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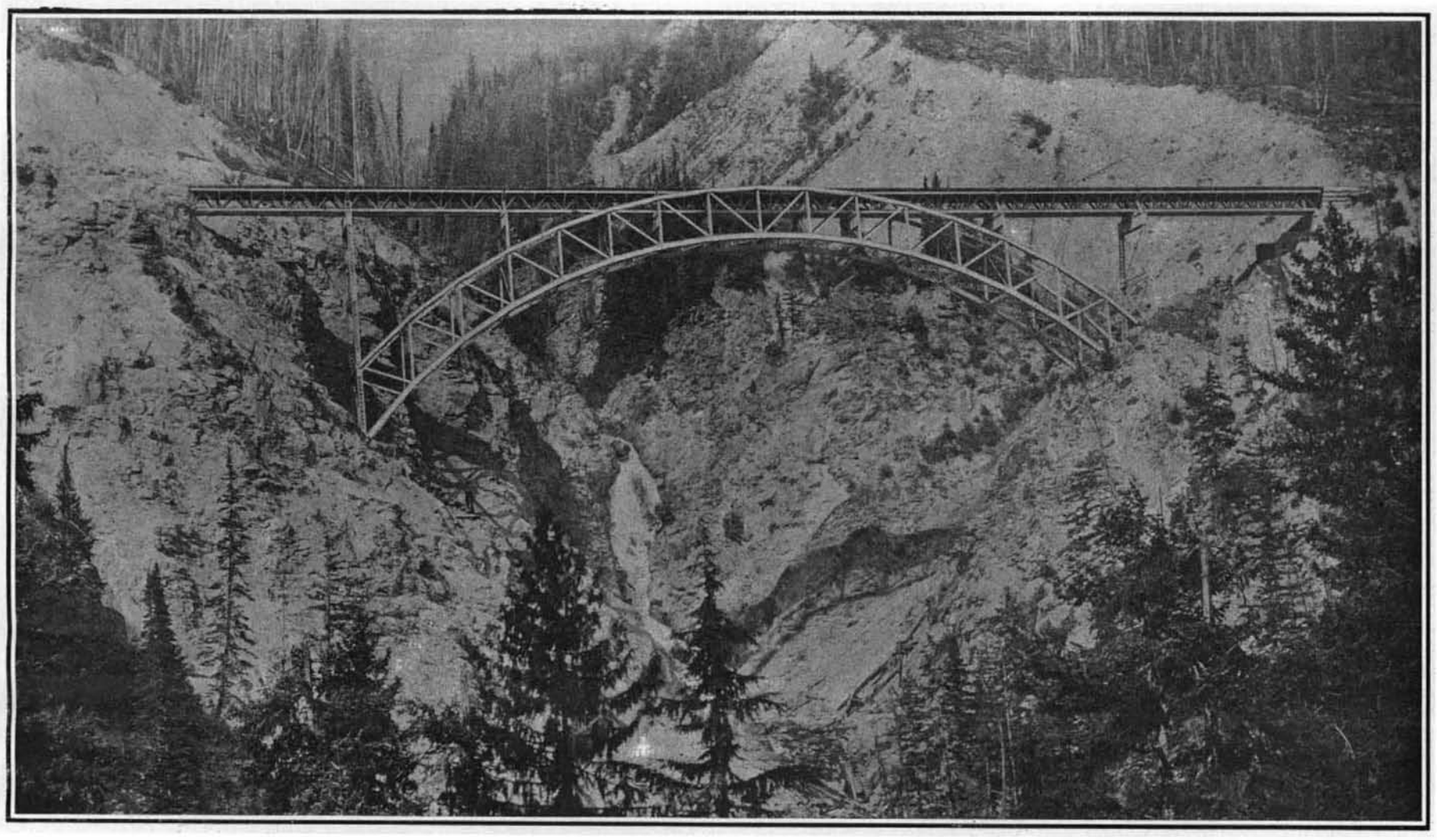
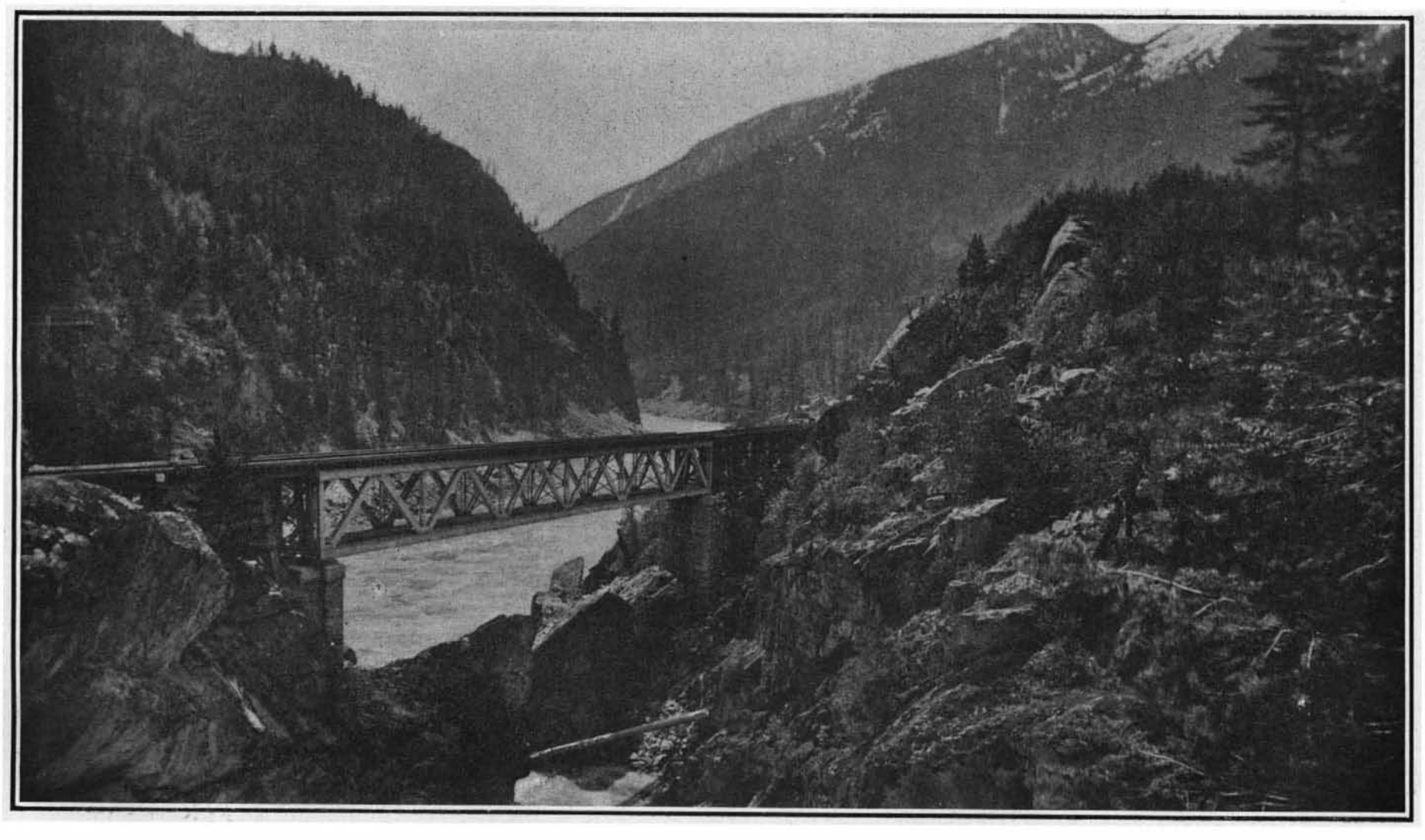


