trimming type, printing-bars, etc. (Linotype).

560395 C. M. Conley; Stereotype-casting apparatus.

560459 C. A. Albrecht; Linotype machine.

560537 W. H. Randall; Linotype machine.

560882 H. A. W. Wood; setting stereotype-matrices.

561063 V. J. A. Rey; Type-preparing machine (nicking for distributing).

561818 F. Sanders; Numbering-machine (high speed, for rotary-press).

561946 J. H. Reinhardt; Numbering-head (type-high with drop-cipher).

561993 L. K. Johnson and A. A. Low; Typesetting apparatus (Alden).

562078 L. K. Johnson and A. A. Low; Type-transferring apparatus (Alden).

562079 } 562080 } L. K. Johnson and A. A. Low; Type-containing channel (Alden).

562081 L. K. Johnson and A. A. Low; Typesetting apparatus (Alden).

562082 L. K. Johnson and A. A. Low; Typesetting case (Alden).

562083 L. K. Johnson and A. A. Low; Typesetting apparatus (Alden).

562560 M. H. Whittaker; Means for trimming linotype-bars.

562563 C. E. Allen; Linotype machine.

562751 A. H. Alexander; Mould for casting lines of type.

562816 } 562954 } C. Forth; Matrix-assembling and distributing machine (Forth Graphotype).

562955 C. Forth; Linotype-casting machine.

563643 E. Bertram and E. Sanders; Linotype machine.

563865 O. Mergenthaler; Linotype machine.

563868 C. Muehleisen; Linotype machine.

564075 S. H., and P. E. Hodgkin; Typesetting or composing-machine.

564076 S. H. and P. E. Hodgkin; Typesetting machine (Pulsometer).

564290 A. Patch; Printing-plate and producing same (of paper similar to stereotype-matrix but in relief).

564624 C. C. Keller; Stereotype-plate holder (clamp).

565252 A. B. Adair; Letter for linotype-slugs (two-line letter, half in each of two matrices).

565439 P. T. Dodge; Type-justifying mechanism (Linotype).

565440 P. T. Dodge; Linotype machine.

565441 P. T. Dodge; Linotype machine spacing-device (step-by-step change of set width).

565483 O. Mergenthaler; Type-justifying mechanism (Linotype).

565484 O. Mergenthaler; Linotype machine.

No.

565485 O. Mergenthaler and C. Muehleisen; Linotype machine.

565486 to 565488 } O. Mergenthaler; Linotype machine.

565489 O. Mergenthaler; Type-justifying mechanism (Linotype).

565490 O. Mergenthaler; Linotype machine.

565514 W. S. Scudder; Type and means for justifying same (wedge-space).

565515 W. S. Scudder; Linotype machine (justifying).

565661 I. Baas, Jr.; Type-mould (pivotal).

565749 C. F. Hilder; Type-justifying mechanism (elastic-space).

565820 F. Wicks; Type-moulding machine (rotary caster).

567212 E. J. Andrews; Typesetting and distributing machine (Thorne).

567252 R. J. Moxley; Type-distributing machine (Empire).

567256 J. Sachs; Electric typesetting machine.

567926 O. C. Strecker; Producing relief-plates for printing (typographic etching).

569337 L. K. Johnson and A. A. Low; Typesetting apparatus (Alden).

569876 W. Kemp, Jr.; Type-matrix (soft metal inserted and struck in a hard block).

570098 L. K. Johnson, and A. A. Low; Typesetting appliance (Alden).

571487 C. de Leon; Numbering-machine (numbering-disks).

571625 J. Seide; Type-binder.

571809 A. W. Storm; Automatic-justifier (for Linotype).

572050 A. Dow; Type-distributor.

572673 A. T. Brown; Type-making machine (swaging characters on pointed blocks).

572705 C. D. Hughes; Type-distributing machine (Empire).

572947 G. A. Bates; Linotype machine.

572974 B. L. Fairchild; Means for justifying type (by wedge-surfaces).

573175 O. Bartusch; Numbering-head (type-high, removable case).

573199 W. Berri; Matrices and apparatus for distributing same.

573383 P. T. Balls; Linotype machine knife-attachment (two-line letter).

1897.

574935 O. M. Peterson; Machine for setting and distributing type and producing impressions therefrom (impression-matrix).

574936 O. M. Peterson and C. C. Hill; Machine for setting and distributing type and producing impressions therefrom (impression-matrix).

576027 W. C. Chase; Machine for removing fin from type (from slugs).

576397 P. T. Dodge; Linotype machine.

576409 J. MacKirdy; Linotype machine.

576414 J. Place; Linotype machine moulding-mechanism.

576584 T. H. Keller; Linotype-trimmer.

576731 L. K. Johnson and A. A. Low; Typesetting appliance (Alden).

576971 W. E. Taylor; Matrix-cleaning machine (for Linotype matrices).

578065 H. F. Meistrell; Linotype machine trimming-attachment.

578216 P. F. Cox; Type-distributing machine (Cox typesetter).

578278 L. C. Timroth; Matrix (flong for stereotyping).

578414 R. J. Moxley; Typesetting machine (Empire typesetter).

578527 L. K. Scotford; Blank for making sponge-rubber-type bases (for hand-stamps).

578544 W. F. Capitain, L. W. Klute and G. F. Wells; Type-mould (pivotal, two cylindrical wires, central piece removed by knife).

578713 J. B. Bell; Typesetting machine (impression-device).

578828 J. L. McMillan; Type-holder (using two metal bands).

579044 B. F. Curtis and D. E. Titsworth; Stereotype-making machine.

No. **1897** (*continued*).

579292 A. S. Capehart; Matrix-bar or plate (Monoline).
579293 A. S. Capehart; Type-line-casting machine.
579541 L. K. Johnson and A. A. Low; Typesetting apparatus (Alden).
579863 B. K. Davis; Type-galley (for proof taking).
580125 G. S. Eaton; Type-finishing machine (for rubbing).
580144 G. A. Pickup and W. A. Moore; Making matrices (for rubber-type).
581046 C. S. Sultzer and H. E. Shedd; Stereotype-plate holder (clamp).
581382 J. West; Typefounders' pump (mica-packing for stuffing-box).
581954 P. F. Cox; Typesetting machine (Cox typesetter).
582743 C. D. Hughes; Type-distributing machine (Empire).
582778 B. F. Curtis; Printing-plate (central-rib keying in groove in bases).
582801 A. Wirsching; Apparatus for casting type-wheels (rubber-face on metal centre for printing-telegraphs).
582833 L. W. Southgate; Method and apparatus for forming and drying stereotype-matrices.
583090 W. Scott; Stereotype-casting apparatus (for curved plates).
583224 W. J. Ennisson and W. H. Honiss; Type-justifying machine (Thorne typesetter).
583360 P. T. Dodge; Linotype machine.
583478 to 583480 L. K. Johnson and A. A. Low; Typesetting appliance (Alden).
583637 W. Scott; Stereotype-plate cutting apparatus.
583686 I. Kitsee; Stereotyping (use of celluloid).
584360 F. A. Johnson; Making controllers for composing-machines (Tachytype).
584361, 584362 F. A. Johnson; Typesetting machine (Johnson typesetter).
584363 F. A. Johnson; Linotype machine (Tachytype).
584364 F. A. Johnson; Matrix-making machine (Tachytype).
584365 F. A. Johnson; Typecasting and composing machine (Tachytype).
584366 F. A. Johnson; Machine for making controllers for composing machines (Tachytype).
584551 J. Jacobson; Matrix and producing same (relief effect by photography).
584664 J. B. Bell; Printers' lead-cutter (for leads and linotype-slugs).
585234 C. Sears; Matrix-making machine.
586237, 586287 L. K. Johnson and A. A. Low; Typesetting apparatus (Alden).
586337 D. S. Kennedy; Linotype machine (Linotype).
587816 T. T. Heath; Typographic machine (making matrix by impression).
587913 E. G. Bates; Numbering-machine (vertical slide).
588087 I. Risley; Machine for justifying typographic impressions.
588770 W. Lyon; Linotype-distributing tool.
588996 L. K. Johnson and A. A. Low; Type-fount (Alden).
589470 T. T. Heath; Matrix (use of ridged backing when striking).
589636 C. J. Botz; Typesetting and line-casting machine.
590177 J. G. Weaver; Preparing onyx-marble for use in relief-printing.
590763 T. Lanston; Machine for preparing perforated record-strips of type-forming machines (Monotype).
591073 P. F. Cox; Test-plate cleaner for type-distributing machines (Cox typesetter).
591422 C. Pieper; Bed-block for stereotype-plates.
591430 J. J. C. Smith; Process of and apparatus for casting printing-type (hard-bronze type).
591777 C. Sears; Machine for making type-bars.
591814 A. S. Capehart; Side-box matrix-bar for line-casting machines (Monoline).
591914 C. W. Dickinson; Typesetting machine (Empire typesetter).
591947 A. S. Capehart; Matrix for line-casting machines (Monoline).

No.
591948 A. S. Capehart; Matrix-bar and making same (Monoline).
592743 C. W. Bowron; Type-justifying machine.
592813 C. T. Murray; Curved stereotype-plate finishing machine.
593667, 593668 L. K. Johnson and A. A. Low; Type-containing channel (Alden).
595079 W. S. Scudder; Method of and means for making matrix-bars for line-casting machines (Monoline).
596340 C. Sears; Type-bar-casting machine.

1898.

596489 G. S. Eaton; Type-finishing machinery.
596598 L. K. Johnson and A. A. Low; Typesetting apparatus (Alden).
596739 T. B. Caswell; Mechanism for operating type-setting, or other machines (perforated controller).
597544 R. J. Moxley; Device for lifting feeler-hooks of type-distributing machines (Empire).
598408 B. F. Bellows; Type-bar-making machine (Electric compositor).
598622 B. F. Bellows; Justifying-mechanism (Electric compositor).
599390 L. K. Johnson and A. A. Low; Typesetting apparatus (Alden).
600292 F. H. Pierpont; Apparatus for facilitating delineation of outlines of type-faces, etc.
601498 P. F. Cox; Typesetting machine (Cox typesetter).
601706 E. B. Converse, Jr.; Typesetting and justifying machine.
602327 S. H. and P. E. Hodgkin; Typesetting machine (Pulsometer).
602439 W. Friese-Greene; Means for composing characters and producing photographic negatives therefrom.
602904 F. A. Hill and W. E. Shehan; Linotype machine attachment.
603879 B. F. Jackson; Matrix-drying apparatus (stereotyping).
604123 B. Ring and B. W. Stickney; Renewing matrices (Linotype).
604149 J. T. Hawkins; Means for securing printing-plates to cylindrical surfaces (by thin metal strips).
604305 P. F. Cox; Machine for discarding leads, spaces, and quads from dead matter (Cox typesetter).
604378 L. Fisher and E. W. Reynolds; Linotype machine.
604404 G. E. Lincoln; Linotype and matrix for making same.
604472 S. H. Horgan; Composite printing-plate and making same.
604635 J. G. Pavyer; Typecasting apparatus.
605141 W. S. Scudder; Monoline composing-machine.
605618 E. Wentscher; Justifying-device for type-setting, or other machines (changing provisional spaces).
605701 P. T. Dodge; Linotype machine.
605777 T. Cahill; Linotype machine, line-casting machine, and machine for making type-bars, linotype-slugs, and matrices.
605894 C. T. Murray; Stereotype-plate (curved).
605954 G. A. Goodson; Composing-machine for typecasting and setting machines (Graphotype).
605955 G. A. Goodson; Typecasting and setting machine (Graphotype).
605956 G. A. Goodson; Controller for typecasting and setting machines (Graphotype).
605957 G. A. Goodson; Differential letter-space register for composing machines (Graphotype).
606007 G. A. Goodson; Composing-machine for typecasting and setting machines (Graphotype).
606168 T. H. Keller; Linotype machine.
606656 M. Gally; Machine for making swage-locked type-bars and product produced by such machine.
606657 M. Gally; Swaged type-bars and apparatus for constructing same.
606678 R. J. Moxley; Typesetting machine (Empire).

No. **1898** (*continued*).

606765 J. S. Ogden; Manufacture of rubber-faced typewheels (for printing-telegraphs).
607045 F. A. Johnson; Typesetting and justifying machine (Johnson typesetter).
607046 F. A. Johnson; Type-justifying machine (Johnson typesetter).
607047 F. A. Johnson; Typesetting and justifying machine (Johnson typesetter).
607758 G. W. Mascord; Linotype machine slug-cutting mechanism.
608002 F. McClintock; Type-justifying machine (Empire).
608067 C. Muehleisen; Linotype machine.
608155 C. Muehleisen; Linotype machine line-closing attachment.
608997 P. H. McGrath; Typesetting and justifying machine (Johnson typesetter).
609097 G. A. Goodson; Composing-machine, paper-controlled (Graphotype).
609098 G. A. Goodson; Typecasting and setting machine (Graphotype).
609315 W. Wynne; Linotype machine knife-attachment.
609453 R. J. Moxley; Type-distributing machine (Empire).
609770 G. A. Bates; Linotype machine.
609883 E. Girod; Linotype machine mould.
610228 T. H. Catherall; Linotype machine.
610231 M. Gally; Type-making machine (impression by swaging from blanks for use with type-bars).
610454 C. Muehleisen; Linotype machine.
612010 W. Berri; Machine for casting justifying-spaces, and justifying lines of type (126 Figs.).
613064 W. A. Forcé; Flexible sheet for rubber stereotype-bases.
613724 H. R. Rogers; Proof-taking and type-bar casting machine.
613786 G. W. Turner and A. F. W. Leslie; Composite printing-plate and apparatus for making same.
613818 C. L. Ireland; Metallic matrix for Linotype machines.
613831 F. J. Wich; Interchangeable ejector-blade for Linotype and analogous machines.
614229 O. Mergenthaler; Linotype machine.
614230 O. Mergenthaler; Linotype machine.
614319 J. D. Chalfant; Type-justifying machine.
614550 C. L. Ireland and F. J. Wich; Linotype machine vice-jaw.
614561 W. J. Lewis, H. Pearce and C. Holliwell; Linotype machine justifying-mechanism.
614562 W. H. Lock and J. Place; Linotype machine moulding-mechanism.
614582 O. V. Sigurdsson; Ejector-blade for Linotype or analogous machines.
614588 } 614589 } F. J. Wich and C. L. Ireland; Linotype machine trimming-mechanism.
614590 F. J. Wich; Linotype machine trimming-mechanism.
614602 G. A. Bates; Linotype machine knife.
614659 E. F. Linke; Indexing-device for typesetting machines (Thorne).
614660 E. F. Linke; Lead-extracting device for type-distributing machines (Thorne).
614661 E. F. Linke; Type-channel follower (Thorne).
614662 E. F. Linke and G. L. Willey; Type-separating machine (Thorne).
614762 T. P. Ritzema; Linotype composing-machine.
614845 N. Dedrick; Engraving machine (for punches or matrices).
615340 W. Berri; Type-comb (of finished type).
615577 H. Schimansky; Manufacturing matrix-sheets (stereotyping).
615909 J. R. Rogers; Linotype machine.
616562 C. Sears; Method of and means for making matrices (in end-fibres of wooden blocks).

1899.

617052 W. W. Sawyer; Numbering-machine (hand-stamp with number rings).
618044 P. T. Dodge; Linotype machine (impression-device).
618308 F. J. Wich; Mechanism for casting curved linotypes.

No.
618348 J. D. Harvey; Linotype or line-casting machine.
618463 L. K. Johnson and A. A. Low; Typesetting apparatus (Alden Type Machine Co.).
618475 A. A. Low; Type-distributing apparatus.
618554 G. A. Bates; Linotype machine mould.
618582 L. B. Pendleton; Mould (Linotype).
618618 F. B. Reed; Linotype machine.
618800 C. R. Murray; Serpentine or crimped type-space.
618926 F. Wicks; Typefounding apparatus (Rotary caster).
619392 W. S. Coe; Linotype machine.
619393 W. S. Coe; Linotype machine.
619441 J. R. Rogers; Linotype machine.
619875 P. T. Dodge; Linotype machine.
620133 S. H. Horgan; Method of and apparatus for securing engraved plates to stereotypes (soldering).
620183 I. Risley and V. F. Lake; Typographic machine (impression; see 588087).
620230 B. F. Curtis; Stereotype-casting box.
620288 A. E. Dowell; Linotype-slugs and making same.
620289 A. E. Dowell; Means for forming type-line bars (from lines of individual type partially melted together).
620381 W. C. Trownsell and J. R. Trego; Linotype machine attachment.
620804 J. R. Rogers; Linotype machine (Linotype).
620890 B. F. Curtis; Stereotype-plate trimming and finishing machine.
621329 H. J. Derbyshire; Line-casting machine (Linotype).
622989 W. E. Bertram; Monoline type-composing and casting machine.
623014 A. W. Hanigan and G. H. Yardley; Line-casting machine space-bar (Monoline).
623075 J. N. Chamberlain; Mechanism for feeding and melting metal (Linotype).
624454 L. M. Chapman and J. M. Gelatt; Linotype machine.
624764 J. S. Duncan; Machine for making printing-plates (Addressograph).
624977 H. E. Reeves; Type-tie (mechanical tightening of tape substituted for string).
625044 W. A. Lorenz; Type-making machine galley-mechanism (Monotype).
625316 E. S. Bradford; Fastening-device for securing printing-plates to cylinders (clamp).
625412 C. W. Pashley; Ball and socket joint (for engraving machine; Linotype).
625445 J. D. Harvey; Linotype mould-adjuster.
625666 P. M. Furlong; Composite printing-plate and producing same.
625679 C. A. Hollenbeck and R. F. Wilson; Type-forming-machine attachment (for Linotype).
625931 L. K. Johnson and A. A. Low; Typesetting apparatus.
625972 E. Girod; Linotype or analogous machine.
625998 J. S. Bancroft; Typecasting and composing machine (Monotype).
626097 I. Risley; Typographic machine (impression; see 588087).
626098 I. Risley and V. F. Lake; Typographic machine (impression; see 588087).
626758 C. D. Hughes; Typesetting apparatus.
626914 E. F. Linke; Type-justifying apparatus (Thorne).
627160 E. Van der Wee; Machine for locating and stamping matrix-bars (Monoline).
628250 S. and M. Maybell; Instantaneous printing-plate holder (clamp).
628442 C. J. Botz; Type-case (for receiving distributed type).
628620 J. S. Bancroft and W. H. Wood; Machine for perforating strips for type-machines.
628631 C. Méray-Horváth; Typecasting and composing machine.
629423 W. H. Caps; Stereotype-plate (coring for ribs).
629459 B. Nadall and M. Barr; Metal-pot mechanism for casting machines (Linotype).
629751 C. R. Murray; Typecasting machine (body-slide; see 359779).
630112 J. R. Rogers; Linotype machine; (arranging sorts-matrices in front of operator; Linotype).

No.	**1899** (*continued*).
630396	B. Nadall; Linotype machine.
630412	J. R. Rogers; Mechanism for assembling and distributing type-dies.
630772	C. J. Botz; Typesetting apparatus.
630831	L. K. Johnson and A. A. Low; Type-containing channel (Alden).
630832	L. K. Johnson and A. A. Low; Typesetting apparatus.
630917	E. C. McFarland; Type-mould (pivotal).
631062	P. F. Cox; Multispace (for justifying).
631989	A. Greenleaf; Linotype machine.
632484	E. V. Beals; Printing-type (relates to 490263).
633088	T. Lanston; Typecasting and composing machine (Monotype).
633190	A. S. Gilman; Distributor or assorter for linotyping or typesetting machines.
633309	C. W. Dickinson; Type-justifying and spacing machine (Empire).
634214	L. K. Johnson and A. A. Low; Type-containing channel (Alden).
634536	C. Muehleisen; Linotype machine.
634715	E. V. Beals and W. B. Norton; Matrix-making machine (stereotyping).
635305	H. J. Derbyshire, Linotype-casting machine.
635640	G. A. Bates; Linotype and mould.
635649	B. A. Brooks; Printing-apparatus (producing a matrix by impression).
635651	A. L. Campfield; Printing-type (projecting bead to interlock with nick).
635830	F. J. Wich; Linotype machine trimming-mechanism.
635866	F. McClintock; Type-justifying machine (Empire).
635997	F. C. Dolby; Mechanism for releasing space-bars of Linotype machines (Linotype).
635998	R. C. Elliott; Magazine for Linotype or analogous machines.
636001	C. L. Ireland; Linotype machine, trimming-mechanism.
636378	G. P. Conant; Mould for casting solid type-wheels.
636390	W. Reid and F. Hess; Linotype machine.
636504	J. S. Duncan; Printing-plate (Addressograph).
636622	D. Z. Borne and J. Frey; Typecasting machine.
636686	C. A. Nelson; Apparatus for straightening Linotype matrix-dies.
636911	O. Mergenthaler; Automatic milling-machine (for Linotype matrices).
636912	O. Mergenthaler; Machine for straightening metal stock (for Linotype matrices).
636913	O. Mergenthaler; Punching press (for striking Linotype matrices).
636915	O. Mergenthaler; Automatic milling-machine (for Linotype matrices).
636916	O. Mergenthaler; Stamping press (for Linotype matrices).
636917, 636918	O. Mergenthaler; Automatic milling-machine (for Linotype matrices).
637009	C. Muehleisen; Apparatus for locally hardening pieces of metal (for Linotype matrices).
637086	J. D. C. Chateau; Composing-machine. (Type-bar machine; see 552745.)
637109	S. S. Haddad; Types for typewriters or printing-presses (Arabic).
637117	C. Holliwell and W. J. Lewis; Linotype-machine mould.
637858	A. Dow; Typesetting apparatus.
638176	J. S. Duncan; Machine for making printing-plates (Addressograph).
638866	F. C. Damm; Linotype machine.
638868	E. Girod; Mechanism for moving Linotype-machine moulds.
639077	H. F. Meistrell; Linotype-machine ejector.
639244, 639245	L. K. Johnson and A. A. Low; Typesetting apparatns.
639379	A. R. Guest and E. T. Richmond; Type for Arabic characters (of uniform set width for type-writing, etc.).
639908	W. W. Sawyer; Numbering-machine (hand-stamp, consecutive, duplicate, or repeat).
640032, 640033	J. R. Rogers; Linotype machine.
640119	R. C. Elliott; Composing-machine (Linotype, using single key to bring down a combination in the correct order).

No.	**1900.**
640274	F. B. Converse, Jr.; Typesetting machine.
640678	J. D. Lyon; Spacing instrument (for width of letters).
640805	J. W. Phœbus; Making stereotype-matrices (dry process).
640867	F. E. Bright; Matrix-bar for machines for making type-bars for printing (Typograph).
641296, 641297	L. K. Johnson and A. A. Low; Typesetting apparatus.
641298	L. K. Johnson, and A. A. Low; Typesetting mechanism.
641310	A. A. Low; Typesetting apparatus.
641875	F. McClintock; Typesetting machine key-mechanism.
642263	C. Sears; Matrix-making machine (impression machine).
642264	C. Sears; Apparatus for preparing justified lines of type-matrices or justified matrix-lines (impression in wood block).
642335	L. K. Johnson; Type-follower for type-containing channels.
642389	F. M. Turck; Numbering-machine (for rotary-press, for sales-slips).
642441	H. J. S. Gilbert-Stringer; Typecasting and composing apparatus (Quadrant).
643274	J. Place; Linotype-machine casting-mechanism.
643289	D. A. Hensley; Linotype machine (Linotype).
643292	C. Holliwell and R. C. Elliott; Linotype machine.
643329	J. MacKirdy; Linotype machine.
643473	P. F. Cox; Typesetting machine.
643976	J. Place; Matrix-alining mechanism for Linotype machines.
644363	O. Mergenthaler; Linotype machine.
644558	P. C. Lawless; Linotype-machine mould-block.
644835	M. W. Smith; Type-making and composing-machine (monotype class).
645073	W. H. Doolittle; Linotype-machine quad-forming attachment.
645164	N. Dedrick; Engraving machine table (see 614845).
645165	N. Dedrick; Engraving machine tool-grinder (for punch and matrix engraving).
645438	J. S. Thompson; Linotype machine.
645472	C. Holliwell; Linotype-machine casting-mechanism.
645512	P. H. McGrath; Typesetting machine.
645801	H. J. S. Gilbert-Stringer and F. Wicks; Apparatus for justifying set-type.
646047	O. G. Bartusch; Consecutive-numbering machine (type-high, for high-speed forward or backward).
646227	E. G. Leonard; Linotyping machine.
646358	P. F. Cox; Typesetting machine.
646359	P. F. Cox; Space- and lead-discarder and distributor loader.
646547	C. Sears; Preparing wood-matrices (for stereotyping; end-grain wood).
646669	W. Scott; Stereotype finishing machine (for curved plates).
646953	J. N. Chamberlain; Linotype-machine metal-heating apparatus.
646971	A. Fraser and F. Rose; Automatic type-distributing apparatus.
646972	A. Fraser and F. Rose; Type-distributing apparatus.
647417	A. Kraus; Composition for stereotyping (from typewriter-made impression).
648025	G. A. Goodson; Typecasting machine.
648116	G. Sandeman and G. M. Brown; Justifying-mechanism for typesetting or similar machines (monotype class).
648201	G. A. Goodson; Automatic machine for producing print or printing-surfaces.
648206	G. R. Hildyard; Producing printing-plates (for typographic process).
648433	J. H. Reinhardt; Numbering-machine (type-high; preventing blurring).
648440	F. Sanders; Numbering-machine (type-high; preventing blurring).
648449	F. J. Wich; Adjustable Linotype-machine mould.
648750	L. K. Johnson and A. A. Low; Typesetting apparatus (Alden).
649110	T. P. Ritzema; Linotype machine.
650296	S. Bradley; Line-casting machine (Monoline).

No.	**1900** (*continued*).
650397	L. K. Johnson and A. A. Low taining channel (Alden).
650398	L. K. Johnson and A. A. Low; apparatus.
650405	A. A. Low; Type-distributin (Alden).
650849	S. L. Long; Typesetting stick.
650934	J. C. Fowler; Machine for pro bars (by impression methods).
651243	F. U. Downing and C. A. L. To type (Greek).
651448	J. H. Richards; Machine for r or burrs from type (of linoty
651496	S. Smith; Linotype machine.
651551	E. F. Linke; Type-distribut (Thorne).
652342	C. W. Bowron; Type-justifying
652420	H. Burg; Typesetting machine
652421	H. Burg; Character-supplying type or matrix-setting mac type setter).
652422	H. Burg; Apparatus for setting or matrices (perforated strip
652423	H. Burg; Type-distributing ma
652480	C. D. Hughes; Carrier for type machines.
652855	C. Muehleisen; Linotype machi
652881	G. A. Bates; Linotype machin
652899	E. F. Nydahl; Automatic type machine.
653050	H. Winter; Stereotype-pl machine.
653142	L. K. Johnson and A. A. Low; apparatus.
653151	F. H. Pierpont; Line-casting ma graph).
654115	T. Lanston; Strip-perforating
654676	W. W. Sawyer; Numbering-ma stamp).
655750	M. Barr; Pantograph engra (three-dimensional).
656312	F. J. Wendell; Manufacture o plates (improved alinement).
656442	J. S. Duncan; Rubber-type.
656443	J. S. Duncan; Type-holder (Ad
656444	J. S. Duncan; Mould for ma type.
657039	R. H. St. John; Spacing or just for type-bar or matrix machi
657040 to 657043	R. H. St. John; Type-bar ma
657282	F. B. Converse, Jr.; Ty ejecting-mechanism.
657309	F. B. Converse, Jr.; Distribu (for characteristically nicked
657429	J. H. Lynch; Linotype machi
657478	T. Cahill; Typewriting mach machine, typesetting machi keyboard-printing instrume claims).
657546	L. K. Johnson and A. A. Low; apparatus.
657874	L. K. Johnson and A. A. Low taining channel (Alden).
658740	O. Mergenthaler; Linotype ma
658944	A. Dow; Type-grab (for mo loose-type).
659170	S. G. Goss; Casting-box for (curved plates).
659384, 659385	F. J. Wendell; Printing-plate
659525	A. W. Hanigan; Melting-pot fo machines.
659761	C. W. Pashley; Chuck and vice machines (for matrices).
659763	J. Place and C. W. Pashle mechanism for engraving ma
659800	W. C. Pritchard; Linotype-m mechanism.
659863	G. A. Vassberg; Linotype mac
659865	G. A. Bates; Linotype machin
660056	A. Elliott and M. Shaen; Type
660163	P. H. McGrath; Typesetting n
660237	G. H. Ziegler; Typecasting ma
660263	A. W. Storm; Electric linotyp
661386	J. R. Rogers; Linotype machir
661437	E. G. Bates and C. Spielmann; numbering-machine (type-hig blurring).

No. 1900 (*continued*).

650397 L. K. Johnson and A. A. Low; Type-containing channel (Alden).
650398 L. K. Johnson and A. A. Low; Typesetting apparatus.
650405 A. A. Low; Type-distributing apparatus (Alden).
650849 S. L. Long; Typesetting stick.
650934 J. C. Fowler; Machine for producing type-bars (by impression methods).
651243 F. U. Downing and C. A. L. Totten; Logotype (Greek).
651448 J. H. Richards; Machine for removing fins or burrs from type (of linotype-slugs).
651496 S. Smith; Linotype machine.
651551 E. F. Linke; Type-distributing machine (Thorne).
652342 C. W. Bowron; Type-justifying machine.
652420 H. Burg; Typesetting machine.
652421 H. Burg; Character-supplying apparatus for type or matrix-setting machines (loose-type setter).
652422 H. Burg; Apparatus for setting lines of type or matrices (perforated strip controlled).
652423 H. Burg; Type-distributing machine.
652480 C. D. Hughes; Carrier for type-distributing machines.
652855 C. Muehleisen; Linotype machine.
652881 G. A. Bates; Linotype machine.
652899 E. F. Nydahl; Automatic type-distributing machine.
653050 H. Winter; Stereotype-plate-trimming machine.
653142 L. K. Johnson and A. A. Low; Typesetting apparatus.
653151 F. H. Pierpont; Line-casting machine (Typograph).
654115 T. Lanston; Strip-perforating machine.
654676 W. W. Sawyer; Numbering-machine (hand-stamp).
655750 M. Barr; Pantograph engraving-machine (three-dimensional).
656312 F. J. Wendell; Manufacture of stereotype-plates (improved alinement).
656442 J. S. Duncan; Rubber-type.
656443 J. S. Duncan; Type-holder (Addressograph).
656444 J. S. Duncan; Mould for making rubber-type.
657039 R. H. St. John; Spacing or justifying device for type-bar or matrix machines.
657040 to 657043 R. H. St. John; Type-bar machine.
657282 F. B. Converse, Jr.; Type-machinery ejecting-mechanism.
657309 F. B. Converse, Jr.; Distributing-machine (for characteristically nicked type).
657429 J. H. Lynch; Linotype machine.
657478 T. Cahill; Typewriting machine, linotype machine, typesetting machine, or other keyboard-printing instrumentality (157 claims).
657546 L. K. Johnson and A. A. Low; Typesetting apparatus.
657874 L. K. Johnson and A. A. Low; Type-containing channel (Alden).
658740 O. Mergenthaler; Linotype machine.
658944 A. Dow; Type-grab (for moving lines of loose-type).
659170 S. G. Goss; Casting-box for stereotyping (curved plates).
659384, 659385 F. J. Wendell; Printing-plate and base.
659525 A. W. Hanigan; Melting-pot for typecasting machines.
659761 C. W. Pashley; Chuck and vice for engraving machines (for matrices).
659763 J. Place and C. W. Pashley; Driving-mechanism for engraving machines.
659800 W. C. Pritchard; Linotype-machine wiper-mechanism.
659863 G. A. Vassberg; Linotype machine.
659865 G. A. Bates; Linotype machine.
660056 A. Elliott and M. Shaen; Type-holder.
660163 P. H. McGrath; Typesetting machine.
660237 G. H. Ziegler; Typecasting machine.
660263 A. W. Storm; Electric linotype machine.
661386 J. R. Rogers; Linotype machine (Linotype).
661437 E. G. Bates and C. Spielmann; Typographic numbering-machine (type-high; preventing blurring).
661780 F. Wesel; Stereotype-plate holder (clamp).
662106 F. J. Wich; Linotype machine.
662573 W. H. B. Miller; Reproducing type, or the like.
662652 E. F. Linke; Type-composing and distributing machine (Thorne).
662724 P. E. Hodgkin and W. May; Typesetting or composing machine.
663405 G. G. Allen; Keyboard (Stenotype).
663971 T. Lanston; Record-strip perforator for type-forming machines.
663996 T. Lanston; Machine for perforating record-strips.
664698 E. Wentscher; Distributing apparatus for matrix or die-setting machines (two-letter Linotype).

1901.

664860 D. A. Hensley; Matrix and space-band cleaning-mechanism for typesetting machines.
665212 I. Hall; Linotype mould.
665326 I. Hall; Linotype (deep ribs for reducing to different bodies from same mould).
665406 P. F. Cox; Typesetting machine.
665596 L. D. Clark; Composite printing-plate or block (metal-base).
666280, 666323 A. A. Low and J. Breakey; Type-distributing apparatus.
666412 J. Donegan; Linotype machine.
666817 C. C. Pugh; Linotype machine.
666835 F. J. Wendell; Printing-plate and base.
666882 C. Holliwell and R. C. Elliott; Linotype-slugs having accented capitals thereon.
666884 E. C. McFarland; Typecasting mould (coring large-body type).
667049 F. Wicks; Apparatus for charging tubes or cases for type-composing machines.
667210 J. C. Fowler; Typecasting and setting machine.
667211 J. C. Fowler; Producing typecasting moulds and matrices.
667212 J. C. and J. C. Fowler, Jr.; Typecasting, composing and justifying machine.
667790 P. G. Nuernberger; Type-making machine (duplex, slug, or clump caster).
668312 A. A. Low; Type-channel and slug (for distributor and setter).
668314 A. A. Low; Type-distributing apparatus.
668346 J. Breakey; Type-distributing apparatus.
668374 W. G. Herz; Stereotype-chase (a chase for securing stereotypes).
668457, 669400, 669401 J. R. Rogers; Linotype machine.
669405 F. Wicks; Metal-pump for typecasting.
669661 T. R. Post; Dating-stamp for use in banks, railway offices, etc. (preventing fraud).
669831 D. A. Hensley; Linotype-machine space-bar.
670167 H. A. W. Wood; Printing-plate bending-apparatus.
670329 O. Schönauer; Automatic type-metal-supplying apparatus for composing- and line-casting machines.
671327 F. Wesel; Stereotype-plate holder (clamp).
671362 F. Wicks; Rotary typecasting apparatus.
671932 C. S. Mills; Printing-plate holder (clamp).
672131 L. E. and H. S. Merrill; Automatic type-justifying space (with recesses to interlock, or not).
672199 M. H. Whittaker and C. H. West; Linotype-machine mould.
672200 M. H. Whittaker and C. H. West; Linotype (tapered ribs for cylindrical work).
672534 D. Lichtenberg-Madsen; Producing matrices and stereotypes of celluloid.
672859 F. A. Ringler; Stereotyping-plate (casting with electrotypes in place).
673485 E. R. Storm; Printing-plate holder (clamp).
673518 O. S. Follett; Numbering-machine printing-wheel (casting in one with ratchet).
674080 P. T. Dodge; Type-matrix.
674092 O. Mergenthaler; Linotype-machine matrix.
674362 J. S. Bancroft; Paper-feed mechanism.
674374 J. S. Bancroft; Fluid-injecting mechanism for typecasting or other machines.
674375 J. S. Bancroft; Galley-mechanism for type-casting and composing machines.

No. **1901** (*continued*).

674376 J. S. Bancroft; Die-centring mechanism for typecasting and composing machines.
675495 A. Pollak and J. Virag; Writing-telegraph; the transmitted impulses and their mutual relation are controlled by a suitable strip, which is perforated to correspond with each character to be transmitted.
675827 H. J. S. Gilbert-Stringer; Typecasting and composing apparatus (Stringertype).
675828 H. J. S. Gilbert-Stringer; Producing formes for printing (Stringertype).
675829 H. J. S. Gilbert-Stringer; Apparatus for composing and justifying matrices and casting types therefrom (Stringertype).
675898 R. Maxwell; Printing-plate (using linotype-slugs on addressograph chain).
676010 J. H. Simpson; Holding-block for stereotype- and electrotype-plates.
676082 E. G. Bates; Automatic numbering-machine (hand-stamp, consecutive, duplicate, or repeat).
676083 E. G. Bates; Numbering and dating machine (hand-stamp).
676084 E. G. Bates; Automatic numbering-machine (type-high; adapting to hand-stamp).
676306 W. Fletcher; Mechanism for spacing and justifying tabular work on Linotype machines (Linotype).
676513 F. G. Price; Printing-plate and impression-surface holder (curved segments).
676908 E. F. Nydahl and G. A. Harling; Type-distributing apparatus.
676975 W. Berri; Type and holder therefor.
677144 F. Sanders; Numbering-machine (consecutive, plunger-operated).
678036 J. R. Rogers; Linotype machine.
678268 O. Mergenthaler; Linotype machine.
678310 F. A. Vinton; Linotype machine.
678831 G. H. Ziegler; Typecasting machine (body-slide; see 376765).
679479 C. Muehleisen; Linotype machine.
679481 } J. R. Rogers; Linotype machine (Typo-
679482 } graph).
680685 L. B. Benton; Type-dressing machine.
682466 E. D. Hardy and W. W. Rebuschatis; Type-locking-device (for locking in galley).
683079 H. H. Stalker; Composing-stick.
684104 J. R. Rogers; Linotype machine.
685035 } P. T. Dodge; Linotype machine.
685036 }
685083 G. H. Ziegler; Type-finishing machine.
685142 O. F. Holmgren; Composing-stick.
685583 P. T. Dodge; Linotype machine.
685980 A. S. Gilman; Linotyping and typesetting machine.
686029 E. S. Crane; Matrix-distributing machine.
686728 C. G. Harris and J. F. McNutt; Numbering-machine (for successively numbering cheques, slips, etc.).
687627 C. Holliwell; Mould and casting-mechanism of Linotype machines (Linotype).
687691 P. C. Lawless; Automatic wiper for use in Linotype machines (Linotype).
687779 } F. H. Pierpont; Stamping, or punching machine (for producing a matrix at each
687780 } revolution; hand-controlled; for Monotype matrices).
687781 F. H. Pierpont; Apparatus for milling, justifying, and measuring matrices, etc., (Monotype).
688218 F. J. Wich; Linotype machine (magazine equipment and escapement; Linotype).
688812 C. A. Albrecht; Multiple-magazine Linotype machine.
688928 H. Burg; Apparatus for provisionally separating lines of type or matrices.
689603 G. A. Vassberg; Linotype machine.
690169 G. H. Meserole; Gas-conducting device for Linotype melting-pots.
690170 G. H. Miller; Numbering-machine (large-wheel, consecutive).

1902.

690707 P. T. Dodge; Linotype machine.
690720 H. J. S. Gilbert-Stringer; Typecasting and composing apparatus (Monoline matrix).
691226 G. H. Ziegler; Typecasting machine matrix-carrier.

No.
691583 A. Bean; Composing-mechanism of typesetting or Linotype machines (Linotype).
691615 R. C. Elliott and C. Holliwell; Means for producing fudge, or late-news linotype-slugs.
691619 H. J. S. Gilbert-Stringer; Type-mould (body-slide; Stringertype break).
691685 M. H. Whittaker; Linotype machine.
691925 J. L. Winter; Matrix (dry process for stereotyping).
691971 A. Réveillé; Apparatus for impressing stereotype-matrices with musical notes, etc.
692072 J. H. Reinhardt; Numbering-machine (drop-cipher controller).
692183 M. P. Freebey; Adjustable-mould for Linotype, or other metal-casting machines (Linotype).
692883 A. A. Low and J. Breakey; Type-distributing apparatus.
692994 J. S. Duncan; Holder for card-indexes and printing-plates (Addressograph).
693145 F. McClintock; Type-justifying machine (Empire; see 608002).
693445 A. V. Ruckmich; Typesetting machine.
694115 B. Smith; Stipple matrix-plate.
694141 D. F. Daley; Linotype-slug (end-lugs to prevent reglets working up).
694269 Z. Halacinski; Type-line composing and casting device.
694297 W. P. Nisbett and P. Andrews; Stereotype-plate cutting-machine.
694306 } L. A. Brott; Machine for the production of
694307 } types and type-bars.
694308 L. A. Brott; Composite type-bar.
694309 L. A. Brott; Production of type-bars.
694310 L. A. Brott; Type-magazine.
694408 J. F. McNutt; Numbering-machine (head with large-wheels for plurality of sets).
694481 L. K. Johnson and A. A. Low; Type-containing channel (for setting, or distributing).
694488 A. A. Low and J. Breakey; Type-channel holder (for distributing-machine).
694682 S. R. Shoup; Numbering-machine (preventing skipping in high-speed check- or slip-printing).
694788 J. R. Rogers; Linotype-justifying device.
694789 J. R. Rogers; Linotype-machine matrix.
694905 S. G. Yundt and W. J. Nolen; Stereotype-plate-holder (clamp).
695017 J. Watson; Type-justifying machine (Empire).
696360 E. V. Beals; Machine for producing printing-bars (casts the face on a blank from a line of assembled matrices).
696532 C. A. Albrecht; Tool for trimming cast type-lines in Linotype machines.
696637 C. Holliwell; Automatically-cored linotype mould-block.
696732 G. A. Goodson; Differential letter-space register for composing-machines.
696733 G. A. Goodson; Typefounding matrix (Graphotype).
696734 G. A. Goodson; Fount of type (avoiding dressing kerns).
696806 P. T. Dodge; Linotype machine.
697011 J. Place and W. J. Lewis; Self-feeding mechanism for metal-pots (Linotype).
697141 S. G. Goss; Casting-box for stereotyping.
697456 P. T. Dodge; Linotype machine.
697859 F. Lucke; Typecasting machine.
697968 W. Berri; Device for justifying lines of type or matrices (Linotype).
698028 R. Krafft; Turf matrix-pulp for stereotyping.
698966 I. Kitsee; Machine for producing stereotype-plate matrices (typewriter electrically connected to an impression machine).
699390 L. K. Johnson and A. A. Low; Type-containing channel (for setting or distributing).
699402 A. A. Low and J. Breakey; Type-distributing apparatus.
699728 G. E. Wallin; Linotype-slug holder.
700022 P. T. Dodge; Linotype matrix.
700288 J. S. Bancroft and M. C. Indahl; Automatic leader for type-composing machines.
700289 J. S. Bancroft; Record-strip feeding-mechanism.
700290 J. S. Bancroft; Type-machine pump-actuating mechanism.

No. **1902** *(continued)*.

700291 J. S. Bancroft; Record-strip feeding-mechanism of automatic typecasting, or other machines.
700300 A. W. Cathcart Making justified matrices (Monotype).
700301 A. W. Cathcart; Matrix die-mechanism (Monotype).
700330 M. C. Indahl; Machine for composing tabular-matter.
700336 W. Kemp, Jr.; Type-composing machine for tabular matter.
700341 T. Lanston; Type composing machine.
700699 to 700701 F. McClintock; Type-justifying machine (Empire).
700712 J. Watson; Type-justifying machine (Empire).
701123 H. C. Zenke; Burner (for melting-pots, linotype machines, etc.).
701368 F. E. Milholland; Linotype galley.
701677 J. L. Carroll; Set of type for printing calendars (4-line logotypes).
701811 F. Holdsworth; Type-justifying machine (Empire).
701881 P. E. Hodgkin and G. E. Kenney; Type-distributing machine.
701989, 701990 J. B. Bell; Linotype machine.
702457 F. McClintock; Typesetting machine key-mechanism.
702458 F. McClintock; Typesetting machine.
702459 F. McClintock and F. Holdsworth; Type-justifying machine (Empire).
702470 C. S. Partridge; Stereotype-plate and base (metal interlocking-bases).
702555 J. Hinklein; Type-distributing machine.
702568 T. Lanston; Type-machine composing-mechanism.
702621 J. Breakey; Type-distributing apparatus.
702781 to 702783 P. T. Dodge; Linotype machine.
702941 G. A. Goodson; Typecasting machine squirt-preventer.
703017 E. Terrell and F. A. Ray; Typesetting machine.
703248 J. Gray; Linotype or similar composing-machine.
703676 E. R. Storm; Printing-plate holder (clamp).
704183 D. W. Fratcher; Composing-machine keyboard attachment.
705341 G. A. Goodson; Typecasting and setting machine.
705386 A. G. Cotsworth; Alining-mechanism for linotype machines.
705525 J. C. and J. C. Fowler, Jr.; Typecasting and setting machine.
705693 E. Mullendorff; Mechanism for justifying lines composed of types or matrices.
705801 F. J. Wich; Trimming-mechanism for Linotype machines.
706002 G. G. Allen; Keyboard (use of colours for groups of keys).
707522 J. R. Reynolds; Type-chase for making matrix-plates (Graphotype).
707523 J. R. Reynolds; Master type-bar for matrix-plates (Graphotype).
707645 O. Mergenthaler and W. T. Hoofnagle; Linotype machine.
708010 H. Barth; Typecasting (producing a vacuum in mould).
708295 O. G. Bartusch; Consecutive-numbering apparatus (plurality of sets, shaft-operated).
708416 A. D. Smith; Linotype-machine attachment.
708645 L. K. Johnson and A. A. Low; Type-containing channel (Typesetter).
708646 L. K. Johnson; Compositor's type-stick (facilitating removal of type).
708661 J. Pinel; Device for forming accents on linotype-slugs (Linotype).
709128 A. P. Waterman and G. H. E. Berthold; Numbering-machine (hand-stamp, consecutive or duplicate).
709284 J. E. Weigl; Stereotyping-matrix (dry).
709398 L. Elias; Asbestos stereotype (matrix).
710057 L. K. Johnson and A. A. Low; Type-line detaching mechanism (for distributor).
710066 A. A. Low; Type-distributing apparatus.

No.
710140 J. J. Chattaway; Numbering-machine (hand-stamp, consecutive, duplicate, or repeat).
710163 D. Murray; Keyboard perforator (production of a perforated strip from a typewriter keyboard).
710380 F. M. Turck; Numbering-machine (consecutively, or serially by means of type-belt).
710652 C. A. Albrecht; Mechanism for pushing the linotype-slugs out of moulds of Linotype machines.
710970 H. Hamlin; Means for securing printing-plates:
711143 W. W. Wotherspoon; Monoline machine.
711288 B. Cole and A. O. Wilson; Linotype leading-device.
711590 C. B. Post; Numbering-machine (large-wheels for printing continuous web).
711593 G. B. Shepard; Matrix-making machine (stereotype).
711807 F. J. Wich; Linotype-machine trimming-mechanism.
712324 A. B. Neill; Numbering or marking machine (large-wheels for printing on linen, etc.).
712755 G. A. Bates; Linotype machine.
712969 J. Roxburgh and R. McClean; Linotype-slug slotting-apparatus.
713246 G. B. Shepard; Matrix-making machine (impression machine).
714621 B. F. Tcherkassov and R. E. Hill; Type for typewriting or printing (Arabic and Persian).
715233 W. Ackerman; Omitting-means for automatic typecasting and composing machines (Graphotype).
715936 J. F. Ames; Fount of type (serrated back and front to interlock; for very heavy pressures).
716236 F. A. Johnson; Typesetting and justifying machine.
716975 C. A. Albrecht; Matrix-distributing mechanism for Linotype machines.
717169 F. B. Converse, Jr.; Typesetting and justifying machine.
717170, 717171 F. B. Converse, Jr.; Typesetting machine.
R 12017 F. Wicks; Orig. No. 669405; Metal-pump for typecasting.

1903.

717763 C. Rozár; Device for casting justifying-spaces in combined typecasting and setting machines.
717960 E. A. Adcock; Typesetting machine.
718519 R. W. Pittman and G. C. Andrews; Holder for printing-plates (clamp).
718622 J. A. Handiboe; Type-holding clamp (metal-strip yoke).
718781 C. Muehleisen; Linotype machine (Linotype).
718837 H. C. Hansen; Machine for mitring printers' rules.
718842 W. A. Hinners; Process of making relief effect printing-plate (half-tone).
718883 J. L. Shilling; Method of making relief effect printing-plates (principal object and background; see 718842).
719270 S. Smith; Linotype machine and matrix.
719296 H. B. Bartlett; Linotype machine.
719321 W. H. Francis; Clamp for pages of type (metal-strip).
719375 C. Rozár; Typesetting-machine keyboard.
719422 G. A. Bates; Linotype machine.
719436 J. W. Champion; Linotype machine (Linotype).
720270 T. Martin; Means for setting tabular matter in Linotype machines.
720314 M. F. Benton; Type (extension-type carrying ornamentations adapted to register with the type between which they are placed).
720736 F. H. Pierpont; Type-mould (body-slide; see 625998).
720795 F. X. Fleck; Linotype machine.
720817 L. L. Kennedy; Linotype machine.
721117 H. A. W. Wood; Automatic stereotype printing-plate casting and finishing apparatus (189 claims; Autoplate).

1903 (*continued*).

No.

721118, 721119 H. A. W. Wood; Stereotype printing-plate casting apparatus (Autoplate).
721120 H. A. W. Wood; Stereotype printing-plate casting and finishing apparatus (Autoplate).
721121 H. A. W. Wood; Stereotype-plate casting apparatus (Autoplate).
721122, 721123 H. A. W. Wood; Stereotype printing-plate finishing-mechanism (Autoplate).
721276 E. G. Bates; Numbering or similar machine (automatic, hand; see 676084).
721389 M. Reid; Type-bar making machine (impresses on a line of matrices a type-bar, the edge of which is made plastic by heat).
722284 L. Cesana; Linotype machine.
722353, 722354 G. A. Bates; Linotype machine.
722404 H. C. Gammeter; Machine for duplicating circular letters to appear as if typewritten (Multigraph).
723073 J. S. Thompson; Linotype machine.
723665 H. S. Folger; Type-holder (for rubber-type).
724418 A. C. Anderson; Stereotype (mortised base).
725653 J. S. Bancroft; Type-machine matrix-centring mechanism.
725861 C. Muehleisen; Linotype machine.
726019 S. J. Briden; Linotype machine.
726412 P. T. Dodge; Linotype machine.
726725 F. E. Milholland; Linotype galley.
727046 F. Wicks; Typecasting machine, type-controlling device.
727267 B. F. Bellows; Type-line justifying machine.
727355 H. C. Hansen; Matrix-truing apparatus (filing-jig with adjustable spherical block).
727914 P. T. Dodge; Linotype machine.
728194 T. H. Boss; Numbering-machine (automatic hand-stamp, consecutive, duplicate, or repeat).
728845 J. C. Bovard; Printers' furniture (for use in making "ribbon face" impressions).
730526 O. Friese; Composing-board in form of a galley for storing composed columns.
730734 G. A. Bates; Linotype machine.
731666 C. H. Cochrane; Type-justifying means.
732026 W. Nicholas; Stereotyping (mould-block for stereotype for Goodson matrix-grid).
732383 J. S. Thompson; Linotype machine.
732395 T. Cleghorn; Typecasting matrix.
732560 W. J. Huston and C. W. Smith, Type-finishing machine.
733202 C. E. Hopkins; Machine for casting and trimming stereotype-plates.
733531 I. Baas; Mould for casting printers' furniture (gate to centre of core).
733559 W. S. Scudder; Line-casting machine.
733571 J. B. Allen; Linotype-machine nipple.
733895 I. Baas; Process of making printers' metal furniture (gate to centre of core).
734096 J. R. Rogers; Linotype machine.
734106 J. S. Thompson; Linotype machine.
734121 P. T. Dodge; Linotype machine.
734166 W. H. Francis; Type-page binder-frame (of sheet-metal).
734437 W. S. Scudder; Line-casting machine.
734576 J. Lagarde; Machine for producing perforated strips for composing, or like machines.
734597 F. E. Peacock; Typecasting-machine pump.
734746 D. A. Poe and W. H. Scharf; Linotype machine (Linotype).
734879 P. F. Jones; Space-bar for Linotype, or other typecasting machine.
735142 G. Palmer; Making half-tone printing-surfaces (direct from original photographs).
735226 J. L. Ebaugh; Linotype machine.
735804 C. S. Partridge; Stereotype casting-box (flat).
737251 F. C. Leethem; Printing-plate finishing machine (flat).
738269 F. Winkler; Type-distributing device.
738476 C. S. Partridge; Stereotype casting-box (flat).
738741 F. B. Converse, Jr.; Justifying-mechanism.
739369 F. W. Wicht and C. Spielmann; Numbering-machine (typographic; drop-cipher; means for removing plunger).
739591 J. L. Ebaugh; Linotype machine (Linotype).
739996 P. T. Dodge; Linotype machine (Linotype).

No.

740310 R. W. Pittman and G. C. Andrews; Holder for printing-plates (clamp).
740352 H. P. Arms; Process of producing plates for printing (high relief from direct drawing on plates and repeated etching).
740470 J. R. Rogers; Linotype machine.
740471 C. P. Rubly; Linotype-matrix cleaner.
740537 C. H. Cochrane; Type-space and means for co-operating therewith for justifying lines of type.
741294 H. B. Bartlett; Linotype machine.
741311 C. R. Culley; Numbering-machine (for consecutively numbering pages, etc.).
741423 F. W. Weeks; Compositors' stick.
741819 A. Nordstrom; Numbering-machine (large-wheels, consecutive, for pages, tickets, etc.).
741957 P. T. Dodge; Linotype machine.
742523 W. S. Timmis; Machine for producing controllers for printing, typecasting, etc.
742671 G. E. Kenney; Typesetting machine (Pulsometer).
743233 T. H. Boss; Numbering-machine (automatic hand-stamp; locking-device; see 728194).
743284 J. G. Holbourns and H. A. Longhurst; Linotype machine.
743569 F. Sanders; Numbering machine (typographic; preventing blurring; see 648440).
743812 J. C. Bonneau; Stereotype-matrix frame (dry-fluid pressure [*sic*]).
743890 A. Kraus and N. Collins; Machine for producing stereotype- or electrotype-matrices.
744087 O. Mergenthaler and E. Lawrenz, Linotype machine.
744102 J. A. Proulx; Linotype leading-device.
744230 J. Pinel; Mechanical controller for automatic typecasting and composing machines.
744836 F. W. Weeks; Type [with printing character at one end (negative) and reading character at opposite end (positive), and a shoulder near this end for permitting removal from and insertion in the line].
744837 F. W. Weeks; Type-holder (for assisting hand; see 744836).
744838 F. W. Weeks; Combined compositors' stick and type-chase (see 744836).
744889 G. J. Wildridge; Material for matrices (heat-resisting flong).
745208 G. G. Little and E. A. Reed; Apparatus for forming type under pressure.
745263 C. G. Sunergren; Method of making printing-surfaces for colour-printing (photographic, relief).
745800 J. M. Dove; Type-machine matrix-centring mechanism.
746295 F. B. Converse, Jr.; Justifying-mechanism.
746415 J. K. Van Valkenburg; Linotype machine (Linotype).
747183 L. K. Johnson; Mechanism for sorting types, etc.
747196 A. A. Low and J. Breakey; Type-distributing apparatus.
747534 J. Burger; Automatic signalling-device for linotype machines.
747738 B. Ludwig; Process of producing celluloid printing-plates.
747794 S. Stephens; Printers' furniture (extensible).
747832 F. C. L. d'Aix; Linotype-machine matrix and justifying-device.
747845 C. E. Beach; Supplemental press base for printing-plates (making ready).

1904.

748578 B. A. Brooks; Mechanism for preparing printing-surfaces (combined loose-type setter and typecaster).
748596 C. N. Field; Stereotype-block (casting detachable-back on to plate).
748715 H. S. Folger; Type-holder (hand type-holder for printing on postcards).
748876 C. R. Murray; Type-mould.
749149 J. S. Bancroft; Centring-mechanism (for Monotype die-case).
749243 L. H. Vold; Controller or stop bar for centring-mechanisms (Monotype).
749350 E. Wunsche; Preparing printing-plates (lithographic plates to work with typographic matter).

No. **1904** (*continued*).

749720 F. B. Converse, Jr.; Justifying-mechanism (Converse Mfg. Co.).
749773 F. B. Converse, Jr.; Typesetting machine (Converse Mfg. Co.).
750127 J. E. Schlorff; Type-holder (adjustable).
750395 C. F. Rockstroh; Printing-plate holder (block and clamp).
750831 J. S. Duncan; Machine for making printing-plates (Addressograph).
751421 W. T. Stutchbury and C. Gorick; Perforator-mechanism for preparing the composing-strip of typesetting and casting machines.
751607 J. Broadhouse; Linotype for printing music typographically.
752069 C. J. Hanfbauer; Attachment for machines for perforating strips (Monotype).
752179 H. Petersen; Linotype matrix (two half characters arranged on a two-letter matrix).
752814 J. S. Bancroft; Type-mould.
752846 F. and A. Leslie; Producing duplicate printing-plates (embossing the metal between male and female dies).
753336 J. A. Watson; Composing-machine justifying-device.
753604 W. G. Middleton; Linotype-machine matrix.
753746 C. N. Smith; Preparing colour-plates for printing (relief plate).
754030 G. L. Venable; Linotype-machine alarm-attachment.
754614 W. S. Scudder; Line-casting machine (Monoline).
754619 W. R. Speechley; Producing notches in linotype-slugs or slugs as they are cast in Linotype machines (Linotype).
754970 E. B. Clark; Linotype-machine attachment.
756063 E. P. Sheldon; Numbering-machine (plurality of numbering-wheels arranged transversely on a cylinder).
756477 J. M. Cooney; Linotype machine.
757099 P. T. Dodge; Linotype machine.
757114 C. E. Hopkins; Stereotype-casting machine (for curved plates).
757319 J. Lagarde; Typesetting or composing machine.
757648 S. J. Briden; Linotype machine (Linotype).
757685 D. D. Scott; Linotype machine.
758103 W. H. Randall; Linotype machine (Linotype).
758284 P. Shea; Linotype-machine attachment.
758599 R. J. Sachers; Printing-plate (aluminium compound plate).
759501 J. M. Cooney and H. L. Totten; Linotype distributor (Linotype).
759502 J. N. Crofut, Linotype machine.
759656 E. G. Bates; Typographic numbering-machine (plunger; drop-wheel).
759955 M. Barr; Automatic engraving machine (three-dimensional).
759956 M. Barr; Automatic engraving machine.
759957 M. Barr; Pantograph engraving machine.
760235 M. A. McKee; Making even the faces of stereotype- or electrotype-plates (making ready).
760257 A. Scheckner; Printing-plate and making same (photo-mechanical relief).
760279 W. S. Timmis; Printing-plate holding-device (block and jaws).
761289 P. T. Dodge; Linotype machine.
761346 A. F. Zeitinger; Typecasting machine (body-slide).
761350 M. Barr; Automatic engraving machine.
761942 L. F. Brewster; Numbering, or registering machine transfer-mechanism (carrying from wheel to wheel).
762101 C. Spielmann; Numbering-machine (hand-stamp for yardage; setting wheels independently).
762323 F. Kohnle; Type-chase (for ticket printing).
763735 } 764116 } P. T. Dodge; Linotype machine.
764133 D. S. Kennedy; Linotype machine.
764167 J. Tunaley; Linotype-machine assembling-mechanism.
764517 F. A. Berry; Stereotype-block (clamping-dogs).
764660 J. S. Duncan; Addressing-machine (working printing-plates automatically with card-indexes; Addressograph).

No.
764793 J. Broadhouse; Matrix or type-die (for composing music on linotype-slugs, turned through a right angle for printing).
765057 M. Wehrlin; Apparatus operated by a perforated band for casting spaces (Méray-Rozár).
765058 M. Wehrlin; Automatic clutch for typecasting and composing machines.
765059 M. Wehrlin; Typecasting and composing machine.
765574 J. E. Gilbert; Half-tone printing-plate overlay and making same.
765775 G. A. Goodson; Typecasting and setting machine (Graphotype).
765965 J. C. Fowler; Typecasting and setting machine (Castotype).
766037 C. B. Herrmann; Producing stereotype-plates for printing purposes (from keyboard impressions).
766134 E. G. Bates; Numbering-machine (with drop-ciphers; see 721276).
766255 T. J. Hume; Automatic typesetting laundry-marking machine.
766369 C. Méray-Horváth; Telegraphic apparatus (for perforating a band at a receiving station to be used for casting type).
767169 J. R. Rogers; Linotype machine.
767202 J. C. Bonneau; Stereotype-matrix press.
768565 J. C. and J. C. Fowler, Jr.; Typecasting and setting machine (Castotype).
768910 J. R. Rogers; Linotype machine.
768981 J. S. Duncan; Rubber-type (Addressograph).
769022 C. S. Rosin; Cylinder-press type-carrier (for printing wooden boxes).
769168 F. A. Johnson; Machine for manufacturing justified-line-matrices.
769443 S. Lack; Composing-stick tilter.
770253 J. S. Bancroft; Type-machine mould-dimensioning mechanism (Monotype).
770254 J. S. Bancroft; Perforating-machine measuring-mechanism (Monotype).
770341 E. T. Waters; Linotype-machine tabulating-attachment.
770598 J. Mayer and C. Albrecht; Typecasting machine type-ejecting device.
771160 to 771162 } P. C. Lawless; Multiple-magazine Linotype machine (see 436532).
771854 W. Ackerman; Matrix-locating mechanism for typecasting machines (Graphotype).
772116 R. D. Tittle; Composing-stick.
772219 C. P. Cottrell; Stereotype-plate clamp (for curved plates).
772337 S. Brown; Apparatus and means for setting type and printing therefrom.
772453 F. A. Berry; Stereotype-block (clamping-dogs).
772494 M. Barr; Variable-throw crank (for grinding punch- and engraving-machine cutters).
773191 E. J. Buehler; Slug, quoin, furniture, etc. (for use with linotype-slugs).
773341 J. R. Rogers; Linotype machine.
773528 F. Schreiner; Stereotype-casting box (for type-high plates).
774026 M. Barr; Apparatus for turning curved surfaces of predetermined non-circular section for three-dimensional pantograph).
774027 M. Barr; Engraving machine (for punches or matrices).
774239 S. Drummond and W. C. Lieberknecht; Typecasting and setting machine leading-attachment.
774528 E. A. Neben; Manufacture of printing-plates (relief).
774686 G. H. Miller; Numbering-machine (large-wheel for check-slips; see 690170).
775073 M. Barr; Automatic engraving machine.
775426 L. K. Johnson; Type-distributing apparatus (Alden).
776499 A. H. Cruse; Ejecting mechanism for stereotype-shaving machines.
776779 P. T. Dodge; Linotype machine.
776890 C. P. Cottrell; Stereotype-plate clamp (for flat plates).
777855 T. A. Haughton; Typesetting machine.
778196 M. C. Indahl; Detachable key-bank for punching or other machines (Monotype keyboard).
778466 E. R. Storm; Printing-plate holder (clamp).
778609 J. R. Rogers Linotype machine.