Stoney Creek Bridge, Selkirk Range, on the Canadian Pacific.



Canadian Pacific Railroad Bridge Across the Skuzzy River, Fraser Canyon.

NEW RAILROAD CONSTRUCTION IN CANADA AND THE NORTHWEST.—[See page 10.]

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NEW YORK, SATURDAY, JULY 6, 1907.

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

OUR NAVAL FORCES IN THE PACIFIC.

When the British Admiralty decided, a few years ago, to call home the squadrons which she had been in the habit of maintaining on the Halifax and West Indies stations, reducing the garrisons both at the famous Nova Scotian fortress and also on the Island of Bermuda, the step was interpreted by the world at large, and very properly so, as an evidence of the cordial relations existing between Great Britain and ourselves. The concentration of the weightier portion of a country's fleet in any particular place may be taken as indicating where that country considers that its interests are, for the time being, most threatened. It is equally true that the withdrawal of naval forces is invariably accepted as indicating that the relations of the two powers affected are thoroughly amicable.

We have heard a great deal of loose talk, lately, about the possibility of a war with Japan. Had the Japanese been a less highly civilized people, this irresponsible chatter might easily have blown the war spirit of that warlike people to a white heat long before this. We hold it to be a proposition indisputable, that if the Japanese press and certain Japanese officials had discussed the possibility of war with the United States with as much reckless abandon as a certain daily journal in this city and certain men of more or less prominence in the country have done, Congress would long ago have resounded with threats and denunciations, and not a small section of the country would have been eagerly awaiting the call to arms.

Fortunately, the governments both of the United States and Japan have been entirely unaffected by this foolish and utterly baseless talk of possible conflict; and that the Navy Department, at least, is satisfied that Japan is friendly, and intends to remain so, is proved by the fact that our naval forces in the Pacific have been reduced to a very conservative peace footing. By way of proving our proposition, we submit below a statement of the number and type of the ships of our navy which are stationed at present in those waters which the alarmists would have us believe are shortly to witness a disastrous naval conflict.

Stationed on the home coast, then, we have at present in commission not a single battleship. Of the three which are there, the "Oregon" is just now undergoing reconstruction; the "Wisconsin" is repairing; and the new "Nebraska," very much behind her date of completion, is only now getting ready to go into commission.

We have no coast defense vessel in commission, the "Wyoming," which is the only vessel of that type at present on the Pacific coast, being now at the yard undergoing repairs. The most effective ships in commission on the coast are the three semi-armored cruisers "Charleston," "St. Louis," and "Milwaukee," vessels of 9,700 tons and 22 knots speed, protected by a partial and light belt of 4-inch armor and a 3-inch deck, and carrying a battery of fourteen 6-inch guns. Two more powerful armored cruisers, the "California" and "South Dakota," of 13,400 tons and 22 knots, protected by a 6-inch belt, and armed with four 8-inch and fourteen 6-inch guns, will shortly be placed in commission, the "California" during the present summer, and the "South Dakota" during the autumn. We have also in commission on the home coast the protected cruisers "Chicago" and "Albany," old boats, built respectively in 1885 and 1897, and the gunboat "Princeton." In the same class, but out of commission, are the cruisers "Boston" and "New Orleans" and the gunboats "Bennington," "Marblehead," "Petrel," and "Wheeling." Of destroyers on the coast we have in commission the "Preble" and "Perry," and out of commission the "Paul Jones"; while there are three torpedo boats in commission and two out of commission. Out of commission also are the two submarines "Grampus" and "Pike." Among the fleet auxiliaries we have in commission the collier "Saturn" and the transport "Buffalo," while out of commission are the transport "Solace" and the hospital ship "Relief." Down in Central American waters is stationed the gunboat "Yorktown."

On the Asiatic side of the Pacific the strength of our fleet lies in its armored cruiser squadron, which consists of four vessels of the "California" class, namely, "Colorado," "Maryland," "Pennsylvania," and "West Virginia," all of which are in commission. In addition to these we have the old monitor "Monadnock," and out of commission the monitor "Monterey." In the protected cruiser class the United States is represented by the sister vessels "Cincinnati" and "Raleigh," built in 1892, each carrying eleven 5-inch guns, and three sister ships "Denver," "Chattanooga," and "Galveston," of 3,200 tons and 16½ knots speed, each armed with ten 5-inch guns; while two other vessels of the "Chattanooga" class, the "Cleveland" and "Denver," are now *en route* to the Asiatic station. Our representation in gunboats is quite numerous, but if we exclude the comparatively modern "Concord," "Helena," and "Wilmington," of between 1,400 and 1,700 tons, the other seven, which are small and very much out-of-date gunboats, captured from Spain during the last war, must be reckoned as of little value. The Asiatic fleet also includes five destroyers, two of which, the "Barry" and "Chauncey," are in commission, and the others in reserve. The fleet auxiliaries attached to this station include three colliers and three supply vessels in commission, and a transport and a collier out of commission at Cavite in the Philippine Islands. Down in the south mid-Pacific, at Samoa, is stationed the gunboat "Annapolis."

In summing up, then, it will be evident that the Navy Department of this country has no apprehension of any near or even remote hostilities, inasmuch as there is not a single battleship in commission, and our fighting strength is represented only by the six armored cruisers of the "California" class, the three semi-armored cruisers of the "Charleston" class, eight small protected cruisers from ten to fifteen years of age, four modern gunboats, four destroyers, and three torpedo boats.

THE ENEMIES OF STRUCTURAL STEEL.

Too much cannot be said of the excellent qualities of structural steel of the standard composition and workmanship. Its reputation for the combined qualities of elasticity, toughness, resistance to compression, and shear and durability has been established by years of useful duty in a thousand different forms and under a thousand different conditions. Steel, however, is subject to two insidious forms of attack, the peril of which lies in the fact that the damage is done under conditions where inspection is difficult and in many cases impossible. We refer to rusting and electrolysis.