1905.

No.

778996 E. A. Osse; Typecasting and composing machine.
779167 J. W. Kerwin; Stereotype-cutting machine (for cutting plates into columns).
779969 J. R. Rogers; Linotype machine.
780667 B. F. Kern and W. J. O. Johnson; Cutting-machine for rubber-type, etc.
781094 L. E. Quick; Type-justifying machine.
781464 F. Schreiner; Machine for impressing or embossing and drying stereotype-matrices.
782299 F. J. Wich; Metal-pump (Autoplate).
782536 J. S. Bancroft; Type-machine adjusting or centring-mechanism.
782549 J. M. Dove, J. S. Bancroft and M. C. Indahl; Type machine die-case transposing-mechanism (Monotype).
782775 L. S. Campbell; Typesetting and distributing machine.
782990 C. Rozár; Apparatus for perforating registering strips for typesetting machines.
783504 M. F. Britt; Hand matrix-assembler (composing-stick for Linotype matrices).
784133 B. F. Bellows; Elevator-mechanism for circulating-matrix machines (Electric Compositor).
784196 F. W. Wicht and C. Spielmann; Numbering-machine (typographic, plunger-operated).
784245 J. S. Bancroft; Type-machine die-case equipment.
784253 P. T. Dodge; Linotype machine.
784267 L. L. Kennedy; Linotype machine.
784275 D. Petri-Palmedo; Linotype machine.
784287 G. E. Wallin; Linotype machine.
784729 E. G. Bates; Numbering-machine (hand-stamp; wheels lever-operated).
785200 L. A. Costigan; Type-page binder-frame.
785349 F. W. Cann; Machine for bevelling the edges of electrotype or stereotype printing-plates.
785374 F. H. Pierpont; Type-mould.
785375 F. H. Pierpont; Type-machine die-case equipment.
785406 C. H. Cochrane; Keyboard (for linotype composing-machines).
785477 F. C. L. d'Aix; Linotype machine.
785478 F. C. L. d'Aix; Matrix for linotype or line-casting machines.
785648 E. A. Adcock; Typesetting machine (Pulsometer).
785649 E. A. Adcock; Type-distributing machine (Pulsometer).
785783 K. West; Paper slack-provider and winding-mechanism (Graphotype).
785823 W. Nicholas; Typecasting machine squirt-preventer (Graphotype).
785964 F. J. Martin; Numbering-machine (hand-stamp; consecutive, duplicate, or repeat).
786020 H. S. Folger; Type-chase and furniture for the same.
786140 C. Muebleisen; Linotype machine.
786155, 786156 J. R. Rogers; Linotype machine.
786199 P. T. Dodge; Linotype machine.
786211 C. L. Grohmann; Linotype machine.
786313 J. Pinel; Typecasting and composing machine.
787138 M. Wehrlin; Intermittent clutch-device for typecasting and composing machines.
787197 J. W. Lewis; Punch-cutting machine.
787769 D. S. Kennedy; Linotype machine.
787786 S. C. Nielsen; Linotype machine.
787817 C. A. Albrecht; Linotype machine.
787821 R. M. Bedell; Linotype machine (Linotype).
788578 F. W. Blair; Linotype-machine alarm.
789113 E. G. Bates; Numbering-machine (hand-stamp; consecutive, duplicate, or repeat).
789114 E. G. Bates; Numbering-machine (hand-stamp; operating and inking).
789646 H. A. Agricola, Jr.; Typographic machine. (Linotype).
789708 S. A. Bhisey; Type-making and setting machine.
790348 P. T. Dodge; Linotype machine.
790447 R. F. Mercer; Linotype machine.
791130 B. F. Bellows; Matrix-distributing machine (Electric Compositor).
791131 B. F. Bellows; Matrix-assembling machine escapement-mechanism (Electric Compositor).

No.

791165, 791166 J. R. Rogers; Linotype machine.
791558 L. K. Johnson and A. A. Low; Type distributing apparatus.
791747 B. F. Bellows; Logotype-casting mechanism.
792247 J. S. Bancroft and M. C. Indahl; Typecasting machine centring-mechanism (Monotype).
792313 G. H. Calmels; Manufacturing typographical blocks.
792472 O. Southwell; Linotype machine.
792504 P. T. Dodge; Linotype machine.
792521 D. S. Kennedy; Linotype machine.
792551 D. Petri Palmedo; Linotype machine.
792574 J. L. Firm; Stereotype-plate casting mechanism (Goss printing-press).
792851 J. R. Rogers; Linotype machine.
792973 P. T. Dodge; Linotype machine.
792993 D. S. Kennedy; Linotype machine.
793691 W. R. Speechley; Serrated rule and linotype-slug for tabular matter (Linotype).
793766 F. E. Bright; Linotype machine.
794162 B. F. Curtis; Stereotype-plate casting and finishing machine.
794628 O. Mergenthaler and E Lawrenz; Typographic machine (producing a line composed of logotypes).
794629 O. Mergenthaler; Producing justified type-lines.
794670 R. J. Foster; Linotype machine.
794959 A. O. Taylor and F. A. Hackett; Means for locking printing-plates (clamp).
795028 P. T. Dodge; Linotype machine.
795878 H. C. Zenke; Linotype machine.
795936 J. R. Rogers; Linotype machine.
795969 C. L. Grohmann; Linotype machine.
796091 W. Scott; Means for cooling stereotype-casting boxes.
796155 L. K. Scotford; Numbering-machine (automatic hand-stamp; consecutive, duplicate, triplicate, or repeat).
796213 F. P. Howard; Linotype-machine liner (for moulds; Linotype).
796318 H. J. S. Gilbert-Stringer; Apparatus for equably justifying composed lines of type.
796487 S. R. Withers; Type (characters and logotypes with space cast in one).
796767 O. Southwell; Linotype machine.
796770 J. H. Street and C. Karsten; Linotype-machine space-bar.
796776 B. Van Wie; Linotype machine.
796778 F. A. Vinton; Linotype machine.
796786 P. G. Wolff; Linotype machine.
796790 H. A. Agricola, Jr.; Typographic machine (Linotype).
796825, 796826 P. T. Dodge; Logotype machine (producing line of justified logotypes with blank added to logotype for space).
796843 D. S. Kennedy; Linotype machine.
796844 L. L. Kennedy; Linotype machine.
796850 C. Muehleisen; Linotype machine.
796859 D. Petri-Palmedo; Linotype machine.
797008 A. A. Low; Type-distributing apparatus.
797022 W. Scott; Means for cooling stereotype-casting boxes.
797370 W. A. Porter; Numbering-machine (typographic; double sliding case).
797381 C. F. Smith and P. R. Dill; Numbering-machine (typographic; "eleven-division" for drop-cipher).
797405 R. Collins; Linotype mouthpiece.
797411 to 797413 P. T. Dodge; Linotype machine (Linotype).
797436 D. S. Kennedy; Linotype machine (Linotype).
797549 B. F. Bellows; Justifying-mechanism. (Electric Compositor).
797980 S. J. Sennett; Automatic typecasting machine.
798047 L. Quanchi; Matrix-blank-making machine (flong).
798298 J. R. Rogers; Linotype machine.
798354 J. W. Lewis; Punch-cutting machine.
798668 T. S. Fox; Apparatus for producing printing-plate designs (typographic).
798994 P. T. Dodge; Linotype machine.
799007 D. S. Kennedy; Linotype machine.
799030 J. M. Bryant; Compound spacer for linotype machines (Typograph).
799054 F. W. Hews; Typecasting machine.

No. **1905** (*continued*).

799613 M. W. Morehouse; Motor attachment for Linotype machines (Linotype).
799759 W. Scott; Stereotype-casting mould.
799792 J. Keenan; Linotype machine.
799933 E. E. Paddock; Linotype machine.
799943 J. R. Rogers; Linotype machine.
799945 F. Schreiner; Stereotype-matrix (from dry sheets).
800173 W. H. Scharf; Linotype machine.
800459 J. Mayer and C. Albrecht; Typecasting machine type-mould.
800556 P. T. Dodge; Linotype machine.
800569 C. L. Grohmann; Linotype machine.
800868 J. M. McGibney; Type-holding device for dating-machines.
800970 B. F. Bellows; Matrix-distributing mechanism (Electric Compositor).
800971 B. F. Bellows; Matrix-assembling mechanism (Electric Compositor).
801092 R. J. Kittredge; Means for holding and registering stereotype and other printing-blocks.
801132 M. Barr; Electrical means for detecting and announcing contact between two conducting bodies (for punch-cutting and engraving).
801140 J. Engelhardt; Making printing-plates (stipple plates).
801291 H. A. W. Wood; Composite printing-plate and making the same (stereotype and half-tone).
801454 L. C. Hay; Producing formes for rule-and-figure tables (Linotype).
801716 A. E. and E. Hall; Stereotype-casting apparatus.
801913 W. G. Reynolds; Typesetting machine.
802108 C. J. O'Brien; Linotype-machine attachment.
802992 J. Keenan; Trimming knife for Linotype machines.
803081 R. D. Tittle; Composing-stick.
803195 H. Schmidt; Type-holder for rubber-type.
803422 H. C. MacConnell; Machine for finishing stereotype and other curved plates.
803928 J. R. Rogers; Linotype machine.
803996 P. T. Dodge; Linotype machine.
804049 J. R. Rogers; Logotype-machine (mould for spaces for justified line of logotypes).
804050 J. R. Rogers; Logotype-machine (casting justified lines of logotypes).
804210 J. W. Butterfield and B. C. Schmitt; Stereotype-plate and base connexion (locking).
804764 F. E. Peacock; Typecasting machine.
804829 } 804830 } A. H. Cruse; Matrix-making machine (mangle-press method for stereotyping).
805459 A. Greenleaf; Justifying mechanism for composing-machines (Linotype).
805580 J. R. and G. A. Pearson; Typecasting and setting machine (Pearson Typo-bar).
805992 D. Petri-Palmedo; Linotype machine.
806070 P. T. Dodge; Linotype machine.
806504 F. Schreiner; Stereotype-casting box.
806529 P. T. Dodge; Slug-casting machine.
807094 C. F. Smith; Numbering-machine (numbers from left to right, prefix stationary; thus: No. 1, No. 99, or No. 100, instead of No. □□1, No. □99, or No. 099).
807282 L. L. Kennedy; Linotype machine.
807566 F. C. L. d'Aix; Line-casting machine.
808070 J. E. Caps and G. H. Vining; Stereotype-plate casting apparatus.
808112 F. H. Pierpont; Standardizing or measuring machine for matrices.
R12404 C. F. Rockstroh; Orig. No. 750395; Printing-plate holder.
R12416 L. Quanchi; Orig. No. 798047; Matrix-blank-making machine (flong).

1906.

808715 F. M. Barker; Printers' composing-stick.
808772 M. W. Morehouse; Linotype machine.
808873 J. R. Rogers; Linotype machine.
808931 J. H. W. Knoop; Linotype-machine attachment.
809229 E. R. Storm; Printing-plate holder (plate-clamp).
809399 C. F. Rockstroh; Stereotype-plate holder.

No.
809524 T. M. North; Trimming-mechanism for stereotype-casting machines.
809548 L. B. Benton; Matrix and punch-cutting machine.
810079 F. A. Pettit; Linotype-knife wiper.
810153 D. S. Kennedy; Linotype machine.
810173 J. E. Saffery; Linotype machine.
810205 H. C. Hensel; Type-distributing mechanism.
811285 J. G. Gosselin; Typesetter's machine. (For assisting hand-setter.)
811328 C. F. Rockstroh; Printing-plate holder (plate-clamp).
811362 R. M. Bedell; Linotype machine.
811372 D. Sr. and Jr., A. L. and J. W. Carlaw; Numbering-arrangement for use in connection with printing and numbering machines (for cheque-books, bill-heads, etc.).
811508 G. H. Kendall; Printing-press numbering-mechanism (positioning and actuating).
811623 J. S. Duncan; Typesetting machine.
811727 H. L. Koehler; Adjustable curved-type and cylinder.
811776 H. L. Koehler; Interchangeable curved-type and plate.
812542 E. V. Beals; Attachment for keyboard machines. (Linotype, matrix-making, or typesetting.)
812585 C. Muehleisen; Typographic machine.
812586 C. Muehleisen; Linotype machine.
812708 C. C. Webster; Machine for manufacturing printers' leads (cutting plurality of short lengths).
812924 S. G. Goss; Stereotyping apparatus.
813261 G. H. Vining; Producing folding matrices (of paper for mailing).
813848 K. U. Whitted; Type (a thin type-face to rest on a block with descending parts top and bottom for clamping in combination with slugs).
813907 T. E. Melvin; Typographic paper-punch (for locking up with type and producing holes in the printed matter).
813912 D. B. Ray; Space for justifying lines of type.
814048 F. A. Johnson; Type-packing mechanism (Unitype).
814469 C. Muehleisen; Linotype machine.
814542 T. S. Homans; Linotype machine.
814681 W. J. Ennisson; Typesetting machine (Unitype).
815001 E. Albert; Making matrices (for electro-typing).
815124 L. K. Scotford; Numbering-machine (hand-stamp, consecutive, duplicate, triplicate, quadruplicate, or repeat).
815999 R. C. Annand; Manufacture of stereotypes and the like.
816202 J. C. Wilson; Time-printing and numbering-machine (hand operated for time, date and consecutive number).
816307 W. S. Eaton; Engraving machine (electrically operated annunciation).
816700 M. Barr; Engraving machine tracer and tool (proportional to each other for punches or matrices).
816841 R. M. Bedell; Linotype machine.
816849 P. T. Dodge; Linotype machine.
817429 J. D. Humphrey; Numbering and stamping machine (balanced head).
817646 D. S. Kennedy; Linotype machine.
818243 C. L. Grohmann; Linotype machine.
818274 M. W. Morehouse; Linotype machine.
818656 H. Barth; Producing printing-surfaces (stereotyping from etched plate).
818993 M. Barr; Holder or quill for holding the rotating tools of engraving machines.
819842 L. B. Benton; Matrix-trimming and similar machine.
820546 A. J. Benjamin; Linotype machine.
821076 C. B. Askew; Printing-type (stepped-type).
821127 W. A. Schraubstadter; Type-perfecting mechanism.
821296 P. E. Kent; Linotype machine.
821342 E. S. Day and H. B. Hubbard; Linotype-machine attachment.
821885 D. B. Ray; Space for justifying lines of type.
822089 F. Wicks; Punch-cutting or engraving apparatus.

No. **1906** (*continued*).

822286 C. T. Libby; Linotype machine.
823660 J. B. Allen; Linotype-machine casting-box.
823788 R. F. Jacobs; Machine for cutting or shortening linotype-slugs.
823888 J. W. McCann; Dummy keyboard (for Linotype learners).
824659 D. S. Kennedy; Linotype machine (Linotype).
824704 J. B. Bell; Linotype-machine mould.
824705 J. B. Bell; Linotype machine.
825054 T. S. Homans; Linotype machine.
825162 C. B. Smith; Geneva-gear numbering and recording machine (prints numbers from wheels).
826578 F. A. Johnson; Typesetting and justifying machine.
826593 M. W. Morehouse; Linotype machine (Linotype).
827238 E. L. Holmes; Linotype machine.
827485 F. W. Weeks; Line-holder and type-chase.
827486 F. W. Weeks; Line-holder and cylindrical type-chase.
827872 L. E. Levy; Matrix-making machine.
828059 W. A. Schraubstadter; Typecasting machine.
828080 H. S. Wilson; Typecasting machine.
828323 G. Kretzchmar; Linotype-machine attachment.
828449 J. S. Bancroft; Perforating machine (Monotype).
828450 J. S. Bancroft and M. C. Indahl; Typecasting machine (Monotype).
828451 J. S. Bancroft and M. C. Indahl; Composing-machine (Monotype).
828470 J. French; Perforator line-measuring-mechanism (Monotype).
828541 P. T. Dodge; Linotype machine.
828553 D. S. Kennedy; Linotype machine.
828564 C. Muehleisen; Typographic machine (assembling from a plurality of magazines; Linotype).
828763 M. W. Morehouse; Linotype machine.
828768 A. J. Parker; Mounting-board for stereotypes and other plates.
829157 F. A. Johnson; Type-distributing machine.
829202 S. G. Goss; Stereotyping apparatus.
829260 W. C. Downing; Numbering-machine (hand).
829290 D. A. Poe; Linotype machine.
829768 T. F. Dixon; Machine for forming printers' rules (rolling-in grooves to restore to height-to-paper).
829868 T. S. Homans; Linotype machine.
830350 W. G. Middleton; Linotype machine.
830358 P. G. Nuernberger and G. Rettig, Jr. Typecasting mould (pivotal).
830436 T. S. Homans; Linotype machine (Linotype).
830445 J. A. Loyster; Typographic numbering-machine (perforated-strip controlled).
831003 F. Johannesen; Linotype machine.
831182 W. D. Palmer; Printers' border (straight, or curved continuous rules and means of locking).
832033 W. N. Bowman; Slug-counter (Linotype).
832396 to 832398 } C. T. Libby; Linotype machine.
832769 F. E. Bright; Linotype machine.
832792 J. G. Holbourns and H. A. Longhurst; Linotype-machine escapement-mechanism.
833477 A. G. Nelson; Printers' rule gauge (for catalogue work).
833479 A. R. Noyes; Linotype machine.
833955 A. Dow; Typesetting and justifying machine and the art relating thereto.
833956 A. Dow; Type-composing and justifying machine.
833957 A. Dow; Typesetting machine.
833958 A. Dow; Case-handling device for typesetting machines.
834123 A. Greenleaf; Typographic machine (turning Linotype-matrices through a right angle as they descend; Linotype).
834164 W. P. Quentell; Typesetting machine.
834397 F. McClintock; Type-distributing machine.
834556 E. G. Bates; Plunger-operated numbering-machine (see 676084).
834777 R. C. Vetter; Type-making machine.
834835 W. G. Middleton; Linotype machine.
834846 D. Petri-Palmedo; Linotype machine.

No.
834971 F. C. L. d'Aix; Line-casting machine.
835256 J. R. Rogers; Linotype machine.
835346 A. G. Baker; Typesetting and distributing machine.
835795 W. Laycock; Type and type-holder (rubber-type).
835993 A. J. Wadsworth; Monotype perforating-machine keyboard.
836026 H. C. Gammeter; Type (Multigraph).
836053 A. Schiepe; Rotary casting-machine (for small articles, especially type).
836332 F. McClintock; Type-distributing machine.
836349 L. Ward; Adjustable liner for Linotype machine (Linotype).
836374 P. T. Dodge; Linotype machine.
836687 F. A. Johnson; Typesetting and justifying machine.
836697 F. McClintock; Type-justifying mechanism.
836698 F. McClintock; Typesetting machine.
836710 J. R. Rogers; Line-printing slug (grooved face to receive a rule for printing cancellations; Linotype).
836742 P. R. Dill; Numbering-machine (drop-cipher for consecutive numbering).
837126 J. R. Rogers; Linotype machine (Linotype).
837127 J. R. Rogers; Matrix for linotype machines (Linotype).
837226 T. S. Homans; Linotype machine (Linotype).
837394 G. Fischer; Metallic matrix-plate.
837837 T. S. Homans; Linotype machine.
837879 F. Pierce; Forming an integral type-column.
838039 R. Miehle; Means for holding and registering printing-plates (plate-clamp).
838062 F. W. Sutcliffe and C. Holliwell; Linotype machine.
838063 838064 } F. W. Sutcliffe; Linotype machine.
838512 C. Wagner; Means for holding printing-plates (plate-clamp).
838609 P. T. Dodge; Linotype machine.
838741 T. M. North; Means for casting stereotype-plates.
838905 J. R. Rogers; Matrix-casting machine (for casting Linotype-matrices; Linotype).
839011 J. W. Lewis; Pantographic engraving machine (for punches and matrices; Keystone Typefoundry).
839484 L. L. Kennedy; Linotype machine.
839504 F. McClintock; Type-justifying machine.
839676 H. A. Toren; Printers' slug and quad (for setting inclined lines).
R12494 H. B. Bartlett; Orig. No. 741294; Linotype machine.
R12545 H. C. Hansen; Orig. No. 727355; Matrix-truing apparatus.

1907.

839924 J. L. Firm; Casting-box for stereotype apparatus.
840346 A. J. Kletzker and J. G. Goesel; Type-bar machine. (Characters formed in relief on the softened edges of metallic type-bar blanks).
840775 S. A. C. Kristensen; Stereotyping (production of matrices).
841098 W. S. Aikman and H. C. Stevenson; Printers' furniture (plate and corner shoes).
841457 L. Schmidt; Single-type casting machine (compound body-slide for low-spaces).
841656 W. Armstrong; Engraving machine (for dies for making typewriter-type).
842198 A. W. Harrison; Mounting-block for printing-plates.
842297 C. A. Bonfils and H. G. Bradt; Producing a combined line and half-tone printing-plate.
842690 E. B. Oswalt; Printing-type (with cylindrical hole and rotatable type fitted; for marking costs and prices).
842842 C. C. Webster; Machine for finishing printers' leads (cutting and smoothing ends).
843002 J. A. Corey; Printing-plate holder (clip).
843173 D. B. Ray; Type-channel for type distributing machines.
843241 B. Van Wie; Linotype mould.
843304 L. Schmidt; Single-type casting machine (two combined deciphering-devices for permitting paper-controller to be used in the same order as produced).

No. **1907** (*continued*).

843576 F. H. Brown, J. E. Hanrahan and G. A. Boyden; Type-making machine.
843577 F. H. Brown, J. E. Hanrahan and G. A. Boyden; Matrix-making plate and block attached.
843578 F. H. Brown, J. E. Hanrahan and G. A. Boyden; Matrix-making means to position plates and blocks.
843766 W. D. Palmer; Printers' border (see 831182).
844162 E. Mertens; Apparatus for producing printing-surfaces (repetition of photographs on same plate).
844555 B. M. Des Jardins; Type-justifier (Unitype).
844556, 844557 B. M. Des Jardins; Type-justifying machine (Unitype).
844558 to 844561 B. M. Des Jardins; Type-justifier (Unitype).
844562 to 844564 B. M. Des Jardins; Type-justifying machine (Unitype).
844565 to 844567 W. J. Ennisson; Type-justifying machine (Thorne).
844568, 844569 W. J. Ennisson; Type-justifying machine (Unitype).
844570 E Wentscher; Justifying-apparatus (Unitype).
844746 E. I. Rice; Printers' lead-cutter (for rules and slugs also).
844917 W. N. Bowman; Linotype-machine attachment.
844968 L. F. Smith; Half-tone printing-plate.
845138 E. Spitzer; Producing printing-plates (photo-mechanical; typographic etching process).
845196 J. R. Rogers; Linotype machine.
845227 R. J. Foster and H. Lauzon; Linotype machine.
845261 D. B. Ray; Type-distributing machine.
845287 C. S. Wright; Typesetting machine.
845307 G. E. Marlatt; Mechanism for throwing lines of matrices into Linotype-machines.
845495 A. Whitehead and G. Porteus; Manufacture of stereotype-matrices.
845512 F. H. Brown, J. E. Hanrahan and G. A. Boyden; Matrix for casting type-characters.
845684 F. H. Brown, J. E. Hanrahan and G. A. Boyden; Matrix-plate for typecasting machines.
845685 F. H. Brown, J. E. Hanrahan and G. A. Boyden; Matrix for casting spaces and quads.
845686 F. H. Brown, J. E. Hanrahan and G. A. Boyden; Type-mould and matrix.
846053 to 846055 J. R. Rogers; Linotype machine.
846584 C. T. Libby; Linotype machine.
846972 J. Allan; Linotype machine.
847021 J. McNamara; Monoline composing-machine.
848308 to 848310 D. S. Kennedy; Linotype machine.
848318 D. Petri-Palmedo; Logotype machine.
848338 R. M. Bedell; Linotype machine (Linotype).
848349 R. G. Clark; Linotype machine.
848352 R. Drummond and W. C. Lieberknecht Typecasting machine.
848771 J. R. Rogers; Linotype machine.
848808 to 848810 F. B. Converse, Jr.; Justifying-mechanism.
848833 L. Kern; Preparing half-tone printing-plates (avoiding making ready).
848896 R. W. Goeh; Clamp for clamping type in type-galleys.
849142 F. A. Langen; Apparatus for exactly printing or impressing type (in conjunction with clocks, calculating machines, etc.).
849795 D. S. Kennedy; Linotype machine.
849830 F. H. Brown, J. E. Hanrahan and G. A. Boyden; Matrix-backing.
850094 J. McNamara; Monoline-machine matrix.
850114 D. S. Kennedy; Linotype machine.
850803 W. H. Stedham and J. N. Miller; Treating printing-plates..
850894 E. G. Bates; Numbering-machine plunger (typographic).
850895 E. G. Bates; Numbering-machine (typographic).

No.
851238 T. S. Homans; Linotype machine.
851504 H. Drewell; Mechanism for perforating automatic typesetting machine operating-bands.
851855 L. B. Benton; Automatic typecasting machine.
852162 F. H. Brown, J. E. Hanrahan and G. A. Boyden; Mould for casting type, spaces and quads.
852215 S. Boisseau; Treating printing-plates.
852224 P. T. Dodge; Producing logotypes.
852642 H. Winter; Stereotype-plate-making apparatus.
852786 W. K. Hodgman; Printing-plate holder (clip).
852822 W. S. Coe; Linotype machine.
852905, 853208 F. H. Richards; Typographic machine (power-driven typewriter).
853540 J. S. Duncan; Metal-type (Addressograph).
853647 P. G. Nuernberger and G. Rettig, Jr.; Type-casting mould.
853749 B. Van Wic; Linotype machine.
853752 H. F. Bechman; Machine or casting-box for making stereotype-plates.
853754 H. F. Bechman; Stereotyping and type-metal founding apparatus.
853801 D. S. Kennedy; Linotype machine.
854095 L. Lebrun; Typesetting and distributing machine.
854456 F. H. Brown, J. E. Hanrahan and G. A. Boyden; Producing matrices.
854457 F. H. Brown, J. E. Hanrahan and G. A. Boyden; Matrix-making master-block.
854458, 854459 F. H. Brown, J. E. Hanrahan and G. A. Boyden; Master-block for producing matrices.
854460 F. H. Brown, J. E. Hanrahan and G. A. Boyden; Type-matrix.
854675 E. Spitzer; Printing-plate (typographic etching process).
855225 F. H. Brown, J. E. Hanrahan and G. A. Boyden; Typecasting-machine mould.
855731 F. H. Richards; Typographic machine (impression-device).
856026 F. H. Brown, J. E. Hanrahan and G. A. Boyden; Pump-mechanism for type-casting machines.
856539 W. I. Ludlow; Typograph (machine for casting slugs from assembled matrices; Ludlow Typograph).
856815 C. W. Seaward; Gas-governor for type-machines and the like.
856898 J. McNamara; Monoline machine.
857531 M. A. McKee; Printing-plate and preparing the same (making ready).
857712 J. S Bancroft; Type-machine mould.
857728 E. A. Eschinger; Type-mould (Monotype).
857934 H. P. Hamburg; Hand-numbering machine (hand for repeating, consecutive, or duplicate numbering).
857974 W. Bancroft; Record-strip or controller for composing, typecasting and other machines.
857976 E. G. Bates; Numbering and dating machine (hand-stamp).
858141 R. M. Bedell; Linotype machine.
858513 T. S. Homans; Linotype machine.
858584 A. Dow; Type-distributing machine.
858585 A. Dow; Typesetting machine.
858755 F. H. Richards; Type-bar blank.
858756 F. H. Richards; Type-bar (vertically grooved sides).
859053 J. S. Duncan; Printing-plate (Addressograph).
859170 P. T. Dodge; Linotype machine.
859202 J. A. Corey; Catch-block or mounting-block for printing-surfaces (clip).
859583 A. Schiepe; Typesetting machine.
859587 A. B. Sherwood; Surface-printing plate (offset).
859618, 859619 J. R. Rogers; Linotype machine.
859647 P. T. Dodge; Linotype machine.
859661 F. P. Howard; Ejector-blade for Linotype and kindred machines (Linotype).
860166, 860167 G. H. Ward; Machine for distributing printers' leads.
860671 S. A. C. Kristensen; Production of matrices for stereotyping and the like.
860739 G. M. Darell; Gauge attachment for lead-cutters.

No. **1907** (*continued*).

860844 R. C. Annand; Stereotype-plate casting-apparatus.
861430 }
R 12726 }
861431 }
R 12726 } F. H. Brown, J. E. Hanrahan and G. A. Boyden; Sorts-machines for making type. (R 12726, Orig. Nos. 861430 and 861431).
861770 J. R. Rogers; Linotype machine (Typograph).
861794 O. G. Bartusch; Numbering-apparatus (automatically covering non-prefix part to prevent inking without using a frisket).
861864 E. C. Lampson; Lifter-attachment for typesetting and typecasting machines.
862511 F. H. Richards; Type-bar and typographic forme (device for securing slugs or type-bars).
862800 W. E. Brand; Typecasting and composing machine; strip-controlled; 185 claims (Monoman Typesetter).
863442 W. P. Quentell; Typesetting machine.
863453 O. G. C. Schmitt; Typesetting machine.
863754 D. A. Poe; Linotype machine.
863965 A. J. Benton; Composing-mechanism for type-machines.
863973 S. H. Emanuel; Printers' furniture (securing wide-ribbon printing in imitation type-writing).
864030 F. H. Pierpont; Machine for grinding type-matrices and other bodies.
864064 H. F. Bechman; Stereotype-plate casting apparatus.
864087 H. M. Duncan, C. H. Pritchard and C. R. Macauley; Typecasting machine.
864430 F. H. Richards; Typographic machine (impression-device).
864519 H. Drewell; Apparatus for the electric operation of typesetting machines.
864564 J. R. Rogers; Linotype machine.
864790 G. H. Lang; Numbering or marking machine (for printing laundry-marks).
864802 B. C. Schmitt; Stereotype-plate and base.
865073 J. B. Bell; Fount of matrices (self-spacing for linotype tabular work).
865086 P. T. Dodge; Linotype machine.
865565 S. Brown; Type-fount or holder.
865838 F. Wicks Machine for composing anil casting logotypes.
865846 C. A. Albrecht; Releasing-device for the matrices in composing-machines with two or more magazines placed one above the other.
866343 H. Drewell; Mechanism for perforating the operating-bands of automatic type-setting machines.
866419 O. G. Bartusch; Numbering-apparatus (simultaneously printing more than one set of numbers; see 708295).
866928 R. Grieser; Printing-plate chain (addressing-machine).
867277 F. A. Johnson; Typecasting machine.
867867 E. V. Beals; Justifying-mechanism for type-matrices and types.
868538 H Drewell; Linotype or composing-machine.
868676 M. J. Lynch; Printers' composing-stick (for rules, borders, leads, etc.).
868754 H. O. Barth, G. H. Riehl and W. Honegger; Printers' brass rule corner (L-section with overhanging quadrant).
868961 E. F. Baum; Flong for stereotyping.
869607 J. S. Weyl; Stereotype-plate holder (clamp).
870019 P. T. Dodge; Linotype machine.
870699 E. Terrell; Typesetting machine.
870926 E. V. Beals; Composing-mechanism for printing-bar, matrix-making, and type-setting machines (co-operation of multiple finger-boards).
870994 C. F. Rockstroh; Printing-plate holder (clip).
871020 L. Allen; Composing-machine (see 805580; Pearson Typo-bar).
871080 J. S. Bancroft; Perforating-machine key-board-mechanism (Monotype).
871081 J. S. Bancroft; Keyboard-mechanism for perforating and other machines (Monotype).
871721 A. P. Miller; Making a printing-plate by photo-engraving (altering plate to avoid making ready).
871899 J. P. Tihon; Distributor of double-magazine Linotype machines.

No.
871902 J. T. Wilson; Typesetting-machine gauge.
872223 F. B. Converse, Jr.; Justifying-mechanism.
872630 M. A. McKee; Treating printing-plates.
872794 E. C. Bruen; Forming plate-high linotype printing-plates.
872967 B. L. Parkinson; Assembling-elevator for Linotype machines.
873203 G. G. Babcock; Linotype machine.
873251 C. T. Libby and G. G. Babcock; Linotype machine.
873642 G. E. Wallin; Linotype-slug receiver.
873736 S. E. Dittman; Printing-plate clamp.
874262 O. Uhlworm; Typecasting and setting machine.
874353 W. H. Welsh; Producing matrices.
874354 W. H. Welsh; Producing matrices.
875212 F. H. Richards; Typographic machine (impression machine).
R12622 H. G. Gammeter; Orig. No. 722404; machine for duplicating circular letters to appear as if typewritten; 278 claims (Multigraph).

1908.

876030 W. S. Warnock; Printers' furniture (sheet-metal).
876521 S. Brown; Flexible-forme for holding and assembling type.
876522 S. Brown; Flexible-strip forme for holding type.
876524 F. J. Caine and G. H. Milton; Adjustable trimming-knife for Linotype machines.
876913 R. N. Rogers; Envelope-addresser (adapted to take address-plates from a stack and to re-stack them).
877653 G. H. Lang; Numbering, or marking machine (see 864790).
877775 C. E. Hopkins; Apparatus for finishing stereotype-plates.
878185 F. H. Brown, J. E. Hanrahan and G. A. Boyden; Typecasting means.
878447 H. Abbott; Time-printing mechanism (time of day of initial and final elapsed record and date of each; Calculagraph).
878663 F. F. W. Oldfield; Mould for the production of base-blocks for mounting printing-blocks (interlocking serrations).
879239 J. B. Bell; Linotype machine.
880264 C. A. Albrecht; Linotype and other type-casting machines.
880341 E. Terrell; Assembling-attachment for type-setting machines.
880346 R. F. Wilson; Assembler-slide brake for linotype machines.
880568 H. Pearce; Linotype-machine magazine.
880779 F. B. Converse, Jr.; Linotype machine.
880875 H. M. Frysinger and W. W. Barrett; Means for setting type-compositions on curved lines.
881467 J. S. Duncan; Metal-type bar-holder (Addressograph).
881716 D. Petri-Palmedo; Linotype-machine mould.
881955 F. H. Richards; Typographic machine (impression-device).
882704 A. Lyle and C. Owens; Machine for producing printing-surfaces (raised metal for addressing).
882932 W. C. Downing; Numbering-machine (hand-stamp; see 829260).
883180 P. T. Dodge; Linotype machine.
883376 J. S. Bancroft and M. C. Indahl; Keyboard perforating-machine (Monotype).
883377 J. S. Bancroft and M. C. Indahl; Record-strip composing-machine (see 770253) (Monotype).
883378 }
R 12819 } J. S. Bancroft and M. C. Indahl; Type-machine (Reissued) (Monotype).
883425 J. R. Rogers; Typecasting and composing machine (Linotype).
884022 D. S. Kennedy; Galley for line-casting machines (Linotype).
884293 D. Petri-Palmedo; Casting lines of single type.
884369 J. O. De Wolf; Printing-plate making apparatus (delivering impressionable metal against a matrix, curved plates for news-papers).
884754 P. G. Nuernberger and G. Rettig, Jr.; Type-casting mould.

No. **1908** (*continued*).

884934 D. S. Knox; Signal attachment for linotype machines.
885156 J. G. Holbourns and H. A. Longhurst; Linotype machine.
885777 T. F. Muldoon; Cabinet for liners and blades for Linotype machines.
885948 M. A. McKee; Stereotype (making ready).
886149 H. G. McCool; Syllabic keyboard for typewriters and typesetting machines.
886327 F. H. Richards; Type-making mechanism.
886328 F. H. Richards; Apparatus for making types and lines of type (forming by aid of external heat).
886329 F. H. Richards; Manufacture of type-bars.
886330 F. H. Richards; Mechanism for making types and lines of type (see 886328).
886331 F. H. Richards; Manufacture of type and type-bars.
886583 H. Degener; Spacer for typesetting and line-casting machines.
886584 to 886587 A. Dow; Linotype machine.
886646 W. H. Scharf; Linotype machine.
887034 A. Dow; Linotype-machine matrix.
887035 A. Dow; Linotype-machine spacer or justifier.
887216 J. McNaughton; Type and means for securing the same.
887372 R. C. Annand; Apparatus for casting curved stereotype-plates.
887373 R. C. Annand; Stereotyping-machine.
887678 G. E. Wallin; Wide-spacing attachment for Linotype machines.
887732 R. C. Annand; Casting of curved stereotype-plates.
888176, 888177 D. S. Kennedy; Linotype machine.
888402 T. S. Homans; Linotype machine (Linotype).
888649, 888650 H. Petersen; Linotype machine.
888786 F. B. Converse; Linotype machine.
889074 G. E. Wallin; Linotype-slug trimmer.
889231 J. G. Holbourns and H. A. Longhurst, Linotype machine.
889400 J. R. Rogers; Linotype machine.
889552 W. H. Scharf; Linotype machine.
889617 D. S. Kennedy; Linotype machine.
889820 O. V. Sigurdsson; Typecasting machine.
889893 A. J. Benton; Leading or slugging device (see 625998; Monotype).
889913 J. M. Dove, J. S. Bancroft and M. C. Indahl. Type-composing machine.
890177, 890178 J. R. Rogers; Linotype machine.
890263 F. B. Converse, Jr.; Linotype machine.
890264 F. B. Converse, Jr.; Type-distributing machine.
890265 F. B. Converse, Jr.; Distributing-machine.
890266 F. B. Converse, Jr.; Matrix-assembling and distributing machine.
890269 J. Froehlich; Sorting-mechanism for linotype machines (Linotype).
890283 D. S. Kennedy; Linotype machine.
890303 J. R. Rogers; Distributor for linotype machines (Linotype).
890425 T. S. Homans; Linotype machine.
890706 J. Pinel; Printing-type casting and setting machine.
891499 L. E. Morningstar; Matrix and method of forming same (stereotyping).
891620 C. Hufl, B. B. White and J. T. Carter; Type-mould.
891637 A. Schiepe; Typecasting machine.
892624 F. H. Richards; Typographic machine (impression-device).
892685 W. A. Roseberry and P. S. Junkin; Liner for moulds for linotype machines.
892891 F. H. Richards; Typographic machine (impression-device).
894265 K. Geiser and A. Schatzmann; Printing-plate (tone-plates).
894398 H. B. Rouse; Printers' rule- and lead-cutter.
894446, 894447 W. J. Knoll; Printing-plate holder (clamp).
895231 B. F. Bellows; Spacer-selecting and -releasing mechanism for use in justifying matrix- or type-lines (Electric Compositor).
896381 A. W. Hanigan; Printers' type.

No.
896487 J. C. Urbank; Printers' furniture (extendible).
896908 A. W. Hanigan; Typecasting machine.
897051 W. and H. B. Bell; Manufacture of half-tone printing-blocks.
897358 R. C. Elliott; Typecasting and composing machine.
898141 W. W. Sawyer; Engraving machine (operating two heads; Bates Mach. Co.).
898836 B. B. Conrad; Numbering-machine (see 521001 and 388307; American Numbering Machine Co.).
899019 H. G. Bartholomew and H. M. Bussy; Apparatus for the production of process printing-plates (half-tone, line and process printing-plates).
899374 H. F. Bechman; Stereotype-plate casting-apparatus.
899843 L. Roberts; Typesetting and distributing machine.
901111 J. L. Lee; Producing stereotype-bases (with soft nailing-strips).
901443 I. Hasselstrom; Numbering-machine (numbering backwards or forwards).
901478 J. R. Rogers; Linotype machine.
902134 H. Burris; Typographers' composing and founding machine (automatically charging the melting-pot).
902196 I. Baas; Type-mould.
902197 I. Baas; Typecasting mould.
902281 J. S. Duncan; Printing-plate (Addressograph).
902326, 902327 F. H. Richards; Mechanism for operating adjustable work-performing-members.
902328 F. H. Richards; Mounting for adjustable working-members (for impression-devices).
902329 F. H. Richards; Mechanical movement (securing alinement).
902339 C. Spielmann and F. W. Wicht; Consecutive-numbering apparatus (plurality of sets of numbering-wheels; any set arranged parallel or normal).
902719 J. S. Duncan; Type-holder (Addressograph).
902861, 902862 W. Danenhower; Type-washing machine.
902941 A. L. Case; Stereotyping-machine.
903331 O. V. Sigurdsson; Typecasting and composing machine.
903342 B. F. Upham; Bending printing-surfaces (elongating flat plate to register with one bent cylindrical).
903405 J. R. Rogers; Linotype machine.
903677 F. B. Converse, Jr.; Justifying-mechanism.
903917 J. S. Thompson; Typecasting and distributing machine.
904510 W. E. Chalfant; Matrix and holder for the same (for securing large-body matrices).
904995 H. A. Reynolds; Matrix notch-chamfering machine.
904996 H. A. Reynolds; Matrix corner-chamfering machine.
905060 T. Draper; Printers' composing-stick.
905155 J. O. De Wolf; Making metallic printing-plates (for newspapers).
905196 E. F. Linke; Typesetting machine, etc. (Unitype).
905516 H. P. Hamburg; Hand numbering-machine.
905541 D. S. Kennedy; Line-casting machine.
905987 B. B. Conrad; Numbering-machine (hand-stamp, adjustable; automatic or lever-operated).
906397 J. S. Duncan; Type-chase (Addressograph).
906586 B. F. Upham; Bending printing-surfaces (making bent cylindrical or flat plates to register).
907128 B. B. Conrad; Numbering-machine (hand-stamp with readable setting).
907754 O. H. Desmarais; Linotype-machine attachment.
907820 J. Kurten; Stereotype printing-plate cooling-device.

1909.

908519 J. S. Thompson; Typecasting machine.
908593 M. S. Miller; Linotype-machine lines.
908634 H. S. Wilson; Type-perfecting machine.
908870 W. H. Kolvenbach; Type-checker.
909115 W. A. Porter; Numbering-machine (typographic; bottom plunger).

No. **1909** (*continued*).

909832 B. F. Upham; Method of bending electrotype-plates.
910317 C. F. Rockstroh; Printing-plate holder or bed-spacer.
910489 J. E. Billington and C. Holliwell; Trimming-mechanism for Linotype machines (Linotype).
910611 F. M. Turck; Printing-press numbering-device (for rotary press; see 830751).
910866 F. Sander; Numbering-machine (typographic; Amer. Numbering Mach. Co.).
911421 F. Maurer; Machine for the production of stereotype-matrices.
911612 F. H. Richards; Type and type-bar making machine.
911681 F. H. Richards; Typographical machine.
911882 D. W. Jones; Casting of curved stereotype printing-plates.
911887 H. Larsen; Linotype machine.
912056 H. A. Armstrong; Typesetting-machine attachment.
912092 M. A. Droitcour; Making printing-plates.
912093 M. A. Droitcour; Printing-plate (celluloid or pyroxilin).
912169 F. H. Richards; Type and type-bar making machine.
912180 W. H. Scharf; Linotype machine.
912228 P. Bunau-Varilla; Improvements in machine for moulding printing-plates of blocks.
912961 W. T. Hoofnagle; Machine for forming justified lines of type.
913035 W. Neasham; Printing-plate holder.
913224 E. Mirus; Typesetting and distributing machine.
913280 B. Gisevius; Producing printing-plates.
913306 F. H. Richards; Typographic machine key-mechanism.
913307 F. H. Richards; Typographic machine key-mechanism.
913447 C. A. Albrecht and C. Muehleisen; Linotype and other typecasting machines.
913546 P. G. Nuernberger and G. Rettig, Jr.; Typecasting machine.
913627 H. Degener; Line-setting and casting machine.
913736 W. J. Knoll; Printing-plate holder.
913743 W. W. Lininger; Typesetting machine.
913851 W. G. Reynolds; Typesetting machine.
915538 J. S. Bancroft and M. C. Indahl; Typecasting machine.
915553 J. B. Church; Composing-machine controller.
915666 O. Dodge; Producing printing surfaces (intaglio, or relief, building electrolytically).
915748 H. Drewell; Means for electrically operating typesetting machines.
916488 F. H. Richards; Typographical machine.
916679 H. Degener; Linotype matrix.
916782 F. H. Richards; Typographical machine.
917975 J. S. Thompson; Typecasting machine.
918515 H. Drewell; Linotype machine.
918572 C. K. Mayer; Linotype-machine copy-holder.
918739 H. Degener; Typesetting and casting machine.
918806 J. W. Willis; Producing relief plates for press-printing by the method known as photo-engraving (etching).
919024 D. S. Kennedy; Linotype machine.
919215 to 919220 } F. H. Richards; Making types and type-bars.
919221 F. H. Richards; Typographical machine.
919222 F. H. Richards; Making type-bars.
919223, 919224 } F. H. Richards; Making types and type-bars.
919225 F. H. Richards; Typographical machine feed-mechanism.
919226 F. H. Richards; Making types and type-bars.
919227 F. H. Richards; Type-bar machine.
919228 F. H. Richards; Die and die-mechanism (for making wrought types and type-bars).
919229 F. H. Richards; Type-bar machine.
919230 to 919232 } F. H. Richards; Making types and type-bars.
919233, 919234 } F. H. Richards; Feed-mechanism (for making type-bars).

No.
919235 F. H. Richards; Means for imparting a movement to type-bars or type-bar blanks.
919236 F. H. Richards; Manufacture of type-bar blanks.
919237 F. H. Richards; Making types and type-bars.
919238 F. H. Richards; Making type-bars.
919239 F. H. Richards; Wrought-metal type-bar.
919240 F. H. Richards; Type-bar machine.
919241 F. H. Richards; Making types and type-bars.
919242 F. H. Richards; Type-bar.
919243 F. H. Richards; Die and die-operating mechanism (for making type-bars).
919408 H. Weiniger; Machine for composing or setting-up type.
919805 C. Albrecht; Linotype machine.
919951 E. M. M. Retaux; Type setting-up and casting machine.
919957 J. R. Rogers; Linotype machine.
920021 B. Cade; Composing and line-casting machine.
920086 A. Savarese; Composing-machine.
920195 I. Schonberg; Typecasting machine.
920617 J. McNamara; Line-casting machine (Monoline).
920917 B. B. Conrad and F. Sander; Typographic numbering-machine (see 910866).
921063 B. F. Bellows; Line-justifying mechanism (temporary spacers; Electric Compositor).
921064 B. F. Bellows; Linotype-making mechanism.
921065 B. F. Bellows: Matrix-distributing mechanism.
921067 M. S. Bentley; Matrix-drying press.
921156 S. H. Perky; Printing-type.
921600 J. S. Duncan; Printing-plate making machine.
921753 B. F. Upham; Fastener for securing printing-plates to type-beds (clamp).
921946 F. H. Brown, J. E. Hanrahan and J. L Sellar; Typesetting and printing-machine.
922129 S. C. Gaunt; Type-mould.
922632 F. H. Richards; Justified type-bar.
923131 J. E. Billington and C. Holliwell; Assembling-mechanism of typographical composing-machines.
923252 L. A. Diss; Machine for making dies or matrices for the manufacture of type, etc.
923275 P. E. Kent; Swage or reshaper for deformed or battered teeth of Linotype matrices.
923998 W. G. Reynolds; Type-making machine.
924000 J. R. Rogers; Line-casting machine
924001 J. R. Rogers; Line-casting machine.
924243 L. L. Kennedy; Line-casting machine.
924326 H. Degener; Typesetting and line-casting machine.
924539 L. A. Diss; Machine for making dies for the manufacture of type (for typewriting machines, etc.).
924939 J. R. Rogers; Slug-casting machine (Linotype).
924957 J. S. Bancroft and M. C. Indahl; Type-machine controlling-mechanism.
925023 F. H. Pierpont; Type-machine mould-actuating mechanism.
925024 F. H. Pierpont; Typecasting machine.
925028 F. H. Richards; Making ribbed-plates (for use in making type-bars).
925073 W. Bancroft; Multiple composing-mechanism.
925268 H. P. Bechman; Stereotype plate-casting apparatus.
925321 W. R. Fisher; Facing stereotype-metal.
925753 R. G. Clark; Line-casting machine.
925754, 925755 } F. B. Converse; Linotype machine.
925842 J. R. Rogers; Linotype machine.
925843 J. R. Rogers; Line-casting machine (Linotype).
925844 J. R. Rogers; Keyboard-mechanism for line-casting machines.
925866 W. H. Brueckmann; Typecasting machine.
926121 J. Jacobson; Producing printing-plates.
926158 F. J. Wick; Assembling-mechanism for typographic composing-machine equipped with alternative founts.
926740 H. H. Hardinge; Typecasting machine.
927597 F. H. Richards; Mechanism for making typographic formes.
927598 F. H. Richards; Typographic forme.
927615 A. Waldt; Matrix-making and drying machine (stereotype).

1909 (*continued*).

No.

927873 W. G. Reynolds; Printing-forme and type (special type for sliding on bars).
928740 B. B. Conrad; Dating machine (advancing number-wheels).
929862 J. Kukla; Device for casting short-quads in typecasting machines.
930693 J. R. Rogers; Linotype machine (reed or verge adjusting-mechanism; Linotype).
931915 R. Dacheux; Device for justifying lines of type.
931998 R. Coopersmith; Matrix-making machine (impressing line by line).
932225 H. A. W. Wood; Stereotype-casting device.
932577 W. M. Rapp; Linotype machine.
932602 A. H. Cruse; Printing-plate casting machine.
932817 L. A. Senegele; Pot-feeder for typecasting machines.
933058 B. A. Brooks; Typographical machine.
933172 S. G. Goss; Stereotype casting-box.
933509 A. F. Welling; Linotype-machine attachment.
933835 J. G. Holbourns and H. A. Longhurst; Means for justifying tabular matter in typographical composing-machines.
934403 J. G. Holbourns and H. A. Longhurst; Means for justifying tabular matter in typographical composing-machines.
935073 W. S. Warnock; Printing-plate foundation.
935439 J. White; Flexible printing-plate clamp.
935543 H. Pearce and J. E. Billington; Galley mechanism for typographical composing-machines.
935635 J. E. Billington and C. Holliwell; Linotype-machine matrix.
935968 B. M. Des Jardins; Typesetting and justifying machine.
936612 B. D. Deyo; Election square rules and linotype-slug holder (mortised for slug).
936776 A. G. Halfpenny; Typesetting and distributing machine.
937378 H. W. J. Meyer; Linotype magazine-rack, or support.
937803 A. F. Herbsleb; Separable stereotype-plate and base.
938074 F. H. Pierpont; Punch-cutting and matrix-cutting machine.
938298 J. S. Bancroft and M. C. Indahl; Record-strip composing-machine.
938433 F. H. Pierpont; Cutter-head mechanism for punch-cutting and like machines.
938434 F. H. Pierpont; Cutter for punch-cutting machines.
938435 F. H. Pierpont; Blank-holder for punch-cutting and like machines.
938938 C. A. Albrecht; Matrix for Linotype and other typecasting machines.
939262 F. Johannesen; Linotype machine.
939291 J. McNamara; Line-casting machine (Monoline).
939325 J. R. Rogers; Keyboard-mechanism for line-casting machines (Linotype).
939631 H. A. Reynolds; Matrix-channelling machine (Electric Compositor).
939632 H. A. Reynolds; Dovetail-notch chamfering-machine for matrices (Electric Compositor).
939633 H. A. Reynolds; Matrix-combination punching machine (Electric Compositor).
939800 S. R. Carter; Linotype-slug trimming machine.
939988 P. T. Dodge; Producing matrices (Linotype).
940071 O. Mergenthaler; Typographic machine or machine of like character.
940087 E. Terrell; Type-receiving and supporting device.
940179 P. J. Meyer; Engraving machine (for numbering-machine wheels).
940277 F. H. Richards; Machine for making types and type-bars.
940377 W. Ackerman; Typecasting and composing machine.
940404 F. H. Richards; Manufacture of type-bars.
940708 C. N. McFarland; Keyboard-locking mechanism for adding machines.
940709 C. N. McFarland; Adding machine; positioning type.
940808 J. Hartnell, Jr.; Making half-tone plates (uses crude-rubber and asphaltum).

No.

941383 H. Pearce; Keyboard-mechanism of typographical machines (Linotype).
941384 H. Pearce and J. E. Billington; Typographical composing and casting machine; multiple-magazine (Linotype).
941549 C. W. Baeder; Stereotype-trimmer.
941931, 941932 O. Koske; Typesetting and casting machine.
942102 F. H. Richards; Type-bar and typographic forme.
942845 J. R. Rogers; Line-casting machine (Linotype).
942846 O. V. Sigurdsson; Typecasting and composing machine (successive casting of single type and assembly in lines rendered integral and delivered to galley; Oddur).
942848 F. B. Converse; Line-casting machine.
943129 G. H. Vining; Machine for sawing and trimming type, plates, etc.
943210 F. Wosinski; Numbering-machine (hand-stamp; consecutive, duplicate, or repeat).
943502 W. G. White; Justifying typewriter (automatic, high-speed, strip controlled, producing justified lines).
943611 W. G. White; Mechanical-controller composing-machine.
943612 W. G. White; Typecasting and composing machine.
944108 O. V. Sigurdsson; Typecasting and composing machine (single type cast and assembled into lines by manipulation of character-keys in a keyboard; Oddur).
944405 J. S. Bancroft and M. C. Indahl; Record-strip composing-machine (Monotype).
944408 B. F. Bellows; Universal type-mould.
944451 E. A. Lundvall and W. Olsen; Numbering-machine (hand-stamp; consecutive).
944493 F. McClintock; Typesetting machine.
944535 S. H. Bean; Printers' composing-stick (for quick-setting to measure).
944588, 944981 F. C. L. d'Aix; Line-casting machine.
R 13048 F. C. L. d'Aix; Orig. No. 834971; Line-casting machine.

1910.

945046 W. J. Rennie; Linotype machine.
945051 W. H. Scharf; Linotype machine.
945497 P. T. Dodge; Line-casting machine (Linotype).
945608 J. R. Rogers; Linotype machine.
945609 J. R. Rogers; Line-casting machine.
945678 H. F. Bechman; Stereotype casting-box.
945694 R. G. Clark; Distributing-mechanism for line-casting machines (Linotype).
945718, 945719 G. D. Hartley; Linotype machine.
945777 H. M. Freck; Typesetting machine.
945789 H. Lang; Stereotype-plate casting machine.
945826, 945827 J. J. Walser; Stereotype-plate casting-mechanism.
945892 C. Woodroffe, H. Pearce and J. E. Billington, Quadding-apparatus of typographical composing-machines.
946443 L. K. Johnson and A. A. Low; Type-distributing apparatus.
946768 J. B. Odell; Typesetting machine.
946824 H. Pautze; Press for stamping raised characters in printing-plates (for addressing-machines).
946866 F. H. Richards; Machine for making type-bars.
946867 F. H. Richards; Manufacture of type-bars.
947005 F. H. Richards; Type-bar forming machine.
947006 F. H. Richards; Type-bar making machine.
947175 T. Dropiowski; Typecasting and setting machine.
947350 F. H. Richards; Producing type-bars.
947760 F. H. Richards; Manufacturing type-bars.
947761 F. H. Richards; Type-bar producing mechanism.
948182 R. F. Mercer; Line-casting machine.
948291 H. Degener; Typesetting and casting machine.
948605 W. N. Clements; Typecasting machine.
948655 H. Winter; Apparatus for producing stereotype-matrices.
948677 G. S. Williamson; Matrix-forming machine (Stereotype).

No. **1910** (*continued*).

949819 H. Cohn; Protecting matrices (coating stereo-matrices to prevent adhesion of metal).
949849 E. P. Sheldon; Numbering-mechanism (changing duplicated and repeated numbers; without stopping machine).
950747 } 950748 } J. S. Duncan; Printing-plate (with card-index tab; Addressograph).
951245 J. G. Holbourns and W. Fletcher; Magazine of typographical composing-machines.
951382 W. Scott; Stereotype-plate casting-apparatus.
951521 H. L. Bell, Sr.; Making cut-printing-plates (coarse-line plates for newspapers).
951654 J. McNamara; Monoline machine.
951655 J. McNamara; Line-casting machine.
951948 J. G. Holbourns and H. A. Longhurst; Typographical composing and distributing machine (Linotype).
951968 J. R. Rogers; Matrix for line-casting machines (Linotype).
952195 A. A. Hill; Time-controlled heating-system for Linotype machines.
952271 C. Muehleisen; Means for levelling matrices in typographical composing-machines.
952312 M. A. Droitcour; Making printing-plates (celluloid; avoiding underlay).
952397 R. F. Wilson; Linotype machine.
952569 D. S. Kennedy; Line-casting machine.
952579 F. H. Richards; Type-bar and typographic forme.
952584 J. R. Rogers; Keyboard-mechanism (Linotype).
952596 J. S. Bancroft and M. C. Indahl; Matrix-dimensioning machine.
952597 J. S. Bancroft and M. C. Indahl; Justifying-mechanism for pattern-controlled composing-machines.
952598 J. S. Bancroft and A. L. Knight; Forming, attaching and positioning nick-pins in type-moulds.
952621 T. Lanston; Controller composing machine.
952631 F. H. Pierpont; Units-measuring mechanisms for composing-machines (Monotype).
952632 F. H. Pierpont; Pattern, or record-strip composing-machine (Monotype).
952633 F. H. Pierpont; Letter-spacing mechanism for typecasting machines (Monotype).
952639 F. H. Richards; Type-bar and typographic forme.
952666 J. S. Bancroft and A. L. Knight; Type-mould (Monotype).
952682 S. Moe; Numbering-machine (consecutive. or duplicate for rotary press).
953237 F. Schimmel; Linotype machine (slugcaster; Rototype).
953745 G. D. Hartley; Line-casting machine.
953764 J. R. Rogers; Linotype machine.
953819 B. B. Conrad; Numbering-machine (combined dater and numberer, hand-operated; see 928740).
954023 H. Drewell; Machine for perforating bands of typesetting machines.
954028 H. H. Hardinge; Automatic typecasting-machine mould.
954412 H. S. Aufermann; Preparing printing-plates in grain manner (half-tone without using gauze).
954459 H. Pearce and J. E. Billington; Typographical composing-machine; quick-change magazine (Linotype).
955116 J. S. Duncan; Machine for making printing-plates (see 624764; Addressograph).
955681 H. Plaut; Linotype machine; slug-guide to prevent transposition (Linotype).
955695 J. R. Rogers; Line-casting machine (Typograph.)
955764 R. G. Clark; Justifier for line-casting machines.
955785 W. F. C. Foster; Numbering-machine (with rotatable disks).
955849 W. Chipperfield; Type-carrier.
956337 G. W. Grasnick; Linotype-machine matrix.
956344 G. D. Hartley; Linotype machine.
956790 J. B. Allen; Linotype machine.
957433 W. G. Middleton; Line-casting machine, etc.
957802 J. R. Rogers; Line-casting machine (Linotype).

No.
957904 F. H. Richards; Machine for making types and type-bars (impression in sheet-metal).
958076 R. M. Bedell; Matrix for line-casting machines.
958317 J. R. Rogers; Line-casting machine; two-magazine Linotype.
958435 F. H. Richards; Type-bar.
958436 F. H. Richards; Making type and type-bars.
958530 C. G. Pickett; Linotype-machine attachment.
958600 R. Dacheux; Type-distributing apparatus.
958738 J. C. Fowler; Individual typecasting and setting machine.
959271 A. O. Taylor; Stereotype-block.
959323 E. S. Dunavant; Mould and operating-mechanism for type-machines.
959725 J. S. Duncan; Printing-plate (Addressograph, for use with card-index; see 692994).
959755 D. S. Kennedy; Line-casting machine.
959961 H. Pearce and J. E. Billington; Automatic pump-stop mechanism for Linotype machines.
959968 H. J. Smith; Printing-type.
960047 O. V. Sigurdsson; Typecasting machine.
960096 L. K. Johnson; Typesetting apparatus.
960218 M. A. Droitcour; Flexible printing-plate and means for securing the same (preventing elongation).
960219 M. A. Droitcour; Flexible printing-plate (celluloid; see 960218).
960684 W. Nicholas; Making matrix-plates for monotype machines.
961035 C. B. Smith; Numbering machine (consecutive numbering, typographic).
961444 S. Hollingsworth; Numbering-machine (ascending, or descending numbers consecutive, or repeated).
961690 P. W. Druitt; Apparatus for reducing the length of cast spaces.
961742 C. A. Albrecht and L. Leidenberg; Type-setting machine for various sizes of type.
961798 } 961799 } J. R. Rogers; Line-casting machine; two-magazine Linotype.
962408 J. S. Bancroft and M. C. Indahl; Driving or transmission-mechanism for type and other machines (Monotype).
962409 J. S. Bancroft and M. C. Indahl; Driving-press for matrices (Monotype).
962410 J. S. Bancroft and M. C. Indahl; Low-quad type-mould (Monotype).
962411 J. S. Bancroft and M. C. Indahl; Low-quad mould for type-machines (Monotype).
962412 J. S. Bancroft and M. C. Indahl; Control-mechanism for low-quad moulds (Monotype).
962857 F. H. Richards; Type-bar and typographic forme.
963076 } 963077 } W. H. Scharf; Linotype machine.
963692 J. S. Duncan; Typesetting and distributing machine.
963790 A. E. Miller; Typecasting machine.
964174 C. A. McCain and C. Henderson; Printing-plate locking-device (clamp).
964205 B. A. Brooks; Preparation of printing-surfaces (line-impression on slug-blank; see 494899).
964328 J. Stivers; Retaining-slug for printers' type-formes (clump with cord groove).
964677 W. Nicholas and W. Ackerman; Typecasting and composing machine; 119 claims, 114 figs. (Graphotype).
964678 W. Nicholas and W. Ackerman; Type-composing machine; 81 claims, 57 figs. (Graphotype).
964679 W. Nicholas and W. Ackerman; Typecasting and composing machine 116 claims, 35 figs. (Graphotype).
965044 W. H. Smith; Numbering-machine (shaft-operated number-heads).
965155 G. W. Clarke; Matrix-plate (square; 8 matrices; 2 on each edge).
965241 J. J. C. Smith; Stereotype-making apparatus.
965242 J. J. C. Smith; Making stereotype-moulds.
965300 T. S. Homans; Linotype machine.
965448 F. H. Frey; Typecasting and tubing machine (receiving short-type in tubes).