The destructive effects of rusting are so well understood, that the efforts to protect the steel commence at the very time that the material receives its finishing pass in the steel mills. In all well-regulated works the finished work receives a coat of protective paint before it is placed in the storage yard, or shipped to the purchaser. If the paint be applied to thoroughly clean surfaces, quite free from rust, and if the steel work be again carefully painted before it is inclosed in the concrete, terra cotta, or other fireproofing material of the building, and the space between the fireproofing and the steel is carefully filled in with cement, experience has shown that it will probably be safe against deterioration by rusting for all time to come. But these theoretical conditions are seldom perfectly fulfilled. Too often the finished shapes at the mill are exposed to the moisture and acids of the atmosphere long enough to take on a coat of rust; and unless this be very carefully removed, the mere application of the ordinary paint of commerce will not prevent oxidation from taking place under the paint on the surface of the steel. In proof of this, we direct attention to the case of the reconstruction of the Mutual Life Insurance Company's building in San Francisco, when, in tearing down the six upper stories, an excellent opportunity was afforded to observe the behavior of structural steel in a steel and masonry building. We made editorial reference to this subject in our issue of March 16. From the account there given it seems that, where the steel had not been thoroughly cleaned before painting, there were occasional instances of some rust under the paint, and although these were rare, they indicated the necessity for a thorough cleaning of the steel before it is painted. Furthermore, there is a sense in which the preservative paint may defeat the very object at which it aims, by serving to conceal badly-rusted surfaces from inspection. The ideal protective covering, both for steel which is to be inclosed from view, and that which will be permanently exposed to the attack of the weather, would be a covering which, like varnish, would be sufficiently transparent to enable the condition of the underlying steel to be carefully inspected. If some composition could be produced, which combined transparency with protective qualities, a long step would be taken in the direction of rendering all steel work, whether exposed or concealed, imperishable.

The problem of the electrolysis of steel is one that we have always with us. Interest in the question was recently revived by the presentation before the American Institute of Electrical Engineers of the experiments of Mr. Knudson of this city, an account of which will be found in our issue of April 13. In these experiments three lengths of wrought-iron pipe were set in three blocks of Portland cement sand concrete. When the blocks were three years old, one of them was placed in a tank of sea water, another in a tank of fresh water, and direct current was fed to them, pieces of sheet iron being placed in the tanks to act as negative electrodes. The third block was placed in sea water; but no current was fed to it. After the blocks had been immersed for thirty days, the third block was found to be in perfect condition and the embedded pipe perfectly bright; but the two blocks to which current had been fed had developed cracks during the test; the pipes were considerably corroded; and the concrete had so greatly deteriorated, that it could be cut with a knife. In drawing deductions from this experiment it must be remembered, of course, that the conditions were unusually severe; but they were not so severe but that the ever-present danger of electrolysis is strongly emphasized. We mention this case, because it not only illustrates the action of electrolysis upon steel work as shown in the corrosion of the embedded pipes, but it indicates how increasingly necessary it is, in these days of reinforced concrete, to prevent the leakage of current from conductors. Although the evils of electrolysis have undoubtedly been greatly exaggerated, we believe that the mischief done is more far-reaching than the electrical companies and the owners of large electrical power plants are willing to admit. The remedy lies in more careful insulation. In the case of armored concrete buildings or buildings of skeleton steel, care should be taken to absolutely insulate the foundations and all that portion of the building which lies below the line of saturation of the earth. Much of the insulation of underground electrical conduits is undoubtedly very faulty, and it has become a question whether the thorough insulation of all forms of conductors should not be made the subject of legal enactment.

SIX MONTHS ELECTRIC OPERATION OF THE GRAND CENTRAL STATION.

The results of electric operation at the Grand Central station and terminal yard, as shown during the six months which have intervened since the electric current was turned on, have been very gratifying. Already the new system has loosened up the congestion, practically abolished the delays to incoming and outgoing trains, and restored the spirits and good temper of the company's patrons to their normal reading.

In proportion to the size of the yard, there was no other terminal in this country, or probably in the world, which was placed at such a disadvantage, from the operator's standpoint, as the Grand Central terminal. The area was so restricted that, outside of the express and mail cars, which of necessity had to be unloaded there, it was possible to store very few trains in the yard, and therefore the majority of the trains, after discharging their passengers, had to be run back over the main lines for a distance of 5½ miles to the Mott Haven yards. Furthermore, these yard movements had to be made in the midst of the regular train movements, and all of them through the two and a quarter miles of the Park Avenue tunnel, which was as badly steam- and smoke-obscured in winter as it was insufferably hot in summer.