No. **1910** (*continued*).

965939 D. B. Ray; Apparatus for separating type into classes for distribution.
966227 C. Muehleisen; Means for adjusting the mould of typographical line-casting machines (Linotype).
966228 C. Muehleisen and C. A. Albrecht; Means for assembling multiple-face matrices in typographical composing-machines (Linotype).
966979 E. A. Adcock; Type-distributing machine.
967875 E. Albert; Producing printing-plates (autotype).
967976 J. R. Rogers; Ejecting-device for line-casting machines, etc. (Linotype).
968064 A. E. Markwell; Linotype machine.
968383 A. E. Miller; Typecasting machine.
968490 C. Muehleisen, G. Molthenkin and L. Leidenberg; Means for producing tabular matter in typographical machines (Linotype).
968766 A. Hoberg; Type-arranging device.
970146 G. E. Wallin; Chute-spring for Linotype machines.
970694 H. Drewell; Typesetting machine.
971040 A. W. Hamaker; Typecasting machine attachment.
971074 F. H. Richards; Logotype, type-bar and typographic forme.
972033 W. Steers; Engraving machine (engraving and routing letters).
972528 A. H. Halloran; Type-measuring device.
972591 F. C. L. d'Aix; Line-casting machine (mould).
973181 W. E. Elliott; Linotype machine.
973191 H. H. Hardinge; Providing nick-projections on type-mould body-blocks.
973454 C. Muehleisen; Apparatus for effecting separation of matrices and space-bars in typographical composing-machines (Linotype).
973566 J. R. Rogers; Keyboard-mechanism for linotype machines, etc. (Linotype).
973683 C. N. McFarland; Computing and recording machine; multiple-key.
973807 P. Orsoni; Machine for rectifying stereotype-plates.
974594 V. Piagneri; Cleaning attachment for space-bands of Linotype machines.
974718 A. G. Stephenson; Printing-rule and system of applying same to printing-formes (for tabular linotype-slugs).
974740 B. F. Bellows and C. Luttropp; Justifying-mechanism (Electric Compositor).
975194 E. A. Adcock; Typesetting machine (Pulsometer).
975344 H. S. Folger; Rubber type-base.
975433, 975434 } D. S. Kennedy; Line-casting machine.
975463 E. Sanborn; Hand-stamp for applying dates upon letters.
975503 W. E. Bertram; Matrix-delivery mechanism for Monoline composing-machines.
975689 W. W. Greenwood; Type-scale (to give column length for 1000 ems).
976295 J. H. Reinhardt; Numbering-machine (for setting commencing number of next job while machine is running).
976919 F. H. Richards; Typographic forme (slugs secured by dovetailed keys).
976920 F. H. Richards; Mechanism for making type and type-bars.
976957 G. E. Wallin; Space-band buffer for Linotype machines.
977217 W. C. F. Papke; Printers' rule in corner, straight-strip, curved or tubular form (of bent and stamped sheet).
977248 H. A. W. Wood; Stereotype printing-plate casting-mechanism (see 721117; Autoplate).
977280 H. Degener; Line-setting and casting machine.
977474 G. F. Read and F. G. Lougee; Movable work-gauge for stereotype-trimming machines, etc.
978108 W. E. Bertram; Fount-selecting mechanism for Monoline composing-machines.
978456 W. M. Kelly; Typesetting and distributing machine.
978754 A. G. Hyde and R. P. Link; Type-alining and supporting means.
978824 M. A. Droitcour; Matrix (stereotype-flong).

No.
979111 B. F. Upham; Printing-surface and producing the same (making ready).
979222 A. S. Taylor; Adjustable hand type-mould.
979864 R. P. Link and A. C. Morgan; Typecasting and composing machine.

1911.

980419 C. E. Hopkins; Apparatus for casting curved stereotypes.
980468 H. A. W. Wood; Stereotype-printing-plate casting machine.
980902 J. S. Bancroft and M. C. Indahl; Automatic justifying means for pattern-controlled composing-machines (Monotype).
980903 J. S. Bancroft and M. C. Indahl; Matrix side-grooving machine (Monotype).
980904 J. S. Bancroft and M. C. Indahl; Composing-machine record-strip (Monotype).
980933 R. C. Elliott; Pattern-controlled composing-machine.
980957 J. J. Hummel; Typesetting machine (plurality of founts and series of magazines; 155 claims).
980959 M. C. Indahl and W. E. Chalfant; Type-machine, die-case equipment (Monotype).
980960 M. C. Indahl and A. C. Knight; Type-mould (Monotype).
980970 A. L. Knight; Low-quad type-mould equipment (Monotype).
980997 F. H. Pierpont; Strip-perforating and -winding machine (Monotype).
980998 F. H. Pierpont; Leading-attachment for composing-machines (Monotype).
981195 M. C. Indahl and W. E. Chalfant; Type-machine matrix.
981438 R. P. Link and A. G. Hyde; Typecasting machine (vacuum and pump).
982172 H. Degener; Typesetting and line-casting machine (Linotype multiple magazine).
982173 H. Degener; Linotype machine.
982174 H. Degener; Matrix-setting and line-casting machine.
982263 W. Flett; Numbering-device (number-cylinder with four number-heads for high speed).
982834 A. W. Le Boeuf; Mould-lock for linotype machines (Electric Compositor).
983648 V. Royle; Apparatus for registering printing-plates.
984207 S. C. Gaunt; Type (for sloping italics and script).
984372 S. Hollingsworth; Numbering-machine (series of numbering-cylinders to print one or both sides of web with numbers and department initials).
984947 R. P. Link and A. C. Morgan; Typecasting and composing machine and typewriter (plurality of matrix-carrying sectors).
985042 J. C. Lotterhand; Printing-mechanism for adding machines.
985874 H. A. W. Wood; Stereotype-plate casting- and finishing-mechanism (Autoplate).
985875 H. A. W. Wood; Stereotype-printing-plate casting-apparatus (Autoplate).
986234 W. H. Smith; Numbering-head (automatically turning all the number-wheels for inking row by row).
987293 H. B. Gale; Matrix-press electrically heated.
987372 C. L. Johnston; Multiple numbering-machine (cylinder with five number-heads for consecutively numbering street-car transfer tickets).
987473 S. M. Lummus; Linotype machine.
987489 J. G. Ranch; Feeding attachment or slug or typecasting machines (feeding ingots in the metal-pot).
987897 J. Mayer; Distributing-mechanism for typographical composing-machines.
988274 A. A. Low and L. K. Johnson; Holder for type-containing channels.
988583 M. A. McKee; Treatment of printing-plates (electrotyped plates).
988984 H. Drewell; Typesetting-apparatus (cancelling errors in bands).
989129 H. Degener; Linotype-machine matrix.
989512 G. H. Riebl and W. Honegger; Typographical gauge.

1911 (*continued*).

No.

989553 J. S. Bancroft and M. C. Indahl; Low-quad mould-control (Monotype).
989554 J. S. Bancroft and M. C. Indahl; Matrix-holder for typecasting machines (Monotype).
989555 J. S. Bancroft and M. C. Indahl; Web-guiding attachment for perforating machine (Monotype).
989556 J. S. Bancroft and M. C. Indahl; Centring-pin adjustment for typecasting machines (Monotype).
989557 J. S. Bancroft and M. C. Indahl; Multiplex composing-machine (Monotype).
989575 H. Degener; Matrix-setting and line-casting machine (Linotype).
989589 R. C. Elliott; Pattern, or record-strip, composing-machine.
989637 F. H. Pierpont; Typecasting machine mould and mould-adjusting mechanism (low-quad; Monotype).
989815 W. Scott; Stereotype-casting mould.
989860 F. and C. A. Meisel; Numbering-head (controlling carrying, avoiding errors in large-numbers).
989908 D. S. Kennedy; Line-casting machine (Linotype).
989943 R. M. Bedell; Line-casting machine (Linotype).
989997 R. Paton; Typecasting machine.
990289 H. Pearce and J. E. Billington; Quadding apparatus of typographical composing-machines.
990584 H. C. Osborn; Type-assembling and distributing.
990970 W. Flett; Stub-numberer (plurality of cylinder-borne number-heads circumferentially-adjustable).
991937 W. E. Bertram; Fount-selecting mechanism for Monoline composing-machines.
991938 W. E. Bertram; Matrix-selecting and delivering mechanism for composing-machines.
991955 A. B. Chilton; Typesetting machine slug-indicator (for various widths of columns).
992030 C. Muehleisen; Composing and assembling mechanism of line-casting machines (Linotype).
992031 C. Muehleisen; Line-casting machine (Linotype).
992032 C. Muehleisen; Distributing-mechanism of line-casting machines (Linotype).
992033 C. Muehleisen; Clutch-mechanism for linotype machine (Linotype).
992121 E. Flower; Preparing printing-plates for bending.
992385 R. W. Pittman; Linotype-machine attachment.
992900 H. Petersen; Linotype machine.
993328 A. G. Stevenson; Printing-rule and system of applying the same to printing-formes (type with second shoulder to carry rule of less height).
993970 M. A. Droitcour; Printing-plate-making apparatus (making plates of celluloid).
995655 H. F. Bechman; Stereotype-plate casting-apparatus.
996300 W. S. Timmis; Machine for producing justified lines (perforated-strip control).
996568 H. Degener; Line-setting and casting machine (Linotype).
996828 R. M. Bedell; Line-casting machine (Linotype).
997130 J. J. Hummel; Magazine for typesetting machine (loose-type setter).
997131 J. J. Hummel; Typesetting-machine operating-keyboard (latch for engaging type-carriers).
997390 D. C. Hughes; Type (for addressing-machines).
997437 E. G. Burkham and R. W. E. Yardley; Machine for cooling stereotype-plates.
997735 }
997736 } W. E. Bertram; Monoline composing-machine.
997811 E. J. Hearst; Matrix-straightening device (for bent Linotype-matrices).
997966 E. W. Cooper; Stereotype-plate clamp.
998081 A. Egli; Machinery for manufacturing curved printing-plates.
998447 G. C. Andrews; Means for bolding and adjusting printing-plates on a base-plate.

No.

998802 J. R. Rogers; Line-casting machine (Linotype).
999513 A. E. Miller; Typecasting machine (spring-operated pump).
1000157 J. Dorneth; Matrix-setting and line-casting machine.
1000445 H. Degener; Typographical line-casting machine (Linotype).
1000635 J. Steel; Type-disk supporting device.
1000789 F. L. Elliott and G. E. Eckerstrom; Printers' lead- and rule-cutter (preventing curling).
1001825 H. Drewell; Machine for perforating operating-bands of typesetting machines.
1002212 E. B. Barber; Machine for casting and composing type-bodies; (see 896908).
1002220 B. Cade; Line-casting and type-composing machine.
1002281 D. S. Kennedy; Line-casting machine (Linotype).
1002320 J. R. Rogers; Line-casting machine (Linotype).
1002325 O. V. Sigurdsson; Typecasting machine (mould and pump).
1002959 B. F. Bellows; Type-mould (body-slide mould; Electric Compositor).
1003187 A. Leuchter; Electrolytic production of printing-plates and the like (deposits iron or nickel and thickens with copper).
1003482 W. J. F. Maidhof; Printing-forme; providing means for supporting the bases of type-blocks, and adjusting the type-blocks in the printing-frame or chase.
1004386 H. Degener; Typographic machine (Linotype).
1004601 J. Steel; Type-assembling device (rotary receiving-table and scale).
1005324 }
1005325 } W. H. Scharf; Linotype machine.
1005438 A. W. Le Boeuf; Linotype mould.
1005463 D. Petri-Palmedo; Linotype mould (slotted; recessed in the rear face, and core having laterally entended tail-piece which fits recess; Linotype).
1005576 K. S. Reist and S. B. Batsford; Distributor and assembler for Linotype machines.
1006207 H. C. Hansen; Printers' rule-, lead- and slug-cutter.
1006444 H. Degener; Typographical line-composing and casting machine.
1006445 H. Degener; Typographical line-casting machine; levelling multiple-strike matrices for distribution (Linotype).
1007314 C. Spielmann; Consecutive-numbering machine (hand-stamp, cheapening construction).
1008056 H. Pearce, J. E. Billington, C. Holliwell and J. R. Burgess; Typographical composing-machine.
1008132 D. Gestetner; Printing-type (hollow-type pierced with a non-circular hole for threading on manifolding machines).
1008175 J. McNamara; Machine for producing printing-slugs (for shaving more from one side than from the other).
1008186 C. Muehleisen; Matrix-setting machine.
1008302 J. S. Bancroft and M. C. Indahl; Matrix-marking machine (Monotype).
1008303 J. S. Bancroft and M. C. Indahl; Pattern or record-strip composing-machine (Monotype).
1008304 J. S. Bancroft and M. C. Indahl; Matrix-milling machine (Monotype).
1008364 F. H. Pierpont; Typecasting machine (varying the movement of the die-case; Monotype).
1008528 A. H. Cruse; Matrix-drying press.
1008556 G. E. Pancoast; Matrix-drying press.
1008705 H. Degener; Typographical composing and casting machine (Linotype).
1008936 E. A. Adcock; Machine for the automatic justification of lines of type (Pulsometer).
1008981 C. Muehleisen; Distributing-mechanism of matrix-composing and line-casting machines (Linotype).
1009206 H. A. W. Wood; Machine for making stereotype-printing-plates (Autoplate).
1009207 }
1009208 } H. A. W. Wood; Stereotype-printing plate casting machine.

No. **1911** (*continued*).

1009209 H. A. W. Wood; Stereotype-printing-plate finishing-mechanism.

1009210 } 1009211 } H. A. W. Wood; Stereotype-printing-plate casting-apparatus.

1009271 H. A. W. Wood; Stereotype-printing-plate finishing-mechanism (Autoplate).

1009272 } 1009367 } H. A. W. Wood; Stereotype-printing-plate casting apparatus (Autoplate).

1009622 C. A. Albrecht; Means for levelling multiple-face matrices in composing-machines (Linotype).

1009718 R. J. Blumenberg; Underscore-type.

1009738 S. G. Goss; Automatic stereotype-plate finishing machine.

1009851 C. Muehleisen; Typographical line-casting machine.

1010401 H. Degener; Typesetting and line-casting machine (linotype pump and metal-pot).

1010435 D. S. Kennedy; Escapement-operating mechanism for linotype machines (Linotype).

1011442 D. S. Kennedy; Line-casting machine (Linotype).

1011558 E. B. Barber; Typecasting machine (revolving foot plate for trimming).

1011581 G. F. Coates; Device to be used in Monotype machines.

1011590 H. Degener; Matrix-setting and type-line-casting machine (Linotype).

R13212 W. H. Smith; Orig. No. 965044; Numbering-machine.

R13331 H. C. Hansen; Orig. No. 1006207; Printers' rule-, lead- and slug-cutter.

1912.

1013621 K. M. Schlueter and F. Schlueter, junr.; Gauge for alining printing-plates.

1013624 J. Steel; Typesetting machine for L-shaped embossed sheet-metal individual type (see 870699 and 880341).

1014017 A. Melchert; Clock-controlled mechanism for setting typewheels of time, etc., printing-devices for automatic insurance-policy vending.

1014110 H. Wollheim; Printing-roll of plurality of movable printing-disks for multiple strip-ticket printing.

1014260 E. H. Sanborn; Dating-stamp with adjustable date-ring concentric with name-part and indicating disk (see 975463).

1014725 J. R. Rogers; Line-casting machine; preventing the casting of slugs with errors due to reversal of matrices (Linotype).

1014740 H. Strecker-Aufermann; Process for preparing printing-plates in a grained manner.

1014954 M. L. Dodge; Bank-cheque printing-machine; segmental gears for setting the type- and indicating-wheels.

1014986 A. J. Ware; Printing-machine for bank-cheques; automatically rotating and locking type.

1015020 J. E. Hanrahan; Type-mould, three sides as well as strike formed in the matrix which slides on the nick-bearing front.

1015479 J. Dorneth; Matrix-setting and line-casting machine; italic matrices on separate guide-wires (Typograph).

1015757 J. S. Duncan; Protecting typographic plates used in conjunction with card-index system (Addressograph).

1015758 J. S. Duncan; Typographic plates with index-cards. Printing-device of sheet-metal constructed to hold a reference-card for use in card-index system; (Addressograph; see 1015757).

1015760 H. C. Gammeter; Rotatable type-holding mechanism for short-type transferred to bulb-headed carrying-bars (Multigraph).

1015900 G. H. Lund; Method of preparing plates for printing; make-ready by distorting the plate.

1015953 W. S. Hadaway, junr.; Matrix-drying press; electrically heated (see 890858; an electric heater).

1016201 M. E. Blume; Apparatus for producing typographic perforated-record sheets; pneumatically actuated punches controlled from a typewriter; facilitating corrections.

1016224 W. M. Kelly; Printers' type; different bodies grooved to same distance from back to permit of use in the same ribbed composing-machine channels.

1016347 F. J. Matych; Stereotype-plate cutter for cutting between the lines.

1016433 P. G. Nuernberger and G. Rettig; Matrix-holder.

1016605 H. F. Bechman; Chase, for holding composed formes of type, with very narrow side-members and grub-screws.

1016682 B. O. Fanslow; Rotary printing-machine for circulars; notched short-type and holder for drum receiving multiple lines.

1017046 H. Friedlein; Transportable ticket-printing and fare-recording apparatus with part fixed and part adjustable types.

1017387 H. Degener; Linotype machine, levelling multiple-face matrices for second elevator (Linotype).

1017444 C. Muehleisen and C. A. Albrecht; Means for levelling multiple-face matrices in line-casting machines; preparatory to entering second elevator (Linotype).

1017520 B. O. Fanslow; Type-case with covers and hinges for transportation.

1017771 E. Lawrenz; Typographic machine for producing lines of line-justified logotypes each bearing its succeeding space (148 figs.; 44 claims; Linotype).

1017772 E. Lawrenz; Typographic machine for producing lines of line-justified logo types (177 figs., 131 claims; see 794628; Linotype).

1017776 H. S. Levy; Method of producing electrotypes; depositing graphite on wax-moulds.

1017929 E. Uhthoff; Typograph composing-machine; ready removal of matrices (Typograph).

1017979 G. H. Lang; Printing-machine for marks on shoe-boxes; plurality of logotype-wheels and number-wheels.

1018233 M. E. Blume; Typographic stamping-apparatus for producing impressions in metal-sheets.

1018519 L. M. Potts; Perforating machine for strip for controlling telegraph-transmitters or linotypes and like machines.

1020023 P. Bunau-Varilla; Machine for moulding curved printing-blocks; accelerating cooling (see 912228).

1020527 D. E. Walshe; Rotary hand-stamp; for rolling impression; dating and cancelling.

1021827 J. Dorneth; Matrix-setting and line-casting machine (space-setting and -distributing device; Typograph).

1021828 J. Dorneth; Typograph machine (cut-out for preventing distribution after splashing; Typograph).

1022067 J. M. Dow; Method and apparatus for making stereotype-plates (preventing formation of blow-holes).

1022323 P. Martin; Holder for printing-surfaces; clip for cylindrical plates.

1022418 W. T. Hoofnagle; Machine for line-justifying lines of type (type are received in word-holders to which the line-justifying spaces, subsequently cast, are transferred; see 912961).

1023958 F. J. Perrin; Composing-stick (easily adjusted knee).

1024296 R. Thomas; Matrix-setting device (for matrix-bars arranged in a plurality of groups; Typograph).

1024491 J. S. Bancroft and M. C. Indahl; Stop-bars and racks for centring-mechanisms (reducing impact; Monotype).

1024492 J. S. Bancroft and M. C. Indahl; Type-casting and composing machine (preventing rotation and falling of type in transit from carrier to line-support; Monotype).

1024503 R. C. Elliott; Line-measuring and automatic line-justifying mechanism for composing-machines (Monotype).

No. **1912** (*continued*).

1024512 A. L. Knight and W. N. Clements; Type-mould (for casting short-body type with carrying-grooves and delivering in line; Monotype).

1024514 B. Leffingwell; Typecasting machine (record-strip controlled cut-out for casting-mechanism; omission of defective matter; Monotype).

1024524 F. H. Pierpont; Typecasting machine (increasing capacity of selective control-mechanism for same number of elements; selective transfer for shifting positioning-control from one group to another; Monotype).

1024606 S. Stephens; Printers' furniture (for each body the use of spaces of 1, 2, . . . 6 points and quads of 12, 18, . . . 42 points).

1025317 M. Sensenschmidt and E. Kaiser; Control-device for ticket-stamping machines (prevents operation without insertion of the correct control-type).

1025495 A. O. Watkins; Printing; takes a shallow impression from reversed non-bevelled type, levels surface (prints from relief, giving white letters on black ground).

1025779 R. H. Bremer; Hand printing-roll stamp; type-carrier and roll-carrier.

1025993 H. Petersen; Ejector-blade for linotype machines (Linograph).

1026185 J. S. Thompson; Typecasting machine (horizontal body-slide and vertical elevating-slide).

1026243 H. Drewell; Typesetting device; correcting during composition (cancelling-symbol introduced on perforated-strip for cancelling letters, words, or lines incorrectly set).

1026244 J. S. Duncan; Typographic plates with index-cards (elevating surface of type above frame; Addressograph).

1026245 J. S. Duncan; Typographic plate with index-card (frame; Addressograph).

1026246 J. S. Duncan; Typographic plate with index-card (combined plate and frame; Addressograph).

1026247 J. S. Duncan; Typographic plate for use with index-card system (plate used as card; Addressograph).

1026248 J. S. Duncan; Typographic plate with index-card system (changing name part of plate only for change of addressee; Addressograph).

1026249 J. S. Duncan; Typographic plate with index-card (visible back to card; Addressograph).

1026250 J. S. Duncan; Typographic plate with index-card (changing name part of plate only for change of addressee; Addressograph; see 1026248).

1026251, 1026252 J. S. Duncan; Typographic plate with index-card (sectional printing-plate for facilitating changes; Addressograph).

1026253 J. S. Duncan; Typographic plate with index-card (detachable tabs for facilitating classification; Addressograph).

1026254 J. S. Duncan; Typographic plate with index-card (detachable section; Addressograph).

1026255 J. S. Duncan; Typographic plate with index-card system (display-ledge for facilitating reference; Addressograph).

1026739 A. Egli; Matrix for stereotype-plate moulds; (providing for protrusions to carry feeder-metal and prevent formation of depressions).

1026767 J. P. Quiggan; Clamps for printing-plates.

1027142 F. D. Montgomery; Method of producing enlarged colour-type engravings by photographic enlargement of small relief plate filled with white.

1027551 A. W. Le Boeuf; Linotype mould (means for holding the slug during the trimming-operation; Electric Compositor).

1027566 W. M. Rapp; Linotype machine (space-band supporting-bar).

1027826 H. Drewell; Line-casting machine (hand lever operated gear for effecting automatic change of mould).

No.

1027833 J. F. Frey; Semicylindrical stereotype-plate trimmer (clamping and machining before the plate has cooled).

1028137 J. R. Rogers; Line-casting machine (mechanism for permitting use of new pattern matrices of different bodies with common alinement at foot or of old pattern with common alinement at top; Linotype).

1028299 M. Stamm; Process for making steel punches (duplicating shallow steel punches).

1028330 E. W. Cooper; Method of casting curved printing-plates and backing curved electrotypes (centrifugal action of rapidly rotating mould).

1028660 E. B. Barber; Typecasting and composing machine using matrix-plate (wedge-adjusting plate; casting different body-sizes; see 1002212 and 896908).

1028694 A. Egli; Machine for casting and finishing cylindrical stereotype-plates; uses three core-cylinders rotated 120° for trimming, shaving, and casting.

1028821 M. Hoge and P. C. Riebe; Base for printing plates of wood-blocks with grain vertical united by septa of longitudinally tenacious material.

1028955 H. Petersen; Matrix for linotype machines (bevelled edges to allow for escape of air from mould; provision of two sets of unsymmetrical distributing-teeth; Linograph).

1029243 J. S. Thompson; Metal-pot for type-casting machines and the like (tubular jobber closing the pump-pot and opening the nipple simultaneously).

1029317 C. G. Pritchard; Composing-machine; casts a slug from assembled matrix-bars.

1029568 H. S. Folger; Hand-stamp (maintaining alinement of type-bands).

1029647 A. Waldt; Stereotyper's steam table (or drying-press).

1029714 W. M. Rapp; Linotype-machine assembler-slide brake.

1030399 J. C. Grant and L. A. Legros; Machine for cutting punches and like master metal-surfaces.

1030678 H. Petersen; Linotype mould (for permitting length and thickness of slug to be varied; Linograph).

1030864 H. Berold; Printer's register-hook (for clamping printing-plates).

1030878 J. Dorneth; Typograph matrix-setting and line-casting machine (matrix adjusting and aliming gear; Typograph).

1030889 E. D. Huxford; Cheque-printing machine (with word and number segments; prints eleven to twenty in words as well as composite numbers and figures).

1031267 M. Hoge and P. C. Riebe; Base for printing-plates (of end-grain wood of truncated triangular section with metal binding for locking with sidesticks at one side only).

1031326 A. B. Dick; Typesetting machine (for filling tubes with short-types for duplicating machines; see 919408).

1031630 A. B. Dick; Type-bars for lines of short-type for multiple-copy printing apparatus.

1031661 H. C. Osborn; Retaining-device for short type or plate printing-surfaces for circulars; combined spring end-stop for grooved-type and clip for plates.

1031803 C. S. Mills; Printing-plate base with side clips and making-up plate to suit either 11-point thick stereotypes or 16-gauge electrotypes.

1031952 C. Muehleisen; Typographical composing-machine (fixed assembler-entrance and plurality of magazines; Linotype).

1032306 E. E. Spencer; Pot-charger for linotype machines (automatic from a magazine of used slugs; Linotype).

1032564 W. J. Poole; Type-composing machine; composes loose-type of equal set for poly- or multigraph; controlled from a type-writer.

No. **1912** (*continued*).

1032594 A. S. Ferguson and G. W. Robertson; Gauges for type-galleys (of L-section to give the length and breadth of the type matter).

1032769 T. R. Post; Dating-stamp (pivotal hand-operated; see 669661).

1032807 J. Bengough; Numbering-apparatus (high-speed; variable number of devices co-acting; adjusting timing).

1033024 R. H. Little; Typecasting machine (matrix formed of a plurality of character-forming units depressed by solenoids to form the whites of the type character).

1033371 H. M. Barber; Method of forming stereotype-plates (holding the matrix by suction).

1033372 H. M. Barber; Machine for casting stereotype-plates (combined vacuum-pan and casting box; see 1033371).

1034089 H. Drewell; Line-casting machine (removing burr from slug).

1034099 H. C. Gammeter; Typesetting and distributing machine (transferring and interlocking; see 722404 and R. 12622; machine for duplicating circular-letters to appear as if typewritten; Multigraph).

1034329 W. J. Yeoell; Method of producing printing-surfaces (in replica by swaging).

1034606 J. J. Franceschini; Registering-device for printing-plates and the like (upper halves for mounting-blocks with dowel holes to fit dowels on fixed lower-half).

1034637 F. Meisel; Printing and numbering machine (automatic disconnection at end of series repeating last number indefinitely; hand-operated disconnection coupled to automatic).

1034839 L. Saltzmann; Method of printing and composition-unit (making ready by supporting type from a machined nick instead of from the foot).

1035084 R. B. Craig and A. Coffman; Printing-mechanism for indicating time in vending-machines (preventing blurring).

1035343 J. C. Grant; Matrices for typecasting and composing machines (Grantype).

1035416 B. Cade and A. Heidrich; Line-composing and typecasting machine (keyboard-operated selectors for matrices pierced to slide on alining-bar; composition of a second line can proceed while slug of first is being cast).

1036678 L. Mohr; Attachment for linotype machines (cutting off or trimming one end of linotype-slugs).

1036751 W. A. Twining; Typesetting and distributing machine (for short-type in flat formes for duplicator).

1037169 M. Pfau; Type-forming machine for forming characters on type for typewriters, etc.

1038018 A. H. Stockall; Printers' galley for use with Monotype or other typecasting machines.

1038219 A. P. Smith; Hand-stamp (legend-plate on back).

1038234 J. S. Thompson; Typesetting and line-justifying machine (for individual type, using temporary line-justifying spacers for which spaces are cast to line-justify).

1038445 F. Schimmel; Machine for setting and casting lines of type-matrices (uses carrying arms for the composing-frames. See 953237; Rototype).

1038991 B. F. Upham; Method of bending printing-surfaces (in duplicate and registering accurately; see 903342, 906586, and 909832).

1039130 H. Hopkins; Adding and writing machine (adding machine type-carriers in conjunction with typewriter-mechanism; Addograph).

1039131 J. J. Howard; Changeable type-blocks (of rubber with grooves adjacent to flanges).

1040861 J. P. Bland; Apparatus for preparing stereotype-matrices (sand- or glass-papering machine for levelling matrix-backs).

No.

1041647 J. H. Matthews; Holder for changeable type-blocks (type-plate for hard-rubber blocks to interlock with main holder).

1041674 J. C. Robertson; Attachment for numbering-devices (carrying printing-surfaces intermediate to successive rotary numbering-heads).

1041676 W. Rödiger and C. Muehleisen; Typographical composing-machine (releasing matrices alternately from two different magazine-channels by successive operations of same key; Linotype).

1041934 H. A. W. Wood; Intaglio and relief printing-device (the intaglio raised above type-height for operating at one handling).

1042208 A. Egli; Device for finishing stereotype printing-plates (milling to length and separating).

1042285 F. Schimmel; Machine for casting and composing type (matrices arranged on periphery of a prismatic block; Rototype).

1042292 J. S. Thompson; Printers' tie-up (of parallel bars with pin-joints for locking up in the forme).

1042368 M. R. Parks; Typesetting-device (selecting type).

1042382 J. S. Bancroft and M. C. Indahl; Control-mechanism for typecasting and composing machines (suppression of cancelled matter; Monotype).

1042475 F. H. Pierpont; Matrix-stamping or punching machine (automatically supplying, supporting, and stamping blanks and delivering matrices; see 687779; Monotype).

1042476 F. H. Pierpont; Spacing-mechanism for typecasting and composing machines (spacing out the individual type by uniform increment of body-widths; Monotype).

1043261 O. V. Sigurdsson; Typecasting and composing machine (for individual type; alining, see 942846; Oddur).

1043334 M. A. McKee; Hot-bending machine for the treatment of curved printing-plates (producing accuracy of curvature).

1043910 E. Duscher; Type-setter (for shouldered-type in line-unit cases).

1045065 H. Neumann and A. Dorner; Hand-stamp for hams and meats.

1045162 J. McNamara; Slug for line-casting machines (with raised ribs on sides and ends for unequal trimming to produce variation in the position of the line).

1045202 O. V. Sigurdsson; Typecasting machine; substitution of matrix-disks (Oddur).

1045360 A. G. Baker; Typesetting machine; distributor; (simultaneous hand-operated distribution and setting-up).

1046155 W. C. Downing; Numbering-machine; (means for dropping-cipher and automatically moving wheels to the printing-position; see 829260).

1046351 W. B. Wait; Embossing-device; (hinged sections carrying embossing plates for simultaneously embossing both sides of pages with raised characters for the blind).

1046649 J. R. Rogers; Mould for linotype machines; (self-contained mould variable in length without adding or removing parts; automatic opening and closing and movement for trimming and ejection; Linotype).

1047289 W. M. Rapp; Linotype machine; improved gauge for recording the length of assembled line of matrices (see 932577).

1047412 E. L. Holmes; Linotype movable jaw-adjusting device; (facilitating setting for length of line of matrices).

1047533 R. T. Johnston; Matrix-making press for stereotype-matrices; (Autoplate).

1047995 E. G. Schwuchow and G. F. Johnston; Etching metallic printing-plates by electricity (to leave relief printing-surface).

1048241 A. H. Wadewitz; Printing-chase; (arrangement of false chase dispensing with quoins).

1048281 W. S. Bing; Hand-stamp (with elastic diaphragm for use on both flat and convex surfaces).

No. **1912** (*continued*).

1048459 J. S. Duncan; Printing-device of sheet-metal and method of making; characters closely-located.

1048460 / 1048461 J. S. Duncan; Die for closely-located characters of sheet-metal printing-plates; (see 1048459).

1048560 T. A. McCall; Perforating machine for guide-perforations of controlling-strip.

1048667 A. Egli; Mould for casting and finishing rotary printing-plates; (holding plate to core and releasing it by slides).

1049074 H. C. Gammeter; Composing-stick for multigraph type; (split tubular-body with fork-end; Multigraph).

1049165 A. G. Stevenson; Printing-rule (of triangular section for securing linotype-slugs having raised projections; Linotabler).

R. 13489 J. R. Rogers; Orig. No. 615909; Linotype machine; (two-letter matrices as in Patent 547633 assembling and alining, also levelling for distributor elevator).

1913.

1049477 J. S. Healy; Cooling-device for curved-stereotype printing-plate casting-apparatus; (Autoplate).

1049518 S. C. Nielsen; Line-casting machine (matrix-escapement; Linotype).

1049787 W. H. Welsh; Process of preparing matrices for electrotyping (in cooling chamber).

1049965 J. J. Zeitz; Type-transfer device (connecting member for tubes and drums; Multigraph).

1050015 J. E. Gartside; Printing-roll (with longitudinal key and internally notched typographic pattern-printing rings).

1050495 A. Smith; Typesetting and distributing machine (sets record-elements in a sector for each line to be composed; type handled by pneumatic suction).

1050496 A. Smith; Record-making machine; record-element adapted to control the operation of typesetting and distributing machines).

1051203 M. A. Droitcour; Process of making toned printing-plates (made-ready).

1051239 U. G. Lee; Typograph (for embossing metal address-printing plates; hand-set and power-pressed).

1051240 U. G. Lee; Typograph (provision for taking thrust and keeping machine-frame in compression).

1051241 U. G. Lee; Typograph (keyboard-operated; preventing embossing from accidental blows to keys).

1051243 C. T. Libby; Printing-types (of different gauges on same body on standard line; caps of same or larger gauge than ascenders).

1051385 W. E. Brand; Type-line quadder (for inserting loose-quads from a magazine automatically. See 862800; Vite-a-type).

1051605 W. Mann; Type-distributing device (for assisting hand; grooved short-type; Multigraph).

1051725 H. C. Gammeter; Type-distributing implement (for assisting hand; grooved short-type; Multigraph).

1052143 E. L. Hamilton; Rubber-stamp (plurality of sets of type-bands for cost, selling price and division-bar).

1052236 H. C. Gammeter; Type-holder (of slotted tube with enlargement for correcting; see 836026; Multigraph).

1052333 H. C. Gammeter; Type-case (for loose grooved short-type permitting extraction one at a time; Multigraph).

1052641 P. Andres; Ticket-printing and recording machine for booking-offices (uses movable type-bars and stationary type).

1052678 W. Loveland and H. E. Sloan; Type-turtle or fudge-bed for rotary printing-presses (facilitating fitting of notched or un-notched type-slugs).

1052742 W. Mock; Typesetting machine (for grooved short-type, key-operated for setting into and distributing from duplicator-drums).

No.

1053167 E. Fjellander; Matrix-changing device for Mergenthaler Linotype machines (tube-receptacles for storing matrices and discharging to the notched-bar).

1053364 A. B. Dick; Type-holder (for grooved short-type to bring to type-high; spring-tube).

1053365 A. B. Dick; Typesetting and distributing apparatus (type-holders for grooved short-type used in composing and distributing machines).

1053440 J. R. Rogers; Typographical machine (obtaining more rapid action of pump; Linotype).

1053518 W. J. F. Maidhof; Printing-forme (with support for die-bases).

1053803 H. S. Folger and A. M. Comstock; Hand-stamp (wheels for carrying date-line bands).

1054130 M. A. McKee; Printing plate shaving machine (for shaving more metal off unsupported portions; avoiding make-ready; see 857531).

1054284 J. S. Duncan; Sectional printing-forme (for embossed-metal sections for duplicating; Addressograph).

1054285 J. S. Duncan; Printing-forme section (of sheet-metal with embossed type-writer characters for duplicating; Addressograph).

1054384 E. B. Barber; Typographic machine (type with dovetail grooves; justification by spreading with temporary spacers; introduces locking-strip; see 1002212).

1054489 E. B. Barber; Typographic machine (complete with swaging-device for locking-strip; 189 claims; see 1054384).

1054582 E. M. von Marchthal; Machine for producing printed matter (printing-telegraph control with minimum of perforations in record-strip).

1054790 W. J. Wilkinson; Process for producing half-tone relief printing-plates (photographic control of differential etching).

1054838 J. C. Grant; Typecasting and composing machine (producing a line of individual type from previously assembled and line-justified matrices at a single operation of casting; Grantype).

1055089 F. Schimmel; Machine for composing and casting lines of type (supplementary polyhedral multiple-strike matrices positioned from keyboard; Rototype).

1055176 C. E. Hopkins; Cooling-apparatus for curved stereotype-plates (Autoplate).

1055300 H. Degener; Typesetting and line-casting machine (trimming-device; Linotype).

1055301 H. Degener; Linotype machine (bringing multiple-strike, mixed-matter matrices to level for distributing. Linotype).

1055302 H. Degener; Trimming-apparatus of type-line-casting machines (Linotype).

1055388 P. T. Dodge; Typecasting machine (for casting type or logotypes singly from strikes in a wheel or plate presented successively to a mould; Linotype).

1055649 J. R. Nolan; Numbering-machine (wheels of numbering-head recessed into each other).

1055770 W. J. F. Maidhof; Printing-forme (supporting bases of type-blocks).

1056024 C. H. Heider; Printing-attachment for lumber planing machines (automatically stamps or prints from die-plates name, address and grade).

1056042 J. D. Morgan; Typograph machine (sets line of type line-justified, inked and impressed for further use planographically).

1056267 P. T. Dodge; Typographical machine (preventing transposition of spacers and character-matrices in rapid working; arrests a spacer in reserve near matrix-line; Linotype).

1056314 H. A. Armstrong; Line-casting machine (preventing transposition of spacers and character-matrices in rapid working; holds a spacer in reserve near matrix-line; see 1056267; Linotype).

No. **1913** (*continued*).

1056355 C. Muehleisen; Matrix-escapement mechanism of typographical composing-machines (Linotype).

1056702 C. W. Ludtke; Type-case attachment (to ordinary case for spaces and quads).

1056765 J. F. Ohmer; Printing-mechanism for ticket issuing and auditing machines (typewheels for month, date and class).

1056839 A. L. Saltzman and J. D. Morgan; Chases for positioning typographic surfaces (for impressions to be used subsequently as relief or planographic surfaces).

1057125 A B. Dick; Printing-apparatus (for duplicating; see 1053364).

1057157 G. E. Lee; Matrix-suspending bar for linotype machines (short removable grooved nose for elevator and distributor bars; Linotype).

1057380 H. S. Folger, and A. M. Comstock; Hand-stamp (spring support to type-holding frame).

1057445 C. Muehleisen; Matrix or type-die for use in typographical composing-machines (facilitating correction with multiple-strike matrices; Linotype).

1057455 J. R. Rogers; Typographical machine (feeding thin matrices to each thread and thick matrices to alternate threads of distributor screws, preventing over-taking at release; see 942845; Linotype).

1057803 L. M. Chapman; Line-casting machine (setting tabular matter; assembler-bar clutch; displacing star-wheel; Linotype).

1058008 M. G. Standley; Registering-stamp (records on a roll contained in the stamp).

1058184 D. S. Kramer; Electric type-metal heater for linotype machines (alternating current).

1058321 C. Muehleisen; Typographical line-casting machine (adjusting trimming-knives for different bodies; see 941384; Linotype).

1058735 J. Dorneth; Typesetting and casting machine (swinging removable buffer to prevent damage to matrices in distribution; Typograph).

1058877 E. M. Low; Typographic composing-machine (plurality of magazines and matrix-distributing mechanisms).

1059718 J. Dorneth; Matrix-setting and line-casting machine (matrix carrying frame with plurality of adjacent rows of matrices).

1059755 G. E. Perry; Hand time-stamp (with indicating means in the handle).

1059805 H. Winter; Machine for trimming the edges of curved electrotype- and stereotype-plates.

1060033 J. W. Simmons; Die-block holder for striking matrices by a drop-hammer.

1060218 W. S. Warnock; Printers clamping-device (for plates).

1060521 W. Wells; Impression stamp (for textile material; see 552800).

1060580 B. F. Bellows; Space-selecting and releasing mechanism; (see 895231; Electric Compositor).

1060679 J. E. Hanrahan; Single-type casting attachment for linotype machines (bye-pass from pump-channel; casts a loose-type as well as a slug at each mould-wheel revolution. Linotype).

1060875 H. A. W. Wood; Combined moulding machine and steam-table (for stereotype matrices).

1060893 S. E. Dittman; Method of producing made-ready printing-surfaces.

1061040 H. C. Brown; Stamping machine for thickness of material (automatic from plurality of stamps).

1061388 A. W. Le Bœuf; Casting control-mechanism for linotype machines (cut-out; Electric Compositor).

1061508 L. M. Todd and C. G. Tiefel; Printing apparatus (for stamping limiting-amount characters on cheques, bonds, etc.).

1061558 F. H. Pierpont; Matrix-gauging and sorting-mechanism (Monotype).

1061559 F. H. Pierpont; Typecasting machine (mould-adjusting and matrix-clamping mechanism; Monotype).

No.

1061560 F. H. Pierpont; Machine for the casting and composing of single types in Semitic languages (cast in order reverse to composition from matrices turned through 180°; Monotype).

1061561 F. H. Pierpont; Record-strip composing-machine (supplemental measuring-mechanism and signal for casting spaced-out German-characters; Monotype).

1061562 F. H. Pierpont; Pump (preventing freezing).

1061564 F. H. Pierpont; Machine for severing uniform lengths from a rod or bar (in uniform motion; for matrix-blanks).

1061745 J. E. Hewett; Means for locking type-formes in a chase (internal channel and ribs on sidesticks and quoins).

1062283 F. Kohnle; Type-chase (with type-holding sockets extending through).

1062392 J. E. Gagnon and A. Kaufmann; Type-case (metal with interlocked partitions).

1062487 W. G. MacMillan; Type-guard (spring galley-stop for holding regiets, type, etc., in position).

1062616 A. G. Stevenson; Variable liner for line-casting moulds (in two parts interlocked by a cast piece).

1062770 F. C. L. d'Aix; Typograph machine (for successive types or slugs).

1063027 H. H. Hancock; Means for making up and piling pages of type (waiting for the press).

1063232 P. Weber; Numbering-machine (hand-stamp holding wheel-frame depressed for changing).

1063267 D. S. Kennedy; Line-casting machine (warning for metal low in pot; Linotype).

1063337 J. S. Duncan; Typesetting machine (for short grooved type; Addressograph).

1063348 J P. Harrison, Jr.; Adding machine (10-key system).

1063363 T. M. Lilleberg; Machine for producing characters by use of a plurality of rectangular wires (63 wires shown in figure).

1063668 A. Egli; Machine for casting and preparing curved stereotype-plates (agitating metal in pot).

1063749 A. J. Tizley; Mould for electrotyping processes (celluloid for cyanide bath).

1063979 G. Laemmer; Typographical machine (clutch-controlling mechanism operated by "foreign" matrices; Linotype).

1064052 A. L. Case; Method of producing stereotype printing-plates (obviating trimming).

1064134 M. A. Droitcour; Method of making printing-plates (celluloid, etc., pressed between rigid plates and vacuum to exhaust air between celluloid and plates).

1064247 U. Piagueri; Space-band chute (Linotype).

1064319 G. C. Glenn; Mouthpiece-wiper for Linotype machines.

1064451 E. L. de Forest; Calculating machine (multiplies by 1 to 9 by one movement of the handle).

1064455 P. T. Dodge; Printing-forme (slugs recessed at sides and top at end to receive slugs overhanging above and below; Linotype).

1064487 D. S. Kennedy; Typographical composing-machine (Linotype).

1065299 A. Dutton; Manufacture of stereotype-plates (gauge for securing accuracy in height).

1065300 A. Dutton; Matrix for the manufacture of stereotype and like blocks for printing (thin asbestos sheets).

1065301 A. Dutton; Apparatus for making stereotype and like blocks (slide-valve for pouring).

1065329 F. C. L. d'Aix; Line-casting machine (see R. 13048).

1065348 A. Eichler; Typographical composing-machine (Linotype).

1065885 F. W. Merrick; Stamping, marking, or numbering-machine (facilitating change of number-wheels).

1066032 C. Muehleisen; Typographical composing and casting machine (guides for matrices and spacers of multiple-face machines; Linotype).

No. **1913** *(continued)*.

1066086 H. Degener; Line-setting and casting machine (guides for matrices and spacers of multiple-face machines; Linotype).

1066148 F. B. Rae; Printing-telegraph system.

1066336 H. S. Steege; Type-chase (holding type at an angle to the inking-roller).

1066576 L. B. Benton; Parallel-lining-device (for engraving matrices of shaded letters).

1066625 D. S. Kennedy; Line-casting machine (trimming-knife wiper; Linotype).

1066690 C. V. Wilgus; Keyboard for calculating machines (preventing inaccurate registration; see 940708, Adder).

1066827 C. Martin; Rotary numbering-head for ticket-printing (differential peripheral spacing of plurality of heads).

1066932 W. J. F. Maidhof; Printing forme for short-type (see 1003482).

1067067 K. M. Schlueter and F. Schlueter, Jr., Mechanism for imposing and registering printing-plates.

1067120 A. B. Ilsley; Type-case of sheet-metal.

1067222 C. L. Johnston; Numbering-machine (for successive repetition; uses embossed plates with plurality of characters).

1067448 M. G. Standley; registering hand-stamp (external and duplicate internal impressions).

1067503 C. E. Burdine; Typographical machine (transferring-device receiving two or more line-sections; for double-column matter; Linotype).

1067519 J. G. Holbourns; Typographical composing-machine (escapement; detaching bank of strikers; Linotype).

1067543 H. Pearce and J. E. Billington; Typographical composing and casting machine (preventing distribution and facilitating correction of improperly line-justified line; Linotype).

1067552 J. R. Rogers; Line-casting machine (distribution for double-magazine; Linotype).

1067553 J. R. Rogers; Typographical composing-machine (escapement; initial acceleration of released matrix; Linotype).

1067590 H. Degener; Matrix-setting and type-line casting-machine (assembling of multiple-face matrices; Linotype).

1067591 H. Degener; Typesetting and line-casting machine (distribution of multiple-face matrices; Linotype).

1067592 H. Degener; Matrix-setting and line-casting machine (bringing multiple-face matrices to one level for distributing; Linotype).

1068384 L. I. Darby; adding-machine (the aggregate sum of additions is recorded and printed).

1068468 J. J. Walser; Chases (to permit close spacing of formes).

1068478 L. B. Benton; Apparatus for cutting matrices (parallel-lining-device for making formers).

1068786 H. Kuntzler; Numeral-wheel support for adding machines (enumerating and accumulating).

1068896 S. J. Harry; Ticket-dating hand-lever stamp.

1068936 F. Schimmel; Apparatus for setting and casting separate types on linotype machines (casts a line of loose-type singly from individual matrices after casting a slug; Rototype).

1068947 J. W. Terry; Ticket-stamping machine (for dates and destinations).

1069104 F. H. Bickford; Calculating machine (quick-acting; over-rotation preventers).

1069152 J. C. Lotterhand; Printing-mechanism for adding machines (type-actuators, Addometer).

1069176 W. A. Reade; Typograph (slug-casting machine with matrix-bars; see 856539; Ludlow Typograph).

1069192 L. R. Schmidt; Hand-stamp (securing type-band operating-mechanism).

1069315 M. Baumann; Apparatus for printing text on tapes (type-segment on printing-roller).

No.

1069356 M. Tilden; Hand-stamp (for printing on eggs).

1069468 E. M. Rathburn; Hand-stamp (with handle flexibly connected to head).

1069868 C. S. Ellis; Hand printing-stamp (dating from type-bands).

1069927 H. Degener; Line-setting and casting-machine (locking matrix-line for casting; Linotype).

1069953 W. W. Hopkins; Calculating machine (10 number-keys also total, error and repeat keys).

1070034 W. W. Hopkins; Calculating machine (totalizer-wheels rotated different distances in registration of digits).

1070235 B. M. Des Jardins; Type line-justifying mechanism (temporary spaces or separators in intervals are replaced by line-justifying spaces; Unitype).

1070410 E. S. Church; Time-printing recorder.

1070485 D. S. Kennedy; Line-casting machine (alternate actuation of two adjacent escapements from a single finger-key; Linotype).

1070687 A. Hoyer; Typographical composing-machine (releasing matrices bearing similar characters from a plurality of magazine-channels alternately or successively; Linotype).

1070876 H. Degener; Typecasting machine (for casting sorts from Monoline, etc., matrices; Linotype).

1070947 H. Degener; Line-setting and casting machine for producing mixed copy (avoiding tilting of spacers; Linotype).

1071150 J. A. Fraser; Printers' furniture (of two stamped sheet-steel dishes united back to back).

1071311 W. S. Graffam; Adding and recording machine (rotating numeral-wheels backwards for subtracting).

1071340 A. Pollák; Apparatus for perforating paper-strips (for automatic telegraphs; [see 675495; writing-telegraph]).

1071349 C. F. Rockstroh, Jr.; Printing-plate holder, and registering-clamp (or register-book).

1071527 W. J. Pannier, Jr.; Stamp (roller pattern with textile band carrying raised-rubber characters).

1071582 J. R. Rogers; Typographical composing-machine (levelling of multiple-face matrices between first and second elevator; Linotype).

1071626 W. J. Pannier, Jr.; Hand-stamp (see 1071527).

1071981 R. F. Barnes; Typographical composing-machine (distributing-mechanism for plurality of magazines; Linotype).

1072037 J. R. Rogers; Line-casting machine (sorting and distributing matrices to plurality of magazines; Linotype).

1072137 A. E. Markwell; Matrix-moulding device (for casting rule-retaining dovetails on type-slugs in the Linotype machine).

1072653 J. R. Rogers; Typographical composing-machine (second elevator receives and sustains matrices at different levels; level changed between second elevator and distributor; Linotype).

1072737 D. S. Kennedy; Typographical machine (escapement-mechanism for plurality of magazines; Linotype).

1072763 L. E. Morrison; Typographical machine (distribution of matrices; delivery to distributor at different levels; Linotype).

1072765 F. W. Neumayer; Line-casting machine (operating multiple-level assembling slides from the keyboard; Linotype).

1072902 G. H. Benedict; Electrotype- or stereotype-plate cleaner.

1072917 C. Crisp; Type-slug casting and similar machine.

1072927 J. Dorneth; Typograph composing-machine (setting matrices first horizontally and then vertically for slug-casting; Typograph).

1073105 G. E. Dunton; Method of backing up electrotype-shells in the manufacture of electrotype-plates.

No. **1913** (*continued*).

1073170 J. R. Rogers; Typographical machine (distribution of matrices; font-determining notch additional to magazine-combination; Linotype).

1073221 T. Dempster, Jr.; Clamp for printers' formes (securing centre to prevent sagging).

1073234 G. S. Hice and J. Barnes; Settable-type device (combination of typewheels and slugs in fudge-box).

1073340 C. G. Furman; Stamping-mechanism (for impressing records of signal-indicating marks).

1073378 F. W. Weston; Printers' plate-holding device (hook or clip for facilitating registering of multicolour-plates).

1073705 D. Petri-Palmedo; Squirt-preventer mechanism for linotype machines (cut-out for pump; Linotype).

1073791 A. P. Brooks; Printers' type and furniture (with interlocking ribs and grooves).

1073838 J. T. Barton; Printer's quoin (ribs and grooves to prevent movement relative to reglet).

1074105 P. T. Dodge; Line-casting machine (means for controlling, from the keyboard, metal supply to melting-pot; Linotype).

1074108 E. M. Erb; Printing-plate holder and registering-clamp.

1074254 T. S. Fox; Four-colour printing-process (with black key and screens at angles of 15°, 45°, 75°, and 105° respectively).

1074546 H. J. S. Gilbert-Stringer and P. W. Druitt; Apparatus for composing and casting type (assembly-box; line-justifying vice; reassembly-box; Stringertype).

1074721 J. P. Hunter and H. Kuntzler; Keyboard-locking mechanism for adding machines (of the "Wales" class).

1074843 H. Degener; Matrix-setting and type-line casting-machine (preventing oblique movement of matrices; Linotype).

1074848 P. T. Dodge; Typographical machine (interconnected mould-end and matrix vice-jaw for casting varying lengths of line; Linotype).

1074933 P. T. Dodge; Typographical composing-machine (movable throat for distribution to multiple magazines; Linotype).

1074945 R. M. Grove; Matrix-distributing mechanism (cut-out operated when a matrix fouls the distributor-screws; Linotype).

1074956 D. S. Kennedy; Typographical machine (plural magazine matrix-escapement gear; locking for inoperative magazine; Linotype).

1074980 J. R. Rogers; Typographical composing-machine (cut-out operated when a matrix fouls the distributor-screws; Linotype).

1075003 M. Barr and E. R. Clarke; Calculating machine (multiplying and recording money values for non-decimal systems and at fractional rates; Autokal).

1075024 H. Degener; Line-setting and casting machine (water-cooling for mould-wheel; Linotype).

1075029 H. C. Gammeter; Machine for feeding type (removes jet and distributes into two channels; Multigraph).

1075137 R. O. Boardman; Typographical composing-machine (vertically sliding throat for plurality of magazines; Linotype).

1075138 R. O. Boardman; Typographical machine (transfer-mechanism for delivering matrices after leaving the distributor-bar in multiple-magazine machines; Linotype).

1075141 H. Degener; Mould-carrier of machines for casting type-slugs (ensuring contact over matrix-surface; Linotype).

1075180 H. A. W. Wood; Slug-delivery for slug-casting machines (mould producing plurality of slugs).

1075724 W. J. Poole; Distributing machine (for individual type).

1075822 E. E. Gregory; Dating-stamp for bills (with advancing gear for 30, 60, 90 days, etc.).

No.

1075965 / 1075966 S. C. Cox; Printing- or addressing-machine (selecting single or plural line-slugs and distributing to magazine or store).

1076029 B. O. Fanslow; Machine for setting and distributing printing-type (for short-type; Polygraph).

1076046 C. M. Letz; Reinforcement for printing-plates (preventing crushing).

1076064 J. R. Rogers; Typographical composing-machines (assembling multiple-strike matrices; see 547633; Linotype).

1076140 J. McNamara; Typographical machine (assembling matrices and spacers; Linotype).

1076184 R. M. Bedell; Typographical machine (interchangeable magazines; Linotype).

1076187 R. O. Boardman; Typographical machine (distributing-mechanism and presentation of matrices thereto; Linotype).

1076258 J. Alsenz; Hand-stamp for printing time.

1076343 A. A. Ball, Jr.; Typographical casting-machine (safety-liner for mould).

1076408 H. Degener; Matrix-setting and line-casting machine (changing magazines).

1076409 P. T. Dodge; Typographical machine (interchangeable multiple-magazines; Linotype).

1076433 G. P. Kingsbury; Line-casting machine (uses space-key to effect change of channel for duplicated channels for e, i, etc.; Linotype).

1076478 R. O. Boardman; Line-casting machine (series of magazines operated by a single movable escapement; Linotype).

1076487 H. Degener; Typographical line-casting machine (limiting descent of interchangeable magazines; Linotype).

1076640 H. C. Osborn; Typesetting and distributing machine (for short grooved-type; Multigraph).

1076906 H. C. Osborn; Mechanism for storing, assembling and distributing type (Multigraph).

1077194 F. Eller; Automatic ticket-printing apparatus (selecting plates or formes from magazine).

1077220 H. R. Cowan; Calculating and printing machine (for adding and subtracting and giving totals and differences; prints on paper fed below or on a book).

1077332 H. Degener; Matrix-setting and type-slug casting machine (guide-ledges for multiple-strike matrices; Linotype).

1077362 M. W. Morehouse; Line-casting machine (bridge for altering distribution to other magazine of multiple-strike matrices; Linotype).

1077397 N. Dodge; Typographical machine (distribution to multiple magazines; Linotype).

1077483 O. Luppe; Method of producing printing-plates.

1077493 A. Smith; Typesetting and type-distributing machine (see 1050495 and 1050496).

1077512 H. Drewell; Matrix-setting and typecasting machine (assembly-block with two receiving-tracks; Linotype).

1077604 S. D. Handlin; Typographical machine (assembling multiple-strike matrices; Linotype).

1077621 M. A. McKee; Treatment of printing-plates (obtaining uniform thickness and avoiding make-ready).

1077642 J. R. Rogers; Line-casting machine (interchanging magazines; Linotype).

1077721 D. S. Kennedy; Typographical machine (restoring to place and retaining displaced matrices in multiple-magazine machines; Linotype).

1077755 R. N. Rogers; Addressing-machine (operating type-plates singly from a stack).

1077759 A. Savarese; Type-composing machine (for individual type subsequently line-justified by hand; see 920086).

1078049 T. H. Knapp; Space-band for linotype machines (with brass or copper inset on stationary wedge; Linotype).

1078358 H. Landsiedel; Adding machine (with recording-gear; see 1039130; Addograph).

No. **1913** (*continued*).

1078359 H. Landsiedel; Adding and recording machine (see 1039130; Addograph).

1078400 W. R. Allen; Type (interlocking to work together as individual type, logotypes, or slugs either on cylinder or flat; Multigraph).

1078401 W. R. Allen; Type-bar (with inclined portions removed to permit of setting on cylinder).

1078422 J. Dorneth; Line-setting and casting machine; (means for interchanging matrices; Typograph).

1078429 S. G. Goss; Matrix-forming machine (mangle-press for flong stereotype-matrices).

1078594 A. H. Wadewitz; Chase-lock (for false chases).

1078612 N. Dodge; Pie-stacking device for typographical machines (for plural magazine; separating founts; see 630112; Linotype).

1078730 J. F. Hoxsey; Adjustable liner (for moulds; see 796213; Linotype).

1078832 C. Collin; Typesetting and distributing machine.

1078854 D. J. Higginbotham; Stamping-device (multiple-surface hand-stamp).

1078930 F. H. Lynds; Linotype mould (for cored or recessed slugs; see 1005463; Linotype).

1079049 J. F. Hoxsey; Mould and liner (for adjustment from 60 to 360 points; see 1078730; Linotype).

1079061 O. M. Pannier; Hand-stamp (applied by rocking-action).

1079076 H. Tugender; Plate holding means (clamps) for printing-machines.

1079078 N. S. Van Sant; Border-rule (slug carries border and corner and is recessed to receive the similar slug at right angles to it; Linotype).

1079086 F. F. Wilson; Printing-bar or slug (with overhung rule-slip cast integral thereto. Linotype).

1079101 M. Böttger; Typographical composing-machine (permitting composition of a large number of hair-space matrices; three keys operating channels independently or controlled by a special key controlling them in sequence; Linotype).

1079321 J. S. Bancroft and M. C. Indahl; Centring or positioning mechanism for type-casting and composing machines (for normal and abnormal matrices; see 980959; Monotype).

1079326 J. B. S. Booth; Typographic composing-machine (multiple line-justification of line; Monotype).

1079361 F. H. Pierpont; Typographic composing-machine; (multiple line-justification of line; see 944405; Monotype).

1079366 F. Sally; Typecasting machine (keeping mould from contact with nozzle for one or more cycles; Monotype).

1079402 G. R. Cornwall; Types (photographic not typographic; transparent with opaque character for printing photographically).

1079478 P. T. Dodge; Typographical machine (retarding matrices in falling into magazine; Linotype).

1079486 A. W. F. Guest; Line-casting machine (retarding matrices in falling into magazines; Linotype).

1079498 D. S. Kennedy; Typographical machine (locking magazines against removal unless escapements are free; Linotype).

1079716 H. C. Osborn; Typesetting and distributing machine (for short grooved-type; Multigraph).

1080201 J. S. Duncan; Printing-device (name, address, and salutation; index-tab receiver; Addressograph).

1080275 C. E. Gilbert; Device for locking lines of type (for short grooved-type; Multigraph).

1080330 H. Degener; Matrix for typesetting and line-casting machines (multiple-strike with bottom-groove and side-grooves; see 982172; Linotype).

No.

1080348 D. S. Kennedy; Typographical composing-machine (fount-distinguisher; see 688218; Linotype).

1080349 L. L. Kennedy; Typographical machine (registering-marks for multiple-mould casting machines; see 758103; Linotype).

1080350 G. P. Kingsbury; Typographical composing-machine (alternate operation of a plurality of escapements; Linotype).

1080351 G. P. Kingsbury; Typographical machine (locking means for plurality of magazines controlled by presence of matrices in the distributor; Linotype).

1080352 D. S. Knox; Line-casting machine (retarder for spacer assembling; preventing damage; Linotype).

1080570 A. W. Le Boeuf; Slug-expeller-mechanism for line-casting machines (Electric Compositor).

1080579 D. Petri-Palmedo; Trigger-mechanism for key-operated machines (power-relay; Electric Compositor).

1080694 H. Hopkins; Calculating machine (visible printing).

1080913 B. F. Joline; Printing-mechanism (setting a relatively small number of words, letters, and figures for printing cheques, etc.).

1081025 P. T. Dodge; Typecasting and composing machine (casts individual type and line-justified spaces from the ordinary linotype matrices and space-bands by use of an automatically adjustable mould to which the matrices are successively presented after line-justification by expansion of space-bands; Linotype).

1081026 P. T. Dodge; Line-casting machine (in plural-magazine machines escapement-reeds or verge-rods moving in angular relation to the path of the magazines; Linotype).

1081047 G. P. Kingsbury; Line-casting machine (delivering matrices from two adjacent channels alternately; Linotype).

1081394 J. H. Matthews and J. Stein; Hand rocker-stamp (detachable rubber-plate carrying rubber-type).

1081753 D. S. Kennedy; Typographical composing-machine (engaging and disengaging reeds or verge-rods by movement of sash-frame; interlocking; see 930693; Linotype).

1081754 D. S. Kennedy; Typographical machine (effecting variation automatically in width of magazine entrance-channels; Linotype).

1081806 R. O. Boardman; Line-casting machine (matrices grooved longitudinally for a portion of the length to clear return of sideway-acting escapement; Linotype).

1081989 J. A. Roshon; Attachment for linotype machines (maintaining metal-level in melting-pot; feeding an old slug for each new one cast).

1082006 B. F. Bellows; Line-justifying mechanism (single or multiple line-justification applicable to matrices or individual type lines; Electric Compositor).

1082059 H. A. W. Wood; Mould for slug-casting machines (inserting dividing pieces in mould to effect casting of logotypes for tabular work with ordinary rules).

1082114 N. Dodge; Typographical machine (matrix-assembling, transferring to first elevator and lifting to distributor; Linotype).

1082197 D. G. Holt and G. R. Horton; Matrix-plate holder and spacer.

1082275 A. W. Le Boeuf; Spacer-handling mechanism for type-bar-making machines (tabular temporary-spacers; see 921063; Electric Compositor).

1082279 E. M. Low; Device for treating type-metals (shell for inserting cleaning-material into molten metal).

1082505, 1082506 J. S. Duncan; Printing-device and control-system (printing-plates with adjustable tripper-mechanism for selection according to classification; Addressograph).

1082541 F. M. Mahood; Stamping-machine (for vouchers, cheques, etc.; hand-operated).

No. **1913** (*continued*).

1082957 G. A. Julius; Apparatus for printing and issuing tickets or checks of different denominations and for registering and totalling numbers and indicating the group- and grand-totals.

1082970 H. C. Osborn; Means for selecting address-plates (variously-located tongue or shoulder; Multigraph).

1083066 G. E. Dunton; Method of treating moulds used in the art of electrotyping (placed on edge in an oven to melt off the wax).

1083195 F. C. L. d'Aix; Typographic machine (mould and ejector devices; see 1062770).

R. 13539 J. C. Lotterhand; Orig. No. 985042. Printing-mechanism for adding machines.

R. 13597 H. Abbott. Orig. No. 878447; Time of day printing-mechanism for initial and final elapsed-time records (Calculagraph).

R. 13633 H. A. W. Wood. Orig. No. 1009271; Stereotype-printing-plate finishing mechanism.

NOTES.

NOTES.

APPENDIX III.

TECHNICAL VOCABULARY.

Πολλαὶ μὲν θνητοῖς γλῶσσαι, μία δ' Ἀθανάτοισιν.
Set on the Monotype in 11-point greek No. 90.

Multæ terricolis linguæ, Cœlestibus una.
Set on the Linotype in 12-point cheltenham No. 1.

Many are the languages of the habiters of the earth, but one the language of the habiters of Heaven.—Rev. H. Carey.
Set on the Typograph in two 12-point faces.

ENGLISH.	FRENCH.	GERMAN.
Type (collectively)	caractères d'imprimerie	Schrift
A type	un caractère	eine Letter ein (Druck-) Buchstabe eine Type
The tang	le jet	der Anguss der Gusszapfen der Spritzer
The face	l'œil	das (Schrift-) Bild die (Bild-) Fläche
The counter	le contre-poinçon	der Bunzen
The neck	le contre-talus le support de talus	das Fleisch
The shoulder	le talus	die Schulter die Achsel
The stem The shank The body	le corps	der (Schrift-) Kegel
The front	le devant	die Vorderseite
The back	le dos	die Rückseite
The nick	le cran	die Signatur (-rinne)
To nick	créner	mit Signatur versehen
The cut nick The planed nick	le cran fait au coupoir	die eingehobelte Signatur
The cast nick	le cran du moule	die eingegossene Signatur
The supplementary nick	le cran supplémentaire	die Nebensignatur
The heel-nick The foot-nick The groove	la gouttière au pied	der (Fuss-) Ausstoss der (Fuss-) Ausschnitt
The depth of the groove	la profondeur de la gouttière	die (Fuss-) Ausstosstiefe
The foot The feet (of the type)	le pied les pieds (des lettres)	der Fuss die Füsse (der Lettern)
The drag The pin-mark	la marque	die (Guss-) Marke das (Guss-) Zeichen die (Anlege-) Marke das (Anlege-) Zeichen
The line	la ligne	die (Grund-) Linie
The upper serifs	les obits	die oberen Ausläufer die oberen Anstriche

English.	French.	German.
The lower serifs	les empattements	die unteren Ausläufer; die unteren Anstriche
The main-strokes	les pleins	die Grundstriche
The hair-lines	les déliés	die Haarstriche
The line-to-front	le talus en pied	der Raum unterhalb der Linie
The line-to-back	la ligne	der Raum oberhalb der Linie
The side-wall	l'approche	der (Matrizenseiten-) Abstand
The body-size	la force de corps	die Kegelstärke
The set	l'épaisseur	die Kegelweite
The depth-of-strike	la profondeur de l'œil	die Bildtiefe; die Stempeleinschlagstiefe
The height-to-paper	la hauteur-en-papier	die Schrifthöhe
Type-high	hauteur-caractère	von Typenhöhe; schrifthoch
The head	la tête	der Kopf
Kerned and bearded sorts	les (lettres) crénées	unterschnittene und überhängende Lettern
Kerns and beards	les saillies	die Überhänge
A kerned sort	un caractère créné à droite ou à gauche	eine unterschnittene Letter
A bearded sort	un caractère créné en haut ou en bas	eine überhängende Letter
To charge the body	faire plein œil	den Kegel ausfüllen
A type with a face which charges the body	un caractère plein-œil	eine Letter mit Bild auf voller Kegelgrösse
A fount (English); A font (American)	une fonte	ein ganzer Satz
A short fount	un minimum	ein Satzminimum
The bill-of-fount; The scheme	la police	der Giesszettel
The slope (of italics)	l'inclinaison; la pente (des italiques)	die Schräge (der Kursivschrift)
The break	la brisure	der Abbruch
Ascenders (b, d, h, l)	les longues du haut	Buchstaben mit Oberlängen
The ascending part	la queue de dessus	die Oberlänge
Descenders (g, p, q, y)	les longues du bas	Buchstaben mit Unterlängen
The descending part; The tail	la queue de dessous	die Unterlänge
Small sorts (a, c, e, m)	lettres courtes	(Buchstaben mit) Mittellängen; kurze Buchstaben
Sorts which charge the body; Long sorts (j, Q, *f*)	lettres pleines	Buchstaben die den Kegel ausfüllen; Buchstaben auf vollem Kegel; ganze Längen
A bastard fount	une fonte sans nom	ein Bastardsatz
A bastard type (an α-point face on a β-point body; $\alpha \neq \beta$)	(un caractère avec un œil de α points fondu sur un corps de β points)	ein Bastardbuchstabe (mit α-Punkt Bild auf einem β-Punkt Kegel)
Lower-case (characters) (a, b, c)	bas de casse; (lettres) minuscules	Gemeine; Minuskeln; kleine Buchstaben

English.	French.	German.
Capitals (A, B, C)	majuscules (lettres) capitales	Versalien Majuskeln grosse Buchstaben
Small capitals (A, B, C)	petites capitales	Kapitälchen
Matter set in capitals	composition en majuscules	Versaliensatz
To keep up (to use capitals freely)	prodiguer les majuscules	(unnötige Versalien benutzen)
To keep down (to use capitals sparingly)	épargner les majuscules	klein drucken (möglichst wenige Versalien benutzen)
Matter interspersed with italics and small capitals	composition lardée	gemischter Satz
Figures	chiffres	Ziffern
An arabic numeral (1, 5, 7)	un chiffre arabe	eine arabische Ziffer
A roman numeral (I, V, VII)	un chiffre romain	eine römische Ziffer
Punctuation	ponctuation	Interpunktion
Points Punctuation marks (. , ; : ! ?)	les points les signes de ponctuation	Interpunktionen
To point	ponctuer	(inter-) punktieren interpungieren
The comma (,)	la virgule	das Komma der Beistrich
The turned comma (')	la virgule retournée	das gedrehte Komma
The semicolon (;)	le point-virgule	das Semikolon der Strichpunkt
The colon (:)	le deux-points	das Kolon der Doppelpunkt
The broken colon (:—)	le deux-points avec tiret	das Kolon mit Strich
The full point The full stop (.) The period	le point	der Punkt das Punktum
The en-dot (.)	le gros point	der starke Punkt
The turned point (·, *e.g.* 3·5; used as decimal mark in England)	le point retourné (dont on fait emploi comme signe decimal en Angleterre)	der gedrehte Punkt (als Dezimalzeichen in England gebraucht)
The apostrophe (')	l'apostrophe	der Apostroph das Auslassungszeichen
The caret (‸)	le bourdon	das Einschaltungszeichen
Quotation marks Inverted commas (" " «») Quotes	les guillemets	die Anführungszeichen die Gänsefüsschen
To quote	guillemeter	in Anführungszeichen einschliessen
Quoted matter	texte entre guillemets	Satz zwischen Anführungszeichen
A quotation	une citation	ein Zitat
Single quotes (' ')	guillemets anglais simples	englische einfache Häkchen
Double quotes (" ")	guillemets anglais doubles	Doppelhäkchen
The hyphen (in compounds)	le trait d'union	der Bindestrich
The hyphen (to join separated syllables of word broken at end of line)	la division	das Teilungszeichen das Divis
To hyphen	diviser	mit einem Bindestrich versehen
Division (of words)	coupure de mot	Trennungen
The note of interrogation The query mark (?)	le point d'interrogation	das Fragezeichen

ENGLISH.	FRENCH.	GERMAN.
The note of exclamation (!)	le point d'exclamation	das Ausrufzeichen
Brackets (( ) [ ] { })		Klammern
To bracket	mettre entre parenthèses	in Klammern einschliessen
The parentheses The round brackets ( )	les parenthèses	die Parenthesen die runden Klammern
The crotchets The square brackets [ ]	les crochets	die eckigen Klammern
The braces { }	les accolades	die Akkoladen
Peculiars (%, ‰, @, ₰)	signes accessoires signes divers	besondere Zeichen
The per cent mark (%)	le pour-cent	das Prozentzeichen
The per mil mark (‰)	le pour-mille	das Promilzeichen
The nullo (o)	le zéro	die Null
The nuller (〃 repetition mark, England and France)	la nullité (signe de répétition, Angleterre et France	(Wiederholungszeichen, England und Frankreich)
(Repetition mark, Germany)	(signe de répétition, Allemagne)	der Nullstrich (– Wiederholungszeichen, Deutschland)
The commercial a (@)	(employé comme signe de par en Angleterre)	(als Prozeichen in England benutzt)
The per mark (₰)	le signe de par	das Prozeichen
The dash The em rule (—)	le tiret	der Gedankenstrich
The swell dash (——)	le filet anglais le couillard	die englische Linie
Leaders	signes conducteurs	Leitezeichen
Dot leaders (...)	points conducteurs	Leitepunkte
Hyphen leaders (---)	traits conducteurs	Leitestriche
Suspension points (......)	les points de suspension	Gedankenpunkte
Abbreviations (abbr.)	abréviations	(Ab-) Kurzungen Abbreviaturen
To abbreviate	abréger	abkürzen
To write with abbreviations	écrire en abrégé	mit Abkürzungen schreiben
Abbreviated	en abrégé	abgekürzt in Abbreviatur
The ampersand (& ⁊)	l'et commercial	das Etzeichen (&) das runde r (⁊)
The etcetera sign (&c., ⁊c)	l'et cætera abrégé	das Etceterazeichen
The arrow (⟶)	la flèche	der Pfeil
The fist The hand (☞) The index	la main	das Handzeichen
Reference marks (* † ‡ §)	renvois appels de notes	Nachweiszeichen Notenzeichen
The asterisk The star (* *)	l'étoile (* cinq pointes) l'astérisque (* six pointes)	das Sternchen das Sternzeichen (* *)
To asterisk	marquer d'un astérisque	besternen
The (single) dagger The (single) obelisk (†) The obelus	la croix	das (Sterbe-) Kreuz
The double dagger The double obelisk (‡) The diesis	la double-croix	das Doppelkreuz
The section (§)	le paragraphe	das Paragraphenzeichen
The parallels (‖ //)	les parallèles	die Parallelen
The paragraph The blind P (¶)	la patte-de-mouche le pied-de-mouche	das Absatzzeichen das Lesezeichen

English.	French.	German.
Notes	les notes	Noten Anmerkungen
A foot-note A bottom-note	une note au bas de la page	eine Fussnote
To foot-note	noter au bas de la page	Fussnoten ansetsen
A side-note	une note marginale une manchette	eine Randglosse
A shoulder note	(une note à l'intérieur en haut de la colonne)	(eine Note an der oberen Innenseite einer Kolumne)
Cut-in notes Let-in notes	(des notes qui rentrent dans le texte)	Randglossen im Text
Marginalia Marginal notes	les manchettes les additions	Marginalien
The runners		die Zeilenzähler
To hook in, above	crocheter au dessus	überschliessen
To hook in, below	crocheter au dessous	unterschliessen
An asterism The stars (⁂)	un astérisme	die drei Sternchen
The response mark (℟)	le répons	das Responszeichen
The versicle (℣)	le verset	das Verszeichen
Heraldic signs	signes héraldiques	heraldische Zeichen
The Greek cross The cross of St. George (✚)	la croix grecque	das griechische Kreuz
The Latin cross (†)	la croix latine la croix haussée la croix longue	das lateinische Kreuz das Passionskreuz
St. Andrew's cross (X)	la croix de Saint-André	das Andreaskreuz
The Maltese cross (✠)	la croix de Malte	das Malteserkreuz
St. Anthony's cross The tau cross (T)	la croix de Saint-Antoine	das ägyptische Kreuz
The Buddhist cross (卐)	la croix de Bouddha	das Buddhakreuz
The double cross (of archbishops and cardinals) (‡)	la double croix (des archevêques et cardinaux)	das Doppelkreuz (der Erzbischöfe und Kardinale)
The triple cross The papal cross (‡)	la triple croix (du pape)	das dreifache Kreuz das Papstkreuz
The Jerusalem cross (☩)	la croix potencée	das Krückenkreuz
Superiors $({}^{a\,2})$	supérieures	hochstehende Buchstaben und Ziffern
An exponent An index	un exposant	ein Exponent eine Hochzahl
Inferiors $({}_{a\,2})$	inférieures	tiefstehende Buchstaben und Ziffern
A suffix	un indice	ein Zeiger eine Marke ein Index
Astronomical signs (☊ ♂ Æ)	signes astronomiques	astronomische Zeichen
Planetary signs (♂ ♃)	signes des planètes	planetarische Zeichen
Zodiacal signs (♌ ♍ ♎)	signes du zodiaque	Zodiakzeichen Tierkreiszeichen
Botanical signs (Z ◯)	signes botaniques	botanische Zeichen
Meteorological signs (▲ ≡)	signes météorologiques	meteorologische Zeichen
Archæological signs (ÆÐÆ)	signes archéologiques	archäologische Zeichen
Medical signs (♃ ℞ ℥)	signes de médecine	Apothekerzeichen
Money signs (£, $)	signes de monnaie	Geldzeichen Münzzeichen

English.	French.	German.
Geometrical signs (△ ⊥ ○)	signes de géométrie	geometrische Zeichen
The triangle mark (△)	le signe "triangle"	das Dreieckzeichen
The square mark (□)	le signe "carré"	das Quadratzeichen
The circle mark (○)	le signe "cercle"	das Kreiszeichen
The angle mark (∠)	le signe d'angle	das Winkelzeichen
The right-angle mark (∟)	le signe d'angle droit	das Winkelrechtzeichen
The perpendicular mark (⊥)	le signe "perpendiculaire"	das Lotzeichen
The parallel mark (‖ //)	le signe "parallèle"	das Parallelzeichen
The rectangle mark (▭)	le signe "rectangle"	das Rechteckzeichen
The rhombus mark (▱)	le signe "losange"	das Rhombuszeichen das Rautezeichen
The semicircle mark (C)	le signe "demi-cercle"	das Halbkreiszeichen
The arc mark (⌒)	le signe d'arc	das Bogenzeichen
Mathematical signs (+ × ∫ ∼)	signes de mathématique	mathematische Zeichen
The plus mark (+)	le signe "plus"	das Pluszeichen das Additionszeichen
The minus mark (−)	le moins	das Minuszeichen
The plus-minus mark (±)	le signe "plus ou moins"	das Plusminuszeichen
The equal (-ity) mark (=)	le signe d'égalité	das Gleichheitszeichen
The multiple mark (×)	le signe "multiplié par"	das Vervielfältigungszeichen das Multiplikationszeichen das Multiplizierzeichen
The divide mark (÷)	le signe "divisé par"	das Teilungszeichen das Dividierzeichen
Fractions ($\frac{2}{3}$ $\frac{1}{16}$)	fractions	Brüche
A straight fraction ($\frac{1}{4}$)	une fraction à barre horizontale une fraction arithmétique	ein gerader Bruch
A sloping fraction A diagonal fraction (1/4)	une fraction à barre diagonale une fraction commerciale	ein schräger Bruch
Solid fractions ($\frac{5}{8}$ $\frac{3}{4}$)	fractions d'une seule pièce	zusammengegossene Bruchziffern
Split fractions ($\frac{5}{7}$ = ^{5}, $_{7}$)	fractions en deux pièces	
Built-up fractions ($\frac{5}{7}$ = ^{5}, –, $_{7}$)	fractions en trois ou plusieurs pièces	zusammengesetzte Bruchziffern
The division line (— /)	la barre de fractions	der Bruchstrich
The horizontal bar (—)	la barre horizontale	der gerade Bruchstrich
The solidus The diagonal stroke (/)	la barre diagonale	der schräge Bruchstrich der Schrägstrich
The numerator	le numérateur	die Oberziffer der Zähler
The denominator	le dénominateur	die Unterziffer der Nenner
The root mark The radix mark (√)	le radical	das Wurzelzeichen
The index of a root	l'indice d'un radical	der Wurzelexponent
The vinculum (‾)	le filet de racine	der Oberstrich
The degrees mark (°)	le signe "degré"	das Gradzeichen
The minutes mark (′)	le signe "minute"	das Minutenzeichen
The seconds mark (″)	le signe "seconde"	das Sekundenzeichen
The thirds mark (‴)	le signe "tierce"	das Tertienzeichen
The infinity mark (∞)	le signe "infini"	das Unendlich (-keits-) zeichen
The ratio mark (:)	le signe "raison"	das Verhältniszeichen
The proportion marks (: , : :)	les signes de proportion	die Proportionszeichen die Proportionspunkte

English.	French.	German.
The variation mark ($\propto$)	le signe de variation	das Variationszeichen
The inequality mark ($\neq$)	le signe d'inégalité	das Ungleichheitszeichen
The difference mark ($\sim$)	le signe de différence	das Differenzzeichen
The congruence mark ($\equiv$)	le signe de la congruence	das Kongruenzzeichen
The integration mark ($\int$)	le signe " intégrale " le signe " somme "	das Integralzeichen
The differential mark (δ)	le signe " différentiel "	das Differentialzeichen
The greater mark ($>$)	le signe " plus grand que "	das " grösser " Zeichen
The not-greater mark ($\ngtr \leqq$)	le signe " pas plus grand que "	das " nicht grösser " Zeichen
The less mark ($<$)	le signe " moins grand que "	das " kleiner " Zeichen
The not-less mark ($\nless \geqq$)	le signe " pas moins grand que "	das " nicht kleiner " Zeichen
Cartographical signs ($\odot$ $\times$)	signes cartographiques	kartographische Zeichen
Map type	caractères pointillés caractères grisés	Kartentypen
Ornamental letters M R	lettres ornées	Zierbuchstaben
Initial letters A E	lettrines	Initialen grosse Anfangsbuchstaben
An initial	une initiale	ein Anfangsbuchstabe
The first line	la première ligne	die erste Zeile
The initial line	la ligne de tête	die Anfangszeile
The head-line	la ligne essentielle	die Hauptzeile die Kopfzeile
Dropped heads	les titres intérieurs	Spiegelseiten
The drop-down	le blanc d'un titre intérieur	der Spiegel
The foot-line	le pied (d'une page) la ligne de cadrats	der Unterschlag
The direction-line The signature-line	la ligne de pied	die Normzeile
The signature	la signature	die Signatur das Bogenzeichen
The title-signature	la signature de titre	die Norm
The catch-line	la ligne perdue	die Stichzeile die Leitzeile
(Last line of a paragraph at the beginning of the next page)	(dernière ligne d'un alinéa au commencement d'une page)	ein Hurenkind
To indent a line	renforcer une ligne	eine Zeile einziehen
To run out a line	faire ligne pleine	eine Zeile stumpf halten
A full-out line	une ligne pleine	eine volle Zeile
To make even To begin even	tomber en ligne (pleine)	stumpf halten
An ordinary paragraph A common par	un alinéa rentrant	ein gewöhnlicher Absatz
A full-out paragraph	un alinéa aligné	ein stumpf gehaltener Absatz
A hanging paragraph	un alinéa saillant un sommaire	
The break-line	la ligne perdue la ligne boiteuse la ligne creuse	der Ausgang die Ausgangszeile
To end a break To quad out	remplir la ligne (avec des cadrats)	den Ausgang ausschliessen mit Quadraten ausschliessen

English.	French.	German.
To end even	tomber en ligne	mit einer vollen Zeile ausgehen
A line of quads	une ligne de blancs	eine Quadratenzeile
A line of points	une ligne pointée	
Interlinear matter	intercalation	
Diacritic marks / Diacritics (^ ̦ ^)	signes diacritiques	diakritische Zeichen / Unterscheidungszeichen
Accents (´ ` ^)	accents	Akzente / Tonzeichen
The acute accent (´)	l'accent aigu	der Akut
The grave accent (`)	l'accent grave	der Gravis
The circumflex (^)	l'accent circonflexe	der Zirkumflex / das Dehnungszeichen
The tilde (˜)	le tilde	die Tilde
The curly n (ñ)	le n tilde	das spanische n
The short-vowel mark (˘)	l'accent prosodique bref	das Kürzezeichen / das Kürzungszeichen
Short letters (ă, ŏ, ŭ)	lettres brèves	Kurzbuchstaben
The long-vowel mark (¯)	l'accent prosodique long	das Längezeichen / das Dehnungszeichen
Long letters (ā, ō, ū)	lettres longues	Langbuchstaben
The doubtful-length mark (⏑̄)	l'accent prosodique douteux	das Kürzungs- und Dehnungszeichen
Long-shorts (ā̆, ō̆)	lettres douteuses	
The cedilla (¸)	la cédille	die Cedille
The diæresis (¨)	le tréma	das Trema
The umlaut mark (˙˙)	le signe de l'inflexion	das Umlautzeichen
To accent / To accentuate (a letter)	accentuer (une lettre)	(einen Buchstaben) mit Tonzeichen versehen
Accented letters (â, é, è)	lettres accentuées	Akzentbuchstaben / akzentuierte Buchstaben / Akzente
Overscored letters (ḡ, m̄)	sortes barrées en dessus	oberstrichene Buchstaben
Underscored letters (e̲, n̲)	sortes barrées en dessous	unterstrichene Buchstaben
Crossed letters (ŧ, ł)	lettres barrées	gestrichene Buchstaben
Scratched figures (2̸)	chiffres barrés	gestrichene Ziffern
Dotted letters (ȧ, ṅ)	lettres ponctuées	punktierte Buchstaben
Dotted figures (1̇, 3̇)	chiffres ponctués	punktierte Ziffern
Typewriter type a b c d e	caractères de machine à écrire	Schreibmaschinenschrift
The point system	le système de points	das Punktsystem
The standard point	le point systématique	der Normalpunkt
The standard line	la ligne systématique	die Normallinie
A cut-in letter / A drop letter	(une lettre de deux points empiétant sur la deuxième ligne)	eine unterschnittene Initiale / ein unterschnittener Buchstabe
A two-line letter	une lettre de deux-points / une binaire	ein Doppelkegelbuchstabe / ein zweizeiliger Buchstabe
A cock-up letter	une montante	eine liniehaltende Initiale
To cock up		Initialen in Linie stellen
To throw up	faire ressortir	auszeichnen
A title-letter	une lettre à titre	ein Titelbuchstabe
Titling type	caractères à titres	Titelschriften
A ligature (ffl, æ, œ)	une ligature	eine Ligatur
Two-letter ligatures (ff, fi)	les doubles	Zweiletterligaturen
Logotypes (ment, ion)	logotypes	Logotypen

English.	French.	German.
Type metal	métal de caractères; alliage	Schriftmetall; (Schrift-) Zeug
To cast	fondre	giessen
A typefounder	un fondeur (de caractères d'imprimerie)	ein Schriftgiesser
A typefoundry	une fonderie de caractères	eine Schriftgiesserei
Typefounding (operation)	la fonte des caractères	Schriftguss
A typecasting machine	une machine à fondre les caractères; une fondeuse	eine Schriftgiessmaschine
A mould	un moule	eine Giessform
The type-mould	le moule à caractères	das (Schrift-) Giessinstrument
The space-mould	le moule à blancs	das Spatiengiessinstrument
A script mould	un moule d'anglaise	eine Schreibschriftgiessform
The script-type mould	le moule à caractères d'écriture	das Schreibschriftgiessinstrument
Hand-mould for quads	moule à main pour cadrats	Handgiessinstrument für Quadrate
Hand lead-mould	moule à main pour interlignes	Handgiessinstrument für Regletten
Machine lead-mould	moule à machine pour fondre les interlignes	Reglettengiessinstrument
Furniture mould	moule à garniture	Steggiessinstrument
Rule mould	moule à filet	Liniengiessinstrument
Rubbing	la frotterie	Reibung
The rubbing file	la lime à frotter	der Reiber
The rubbing stone	la meule	der Reibstein
To set up type; To compose	composer	Schrift setzen
Composition	composition	Schriftsatz
To set up wrong	faire une mauvaise composition	versetzen
Reset !	recomposez !	Neusatz !
A literal; A wrong letter	une coquille	ein versetzter Buchstabe
A dittogram (a letter repeated by mistake)	un doublon (lettre doublée par erreur)	ein Dittogramm (ein irrtümlich wiederholter Buchstabe)
An out	un bourdon	eine Leiche; eine Auslassung
A double; A doublet (a word, etc., repeated by mistake)	un doublon (mot, etc., doublé par erreur)	eine Hochzeit (ein Wort, etc., irrtümlich wiederholt)
To double	doubler	Hochzeit machen
Outs and doubles	bourdons et doublons	Leichen und Hochzeiten
Wrong fount (abbreviation, w.f.)	œil étranger	falsche Schrift
Transposed words	mots transposés	versetzte Wörter; verstellte Wörter
Transposed lines	lignes transposées	versetzte Zeilen; verstellte Zeilen
To compose in slip	composer en placard	Packet setzen
To be in type	être composé	(ab-) gesetzt sein; druckfertig sein
To set (a MS.) in type	composer (un manuscrit) en caractères	(ein Ms.) absetzen

English.	French.	German.
To set in columns	composer en colonnes	in Spalten setzen
Matter set in columns	matière composée en colonnes	gespalteuer Satz
To set in narrow measure	composer en lignes courtes	engspaltig setzen
Set in double columns	composée en double colonne	zweispaltig gesetzt
A column	une colonne	eine (Satz-) Spalte
A take	une cote	eine Schiebung
To set in panels / To panel	(composer en alinéas isolés par des lingots)	in Feldern setzen
A panel	(un alinéa entre lingots)	ein (Satz-) Feld
Rule-work	composition de tableaux	Tabellensatz / Liniensatz
To set up broken type	redresser des caractères couchés	die Schrift aufsetzen
To set up pie	composer un pâté	(Zwiebel-) Fische aufsetzen
A typedressing machine	une émondeuse	eine Schriftschleifmaschine
The setting-up stick	le bâton	
The dressing-stick	le composteur à coupoir	der Fertigmachwinkelhaken
Dressing (operation)	la couperie	das Bestossen
The dressing-bench	le coupoir	das Bestosszeug
The turning-gauge	le calibre	das Kalibermass / das Kernmass
The height-to-paper gauge	le calibre de hauteur	die Schrifthöhenlehre
The body gauge	le typomètre	das Typometer
The micrometer	le palmer / le micromètre	das Mikrometer
The depth-of-strike micrometer	le calibre de profondeur de frappe	das Tiefenmass / die Justiernadel
The lining-gauge	le calibre de ligne	das Justorium
The nicking plane	le rabot de pied	der Fusshobel
The kerning, nicking, and bearding plane	le rabot de coupoir	der Universalhobel
To space	espacer	ausschliessen / spatiieren / spatiinieren
To line-justify / To justify the lines	justifier	die Linien justieren
A space-mark (#)	un signe de séparation	ein Spatiumzeichen
A space between two words	une espace entre deux mots	ein Wortzwischenraum
A space (type)	une espace	ein Spatium / eine Spatie / ein Ausschlusstück
The spaces	les espaces / les blancs	die Spatien / der Ausschluss
Quads / Quadrats	cadrats	Quadrate
A four-em quad	un cadrat de quatre cadratins	ein 4-Cicero-Quadrat / eine ganze Konkordanz
A three-em quad	un cadrat de trois cadratins	ein 3-Cicero-Quadrat / eine Dreiviertelkonkordanz
A two-em quad	un cadrat de deux cadratins	ein 2-Cicero-Quadrat / eine Halbkonkordanz
An em quad	un cadratin	ein Geviert
An en quad ($\frac{1}{2}$ em)	un demi-cadratin	ein Halbgeviert

English.	French.	German.
A thick space ($\frac{1}{3}$ em)	une espace forte	ein Drittelgeviert
A middle space ($\frac{1}{4}$ em)	une espace moyenne	ein Viertelgeviert
A thin space ($\frac{1}{5}$ em)	une espace fine	ein Fünftelgeviert
A sixth-em	un sixième de cadratin	ein Sechstelgeviert
An eighth-em	un huitième de cadratin	ein Achtelgeviert
A hair-space	une espace très-fine	ein Haarspatium eine Haarspatie
The height-to-paper of spaces	la hauteur-en-papier des espaces	die Ausschlusshöhe
A rule	un filet	eine (Setz-) Linie
A brass rule	un filet cuivre	eine Messinglinie
A type-metal rule (1 to 12 points)	un filet matière (1 à 12 points)	eine Zeuglinie
A reglet	une réglette	eine Reglette
A wood rule	un filet (de bois) pour affiches	eine Holzlinie
A combination rule	un filet systématique	eine Akzidenzlinie
A dotted rule	un filet pointillé	eine punktierte Linie
A waved rule	un filet ondulé	eine Wellenlinie
Ornamental rules	filets de fantaisie	Zierlinien
The rule case	la casse à filets	der Linienkasten
The quotations	les garnitures	die Stege
Wood furniture	garnitures en bois	Holzstege
Metal furniture	garnitures en matière	Bleistege
Steel furniture	garnitures en acier	Eisenstege
Cast-iron furniture	garnitures en fonte	Guss (-eisen-) stege
Hollow quotations	garnitures creuses	Hohlstege
A hollowed clump A recessed clump	un lingot creux sur le plat	
Improved french furniture	garnitures à colonnes	
Curved furniture	garnitures cintrées	Bogenstege
A lead (1 to 4 points)	une interligne	ein Durchschuss
A clump (English) A slug (American)	un lingot	ein dicker Durchschuss
Leaded matter Leaded type	matière interlignée caractères interlignés	durchschossener Satz
To lead	interligner	(Zeilen) durchschiessen
Solid matter	composition pleine	undurchschossener Satz kompresser Satz
To run on solid	réunir en composition pleine	kompress setzen
To run on (a paragraph)	réunir (à la fin d'un paragraphe)	
To run over	remanier	überlaufen
To run back	remanier	zurückbringen
To cause overrunning	entraîner le remaniement	überlaufen machen
Ornaments Natural objects Conventional signs	ornements signes conventionnels	Zierleisten Ornamente Verzierungen Vignetten
Borders	les bordures	Einfassungen
Combination borders	bordures à combinaison	Kombinationseinfassungen
Line borders	filets de cadres	Linieneinfassungen
A rule for borders	un filet pour bordures	eine Einfassungslinie
Border-pieces	pièces de bordure motifs de bordure	Leisten
A head-piece	une tête de page	eine Kopfleiste eine Kopfvignette

ENGLISH.	FRENCH.	GERMAN.
A tail-piece	un cul-de-lampe	eine Schlussvignette ein Finalstock eine Schlussleiste
Corners	les coins	Eckstücke Ecken
Groundwork	fonds	Unterdruck
A cheque rule	un filet azuré pour chèques	eine Assureelinie eine Wechsellinie
The colophon	le colophon	das Kolophon
The catchword The direction-word	la réclame	der Kustos der Blatthüter
A flourish ( )	un parafe	ein Schnörkel
A rule-cutter A rule-cutting machine	un coupoir à filets	eine Linienschneidmaschine ein Längenschneidapparat
Wooden type	caractères en bois	Holztypen
(Wood-) Block letters	caractères bâton	Holzschrift
Rubber type	caractères en caoutchouc	Kautschuktypen
A punch-cutter (man)	un graveur de poinçons	ein Stempelschneider
A punch-cutter (machine)	une machine à graver les poinçons	eine Stempelschneidmaschine
The art of punch-cutting	l'art de graver les poinçons	die Stempelschneidekunst der Stempelschnitt
Punch-cutting	la gravure des poinçons	das Stempelschneiden
The punch	le poinçon	der Stempel die Patrize
A steel punch	un poinçon en acier	ein Stahlstempel
The counter-punch	le contre-poinçon	der Konterstempel
To bevel	biseauter	gehren
To cut a bevel	tailler un biseau	die Gehrung schneiden
The standards (H O m o p)	les étalons	die Normalbuchstaben die Zurichtsbuchstaben
A smoke (-proof)	un fumé	ein Russabdruck ein Russabzug
A matrix	une matrice	eine Mater eine Matrize
A struck matrix	une matrice frappée	eine mit Stempel geprägte Matrize
An electrotyped matrix	une matrice électrotypée	eine galvanische Matrize
To justify the matrix	justifier la matrice	die Mater justieren
The justification	la justification	die Justierung
A matrix justified for line and set	une matrice justifiée pour ligne et pour épaisseur une matrice en registre arrêté	eine Matrize nach Linie und Weite justiert
To aline	aligner	alinieren auf Linie zurichten
To be alined	tirer ligne	Linie halten
To be out of line	chevaucher	nicht Linie halten
A compositor (abbr., a comp)	un compositeur	ein (Schrift-) Setzer
The composing-stick	le composteur	der Winkelhaken
To set the stick to the measure	justifier le composteur	den Winkelhaken stellen
The fixed jaw (of the composing-stick)	le petit côté le talon le dos (du composteur)	der Anschlag die feste Wand (des Winkelhakens)
The movable jaw (of the composing-stick)	la languette (du composteur)	der Schieber der Schlitten (des Winkelhakens)

English.	French.	German.
The jaw clamp	le levier du composteur	die Schleife der Frosch
The setting-rule The composing-rule	le typomètre	die Setzlinie
The case	la casse	der Schriftkasten der Setzkasten
To lay a case	mettre en casse	einen Schriftkasten füllen einen (Schrift-) Kasten einlegen
The lower case (abbreviation, l.c.)	le bas de casse	der Kleinletterkasten
The upper case (abbreviation, u.c.)	le haut de casse	der Grossletterkasten
Close spacing Close-spaced setting	espacement serré	enger Satz
Close-spaced type	composition serrée	gedrängte Schrift
To set closely To keep in	serrer la composition	eng anschliessen
To close up To take in	rapprocher	den Satz anschliessen einbringen
To join up	réunir	
To drive out (a line)	jeter des espaces	ausbringen
To space well	justifier également	gleichmässig ausschliessen
To space too tightly	serrer trop l'espacement	zu eng anschliessen
To overrun the line	dépasser la justification	über das Format gehen über die Justierung gehen
To space out	espacer	sperren spatiieren spatiinieren
Spaced (-out) type (German equivalent of italics)	caractères avec espacement à un point (au lieu d'italiques en Allemand)	gesperrter Satz
Unspaced type (German equivalent of romans)	caractères sans espacement (au lieu de romains en Allemand)	ungesperrter Satz
To white out To branch out	jeter du blanc blanchir donner de l'air	licht halten die Zwischenräume vergrössern
To drive out	chasser	austreiben
To get in	gagner	einbringen
The format The size of volume	le format	das Format
The margins	les marges	der Papierrand
The back margin	le petit fond	der Bundsteg
The head margin	la marge de tête	der Kopfsteg
The fore-edge margin	le grand fond	der Aussensteg
The tail margin	la marge de pied	der Fusssteg
The measure (of a page or column)	la largeur (d'une page ou d'une colonne)	die Formatbreite (einer Seite oder Spalte)
The length of a page	la longueur d'une page	die Formatlänge
The length of a column	la longueur d'une colonne	das Kolumnenmass
The manuscript (abbreviation, MS., plural, MSS.) The copy	la copie	das Manuskript (Kürzung: Ms.)
The author	l'auteur	der Autor
Type wanted ! Out of sorts !	sortes manquent !	Schrift fehlt !
Imperfections	défets	Defekte

English.	French.	German.
The type is used up	la fonte est finie	die Schrift ist versetzt
A missing letter	une sorte qui manque	ein fehlender Buchstabe
Battered type (collectively)	vieille matière	lädierte Schrift
A battered type	un caractère cogné	eine beschädigte Type
To turn for letters	bloquer	blockieren
Turned sorts	caractères bloqués	Fliegenköpfe Blockaden
To rectify the turned letters	débloquer	die Fliegenköpfe berichtigen
The making up of a line of several bodies (as in mathematical formulæ)	le parangonnage	die Überlegung und Unterlegung
The tweezers	les pinces	die Korrigierzange die Pinzette
The bodkin	la pointe	die Ahle
A galley	une galée	ein (Setz-) Schiff
A pull	une impression	ein Abzug ein Druck
To pull (off) a proof	tirer une épreuve	einen Abzug machen
The proof	l'épreuve	der Korrekturabzug der Korrekturbogen
A proof impression	le bon à tirer	ein Probeabzug
A galley-proof A galley-slip	une épreuve en placard	ein Fahnenabzug
A brush-proof	une épreuve à la brosse	ein Bürstenabzug ein Abklatsch
To mackle	maculer doubler	schmitzen duplieren
A mackle	une macule	ein duplierter Druck
A slur A shake	un papillotage	ein schmieriger Druck
Blacks	espaces qui lèvent espaces qui marquent	Spiess
To push down upstanding spaces	baisser les espaces	die Spiesse niederdrücken
A monk (black patch in letterpress)	(tache noire dans l'impression)	(verschmierte Stelle im Druck)
A friar (light patch in letterpress)	un moine une fente un bouquet (endroit qui est resté blanc)	ein Mönch (blasse Stelle im Druck)
To be full of friars	venir par bouquets	voller Mönche sein
Monks and friars	rebut	Misdruck
A type off its feet	un caractère couché	ein abgefallener Buchstabe
Picks	lettres sales	Putzen
Printed in slip	imprimé en placard	in Fahnen abgezogen
To make up into columns	mettre en colonnes	den Satz zu Spalten umbrechen
To make up into pages To page	mettre en pages	den Satz zu Seiten umbrechen
To paginate	paginer folioter	paginieren mit Seitenzahlen versehen
A page	une page	eine Seite
An unnumbered page	une page non-chiffrée	eine unpaginierte Seite
A numbered page	une page chiffrée	eine paginierte Seite
The page number	le folio	die Seitenziffer
A full page	une page pleine	eine volle Seite
A blank page A white page	une page blanche une fausse-page	eine Blankseite

English.	French.	German.
The standard page	la page normale	die Normalseite
A long page	une page longue	eine lange Seite
A short page	une page courte	eine kurze Seite
The recto	le recto	die rechte Seite
The verso	le verso	die linke Seite
The obverse page	l'avers	die Vorderseite die Schöndruckseite
The reverse page	le revers	die Rückseite die Widerdruckseite
The odd pages	les pages impaires	die ungeraden Seiten
The even pages	les pages paires	die geraden Seiten
A signature-page	une page-signature	eine Normseite
A specimen page	une page-spécimen	eine Probeseite
A leaf	un feuillet	ein Blatt
An inset	un onglet	ein Einsatz
Preliminary matter The title-sheets	les parties éventuelles	die Titelbogen
The title-page	la page du titre	die Titelseite
The title	le titre	der Titel
The sub-title	le sous-titre	der Nebentitel
The half-title	l'avant-titre	der Schmutztitel
The bastard title	le faux-titre (principal)	der Vortitel
The fly-titles	les faux-titres	die Untertitel
Head-lines	lignes de tête	Kolumnentitel
The running-title	le titre courant	der lebende Kolumnentitel
The catchword (heading)	la lettrine	das Schlagwort das Stichwort
A clean proof	une épreuve peu chargée	ein Abzug von reinem Satz eine Jungfer
A foul proof	une épreuve chargée	ein Abzug von unreinem Satz
The second proof The revise	la deuxième épreuve la revision	der zweite Abzug die zweite Korrektur
The third proof The second revise	la troisième épreuve la deuxième revision	der dritte Abzug die dritte Korrektur die Revision
A correction mark	un signe de correction	ein Korrekturzeichen
The corrections	les corrections	die Korrekturen
The proof-reader	le correcteur	der Korrektor der Korrekturleser
The indoor (proof-) reader The house-reader	le correcteur d'imprimerie	der Hauskorrektor
The reader of the last proof	le correcteur en bon à tirer	
To read proofs	faire la correction (des épreuves)	die Korrektur besorgen
To read the last proof	(faire la correction pour le bon à tirer)	die letzte Revision besorgen
The type-corrector	le corrigeur	der Korrektor auf dem Blei
The planer for proofs	le taquoir à épreuves	das Klopfholz mit Überzug
The printer's plane	le taquoir	das Klopfholz
The chase	le châssis	der Formrahmen der Schliessrahmen
To dress the chases	garnir les formes	das Format machen das Format über die Form legen
The quoins	les coins (de serrage)	die (Schliess-) Keile

English.	French.	German.
To quoin up the forme	serrer la forme	die Form verkeilen
The locking gear	le serrage	das Schliesszeug
The side-stick	le biseau	
The composing-machine	la machine à composer	die Setzmaschine
The keyboard	le clavier	die Klaviatur die Tastatur das Tastbrett der Tastapparat
(The) Setting (of) several (different) bodies	la composition de plusieurs corps (différents)	Satz verschiedener Kegel
(The) Setting (of) several (different) founts	la composition de plusieurs œils (différents)	gemischter Satz
The arrangement of the keyboard	la disposition du clavier	das Klaviaturschema die Tastenanordnung
Rivers of white	lézardes	krumme Gassen
Straight rivers	rues	gerade Gassen
The forme The form	la forme	die Form
To unlock the forme To untie the forme	desserer la forme	das Format abschlagen
The printing-ink	l'encre d'imprimerie	die Druckfarbe
The black printing-ink	l'encre noire (d'imprimerie)	die Druckerschwärze
Rubricated	imprimé en rouge	rot gedruckt
Rubrics	lettres rouges	rote Buchstaben
The balls	les balles	die Ballen
The ball-knife	le couteau à lame ronde	das Ballenmesser
The inking-rollers	les rouleaux encreurs	die Farb (-auftrag-) walzen
Live matter Standing matter	composition à conserver la conserve	druckfertiger Satz
Dead matter	composition à distribuer	abzulegender Satz
To distribute (type)	distribuer (les caractères)	(Schrift) ablegen
To distribute (the type) into wrong boxes	faire des coquilles en casse	(Schrift) falsch ablegen
Sorts	des sortes	abgelegte Lettern
Pie	un pâté	Zwiebelfische gequirlter Satz Eierkuchen
To pie	mettre en pâte	einen Eierkuchen machen Satzzusammenschmeissen
To fall into pie To go to pie	se mettre en pâte tomber en pâte	zu Zwiebelfischen zusammenfallen
To distribute a pie	distribuer un pâté dépâtisser	Zwiebelfische ablegen
The distributing machine	la machine à distribuer	die Ablegemaschine
The case for defective letters The hell-box	le cassetin au diable	der Defektkasten der Zeugkasten
The case frame	le rang pour casses	das (Setz-) Regal
Imposing Imposition	imposition	Ausschiessen Ausschiessung Formatmachen
The imposing-table The imposing-stone	le marbre	die Schliessplatte die Ausschiessplatte der Ausschiesstein
The stand for the imposing-table	le pied du marbre	der Schliess (-platten-) tisch
Stereotyping	le clichage	die Stereotypie

English.	French.	German.
The plaster process of stereotyping	le clichage au plâtre	die Gips-Stereotypie
The paper process of stereotyping	le clichage au papier	die Papier-Stereotypie
Types in store / Stock types	caractères (que les imprimeries ont) en nombre	Lagerschriften
The height of type adopted by a printing-office	la hauteur de caractère de l'imprimerie	die Haushöhe
The size of body of type used in a printing-office	la force de corps de l'imprimerie	der Hauskegel
Small type (Then)	petits caractères	kleine Schrift
Medium type (Then)	caractères moyens	mittlere Schrift
Large type (Then)	gros caractères	grobe Schrift
The remove	la gradation	der Schriftgrad
Upright characters (THEN)	caractères droits	gerade Schrift
Inclined characters (*THEN*)	caractères penchés	schräge Schrift
Wide type (Then)	caractères larges	breite Schrift
Standard-width type (Then)	caractères normaux	Schrift von normaler Breite
Narrow type (Then)	caractères étroits	dünne Schrift
Full-faced type (**Then**)	caractères gras	fette Schrift
Bold-faced type (**Then**)	caractères égyptienne	halbfette Schrift
Lean-faced type (Then)	caractères maigres	hagere Schrift
Book faces	caractères de labeur	Brotschriften
Jobbing faces / Display faces	caractères de fantaisie	Akzidenzschriften
Jobbing work	travaux de ville	Akzidenzarbeiten
Type for bills / Type for placards	caractères pour affiches	Plakatschrift
Sanserifs (Then)	lettres simples / lettres antiques	Buchstaben ohne Ausläufer
Swash letters (*AN*)	lettres à parafe	Schnörkelbuchstaben
Uncial letters (οτρα)	lettres onciales	Unzialschrift
Roman characters (as opposed to german) (Then)	caractères romains (opposé à allemands)	Antiquaschrift (Fraktur gegenübergestellt)
German characters (as opposed to roman) (Then)	caractères allemands (opposé à romains)	Frakturschrift (Antiquaschrift gegenübergestellt)
Italic characters / Italics (*Then*)	caractères italiques / les italiques	Kursivschrift
Grotesque (**THEN**)	les antiques	Grotesk (-schrift) / Steinschrift
Modern roman (Then)	les romains classiques	englische Antiqua
Modern italic (*Then*)	les classiques italiques	gewöhnliche Kursivschrift
Old style roman (Then)	les elzévirs romains	Mediävalantiqua
Old style italic (*Then*)	les elzévirs italiques	Mediävalkursiv
Ionic (roman) (Then)	les égyptiens (romains)	Egyptienne (Antiqua)
Clarendon (roman) / Antique (roman) (**Then**)	les égyptiennes	Clarendonschrift (Antiqua)

ENGLISH.	FRENCH.	GERMAN.
French Clarendon (**Then**)	l'italienne	Italienne
Old English / Black-letter (Then)	les gothiques	gotische Schrift
Elzevir (Then)	l'elzévir	Elzevirschrift
Jenson / Venetian (Then)	l'elzévir gras / le jenson	
Script (latin and german) (*Then*)	écriture (anglaise et allemande)	Schreibschrift (Antiqua und Fraktur)
Ronde (*Then*)	la ronde	gewöhnliche Rundschrift
Music type	signes de musique	Notentypen
Shorthand writing / Stenography	sténographie	Stenographie / Kurzschrift
(Written or printed) Shorthand	une reproduction sténographique	ein Stenogramm
Syllabic (system of) writing	syllabisme	Silbenschrift
A syllable	une syllabe	eine Silbe
A syllabic symbol	un caractère syllabique	ein Silben (-schrift-) zeichen
The syllabary	le syllabaire	das Syllabarium
A letter	une lettre	ein Buchstabe
The alphabet	l'alphabet	das Alphabet
A character	un caractère	ein Schriftzeichen
CHARACTERS :—	CARACTÈRES :	SCHRIFTEN :
Amharic characters	caractères amhariques	amharische Schrift
Arabic characters	caractères arabes	arabische Schrift
Aramaic characters	caractères araméens	aramäische Schrift
Armenian characters	caractères arméniens	armenische Schrift
Burmese characters	caractères birmans	birmanische Schrift
Chinese characters	caractères chinois	chinesische Schriftzeichen
Coptic characters	caractères coptes	koptische Schrift
Cufic characters	caractères koufiques	kufische Schrift
Cuneiform characters	caractères cunéiformes / les cunéiformes	Keilschrift
Cyrillic characters	caractères cyrilliens	cyrillische Schrift
Demotic characters	caractères démotiques	demotische Schrift
Devanagari characters, old kinds	caractères dévanâgarîs, espèces anciennes	Devanagarischriften / Altsanskritschriften
Erse characters / Irish characters (known in the trade as Gaelic)	caractères irlandais	irische Schrift
Estrangelo characters	caractères estrangélâs	Estrangeloschrift
Ethiopic characters	caractères éthiopiens	äthiopische Schrift
Etruscan characters	caractères étrusques	etruskische Schrift
Georgian characters, ordinary	caractères géorgiens vulgaires	georgische Verkehrschrift
Georgian ecclesiastical script	caractères géorgiens ecclésiastiques	georgische Kirchenschrift
German characters (as opposed to latin)	caractères allemands (opposé aux latins)	deutsche Schrift (lateinischer gegenübergestellt)
Gothic characters (old)	caractères (vieux) gothiques	(alt-) gotische Schrift
Greek characters	caractères grecs	griechische Schrift
Hebraic script, old	vielle écriture hébraïque	althebräische Schrift
Hebrew characters	caractères hébraïques	hebräische Schrift
Hieratic characters	hiérogrammes	hieratische Schrift

English.	French.	German.
Hieroglyphs	hiéroglyphes	Hieroglyphen
Himyarite characters	caractères himyarites	himjarische Schrift
Ideographs / Ideograms	idéogrammes	ideographische Zeichen
Japanese characters (several kinds)	caractères japonais (plusieurs espèces)	japanische Schriften (verschiedene Sorten)
Javanese characters	caractères javanais	javanische Schrift
Kanarese characters	caractères kanaras	kanaresische Schrift
Latin characters (as opposed to german)	caractères latins (opposé à allemands)	lateinische Schrift (deutscher gegenübergestellt)
Magadha characters	caractères magadhas	Magadhaschrift
Mongolian characters	caractères mongols	mongolische Schrift
Nagari characters, modern kinds	caractères nâgarîs, espèces modernes	Nagarischriften / Neusanskritschriften
Numidian characters	caractères numides	numidische Schrift
Pahlavi characters	caractères pehlvis	Pahlavischrift
Peshito characters	caractères de la Peshito	Peschitoschrift
Phœnician characters	caractères phéniciens	phönizische Schrift
Rabbinical characters	caractères rabbiniques	rabbinische Schrift
Runes / Runic characters	runes / caractères runiques	Runen
Russian characters	caractères russes	russische Schrift
Sabæan characters	caractères sabéens	sabäische Schrift
Samaritan characters	caractères samaritains	samaritanische Schrift
Semitic characters	caractères sémitiques	semitische Schrift
Siamese characters	caractères siamois	siamesische Schrift
Sinhalese characters / Cingalese characters	caractères cingalais	singalesische Schrift
Syriac characters	caractères syriaques	syrische Schrift
Tamil characters	caractères tamouls	tamulische Schrift
Telugu characters	caractères télingas	telingische Schrift
Tibetan characters	caractères thibétains	tibetanische Schrift
Zend characters	caractères zends	Zendschrift
Languages :—	Langues :	Sprachen :
Albanian	Albanais	Albanesisch
Arabic	Arabe	Arabisch
Armenian	Arménien	Armenisch
Baluchi	Béloutche	Balutschi
Basque	Basque	Baskisch
Bohemian	Bohémien	Böhmisch
Breton	Breton	Bretagnisch
Bulgarian	Bulgare	Bulgarisch
Burmese	Birman	Birmanisch
Chinese	Chinois	Chinesisch
Corsican	Corse	Korsisch
Croatian	Croate	Kroatisch
Czech	Tchèque	Tschechisch
Danish	Danois	Dänisch
Dutch	Hollandais	Holländisch
English	Anglais	Englisch
Erse / Irish	Irlandais	Irisch
Finnish	Finnois	Finnisch
Flemish	Flamand	Flamändisch
French	Français	Französisch
Frisian	Frison	Friesisch
Gaelic	Gaélique	Gälisch
Georgian	Géorgien	Georgisch

English.	French.	German.
German	Allemand	Deutsch
Germanic	Germanique	Germanisch
Greek, modern	Grec moderne	Neugriechisch
Greek, old	Grec ancien	Altgriechisch
Hebrew	Hébreu	Hebräisch
Hindi	Hindî	Hindi
Hindustani	Hindoustani	Hindustani
Hungarian / Magyar	Hongrois / Magyar	Ungarisch / Magyarisch
Icelandic	Islandais	Isländisch
Italian	Italien	Italienisch
Japanese	Japonais	Japanisch
Javanese	Javanais	Javanisch
Kaffir	Cafre	Kaffernsprache
Kanarese	Kanara	Kanaresisch
Lappic / Lapp	Lapon	Lappländisch
Latin	Latin	Lateinisch
Lettish	Letton	Lettisch
Livonian	Livonien	Livländisch
Lithuanian	Lithuanien	Litauisch
Maghrabi	Maghrebin	Magreb
Moorish	Maugrabin	Maurisch
Malagasy	Malgache	Madegassisch
Malay	Malais	Malaiisch
Maltese	Maltais	Maltesisch
Manchu	Mandchou	Mandschu
Norwegian	Norvégien	Norwegisch
Pali	Pali	Pali
Palmyrene	Palmyréen	Palmyrisch
Persian	Persan	Persisch
Pidgin-English	Pidgin	Pidgin-Englisch
Piedmontese	Piémontais	Piemontesisch
Polish	Polonais	Polnisch
Portuguese	Portugais	Portugiesisch
Provençal	Provençal	Provenzalisch
Roumanian	Roumain	Rumänisch
Russian	Russe	Russisch
Ruthenian	Ruthène	Ruthenisch
Sanscrit	Sanscrit	Sanskrit
Sardinian	Sarde	Sardinisch
Serbian	Serbe	Serbisch
Siamese	Siamois	Siamesisch
Sinhalese / Cingalese	Cingalais	Singalesisch
Slavonian	Esclavon	Slavonisch
Slovak	Slovaque	Slovakisch
Slovenian	Slovène	Slowenisch
Spanish	Espagnol	Spanisch
Swedish	Suédois	Schwedisch
Tamil	Tamoul	Tamulisch
Telugu	Télougou	Telingisch
Tibetan	Thibétain	Tibetanisch
Turkish	Turc	Türkisch
Urdu	Ourdou	Urdu
Wallach	Valaque	Walachisch
Welsh	Gallois	Wallisisch
Yiddish	argot des Juifs	Jüdisch-Deutsch

APPENDIX IV.

NOTE

ON STANDARDIZATION OF NOMENCLATURE.

In the first instance the "Authors' and Printers' Dictionary," by F. Howard Collins, was followed for spelling and capitalization, and for the hyphening of compound words. Even in that carefully written work corrections were found to be necessary, for example: the first impression gives "**forme** not form," while the fifth impression gives "**form** not forme," and there are occasional discrepancies; for instance, in both editions the body-size English is spelt with a capital **E** and double english with a lower-case **e**.

Reference to Murray's "Oxford Dictionary," so far as it has been completed (to S–T at the time of writing) has revealed other deviations from that standard work, and in revising the proofs an endeavour has been made to follow Murray as closely as possible.

The authors have found other difficulties due to the large number of printing and typefounding words which have several meanings, and to the inconsistency of the different authorities. It is remarkable that standardization of such order as to conform to modern mechanical methods of interchangeability should, in typefounding, date back to eighty years before its need became apparent in such common articles as bolts and nuts; but it is not remarkable that typographic nomenclature should have remained unstandardized, for it is only in quite recent times that the work of such standardization committees as those dealing with automobile parts have commenced their work with the standardization of nomenclature.

Nomenclature has been particularly vague and inconsistent in many instances. The term *slug* was in use in America as the equivalent of the English clump or thick lead; but no term existed for a line of type cast in one piece. In the descriptive matter of those patents which lead up to the invention of the **type-slug**, bars with raised type, called type-bars, were used for making impressions in flong; in the next stage of invention long multiple-strike matrices were used, these being also termed type-bars, and the term *type-bar* was in some instances even applied to the product or type-slug, until later the term *linotype* was coined for the type-slug; it is used in this sense in Mergenthaler's American patent 393846 of 1888. This innovation, however, did not save the patents from confusion of terms, for the word *linotype* shortly after its birth became applied to the machine producing the type-slug, and subsequently to all kinds of machines also producing type-slugs, but themselves of very different construction, the original meaning of the word being still maintained to denote the type-slug itself. In fact the word *linotype* has come to be used so loosely that the authors have heard it applied even to machines used for setting individual type.

Although the "Oxford Dictionary" gives linotype and monotype with lower-case letters, the authors, in their examination of patents, have suffered so severely from the ambiguities introduced by the too extended range of meanings attached to these words, that they have capitalized the names *Linotype*, *Monotype* and also the names of other machines, when reference is made to the particular machines constructed by the companies or corporations bearing those names. A statement referring to a Linotype machine is, therefore, not necessarily true for all machines of the **linotype** class; for the general meaning, including such widely different machines as the Typograph and the Monoline, a lower-case letter is used. The same applies to statements referring to the **Monotype** machine; such statements may not necessarily hold for the Graphotype and Tachytype, which, however, belong to the **monotype** class.

The term **type-bar** has been confined in this work to a composite slug consisting of individual type-heads combined with a bar which forms the body of the slug.

The American term *impression machine* is also liable to be misunderstood, as it may include not only matrix-impressing machines, but others which impress the type character on a slug of soft or locally softened material, an ambiguity to which the English term **stereo-matrix** machine is not liable.

Even the word *form* with its double meaning proves a frequent source of difficulty, and for this reason the authors have used the spelling **forme** merely for the sake of avoiding risk of misunderstanding. Amongst the names of the styles of type the original and correct spelling of one is **sanserif**, and it is probable that the term **serif** has been derived from this; the usual trade practice, however, is to call this particular style of type, which has no serifs, **sans serif**, and as this spelling is so much more common it has been retained.

The authors are informed on what they believe to be the highest authority that the capitalization of names derived from countries and persons should be abandoned so soon as these words have lost their geographical or personal association. Thus the **greek** character is used for mathematics, for physics and for other purposes besides the **Greek** language, the type for which is made up according to the **Greek** bill of fount, and a quotation from the Koran in the **Arabic** language is printed on a page which is numbered in **arabic** numerals. There is method in this, but why the braille alphabet should be generally spelt with a lower-case letter, and the much more generally used Morse with a capital letter the authors have not been able to discover.

The use of the hyphen has also proved to be a matter in which it seems almost impossible to establish consistency. It is usual, the authors believe, for two associated nouns to start their career, as in the case of rail way, as separate words, but on coming into more general use they are joined by a hyphen as rail-way, and when thoroughly acclimatized they become a single word as railway.

Wherever definite expression or clearness of meaning has come into conflict with what some might consider the more scholarly use of words, nicety of language has had to give way to the demand for accuracy of definition.

Even on such apparently simple matters as punctuation the authorities do not agree; Collins in the fourth edition of the "Authors' and Printers' Dictionary" states, on p. 318: "quotations, *all* extracts in the exact words of the original, if set in the text type, to have double turned commas at the commencement, and at the beginning of each paragraph (*not* each line) . . . " while the 19th edition of "Rules for Compositors and Readers at the University Press, Oxford," (the printers of the "Authors' and Printers' Dictionary") states, on p. 43: "Single quotes are to be used for the first quotation; then double quotes for a quotation within a quotation."

Some of the difficulties which the authors have encountered from the lack of a standard nomenclature are mentioned in the body of this work, examples are: double pica meaning 22-point or 24-point, and antique meaning more than one style of face; the terms for expressing wider and narrower faces than the standard are also subject to differences of meaning, and students of this subject will doubtless recall other instances of ambiguity of nomenclature.

APPENDIX V.

LIST OF ILLUSTRATIONS.

INDEX.

Un autor debe siempre escribir el índice, quienquiera que haya escrito el libro.

From the Spanish.

Set in the body-fount of the book; 10-point old-style (Clowes).

The more important references are given in **heavy type**; plates in roman numerals, capitals; preliminary matter in roman numerals, lower-case; non-naturalized foreign words in italics; names of type-bodies and of type faces commence with a lower-case letter when this is the ordinary practice.

Set in body-fount of index; 6-point old-style (Clowes).

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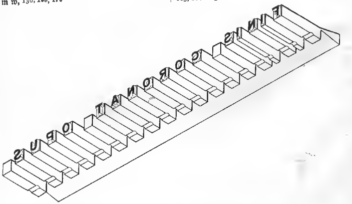

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