At the present time, in spite of the inexplicable, but seemingly inevitable, delay of the New York, New Haven and Hartford Company in getting its electric system into operation, the New York Central Company, by the use of its multiple-unit local trains, and the almost complete substitution of electric locomotives for steam locomotives on its through trains, has made a vast improvement in conditions, both in the tunnel and the station yard. The atmosphere in the tunnel is greatly improved, and were it not for the continuing nuisance of the New Haven steam locomotives, the air of the tunnel would to-day be absolutely clear and sweet. The reduction in the number of train movements in the yard and station has been remarkable. Formerly, every time a steam train entered the station and left it, there were four separate operations connected with the train, involving eight signal operations. First, the train pulled into the station; secondly, a locomotive backed up to the rear end of the train; thirdly, the train was pulled out from the station; and fourthly, the locomotive which brought the train in backed out of the station. But the multiple-unit train merely enters the station and leaves it again, the only transfer being that of the motorman, who walks from one train to the other.

When the electric operation was commenced in De-

cember of last year, the total number of movements to and from the Grand Central terminal was, according to the official time table, 1,213. By the introduction of electric operation, the total yard train movements have been reduced by 690. It is this reduction more than anything else which has loosened up the congestion that completely disorganized the schedule during the autumn and early winter of last year.

Over and above the adjustment of the train schedule, the station and yard have been greatly improved in other respects, and notably in the reduction of noise, and the abolition of steam, smoke, and cinders. The multiple-unit trains, as used in local service, and even the large 97-ton locomotives, run with a smoothness and quietness which are very noticeable. When that greatly hoped for, but long-deferred day arrives on which the New Haven Company shall have been able to make its high-tension system work, and that company's steam locomotives shall have been withdrawn, there will be very little visible or audible evidence of the existence in this part of the city of one of the greatest terminal stations in the world.

ORIGINAL METHODS OF TONING DEVELOPED PHOTOGRAPHIC PRINTS.

BY MILTON B. PUNNETT.

The desire to obtain colors other than those given by development *per se* has led the manufacturers and users of bromide and so-called gaslight papers to resort to different methods. Of the many methods used, the one that has found the greatest application is the so-called sulphide method, of which the Velox redeveloper may be taken as a good example. About twelve years ago the writer recommended in one of the photographic magazines a similar method for obtaining sepia colors on lantern slides. Sulphide tones properly made are permanent. Sufficient time has elapsed since their introduction to thoroughly prove this. Facility of production is also in their favor. The tones are, however, not very varied, nearly always being some shade of sepia. Experiments to obtain some other permanent sulphide tone were made by the writer with what appeared to him to be a fair degree of success. It was found when finished prints made on Velox or Nepera bromide paper (I mention these papers because my experiments were confined to them) were immersed in a solution of ammonium sulphocyanate and sodium sulphide, a good purplish tone, very often equal to a gold tone on printing-out paper, was obtained.

The following formula has proved the most satisfactory of any tried:

A.

Ammonium sulphocyanate...	8 ounces
Water to make.....	16 ounces (fluid)

B.

Sodium sulphide (crystals)..	½ ounce
Water	3 ounces

Following are condensed instructions for its use:

Bath No. 1.

Solution A.....	1 ounce
Water	3 ounces
Solution B.....	1 drachm

Mix just before toning.

Immerse the fixed and washed (and preferably dried) print. The toning action begins almost immediately, ranging through the purple tones first and then into the sepias.

Allow the print to remain in the toner till the desired color is reached, then wash fifteen minutes in running water and dry as usual.

With the bath at 70 deg. to 80 deg. F., prints will tone in from fifteen to forty minutes; at 90 deg. to 100 deg. F. five to fifteen minutes will suffice, but it is not advisable to use the bath at a higher temperature than 100 deg. F., owing to its softening action on the film.

Prints developed with Velox N. A. developer tone quicker than prints developed with ordinary developer.

The rapidity of the toning may also be increased by adding more of solution B, but not more than one drachm should be added to the original solution at one time, as this would render the bath too alkaline and soften the film.

It works best when freshly mixed, and after forty minutes or so more B solution may be added.

The old bath may be kept for future toning, but before use it should be filtered or decanted to remove the white precipitate formed, and fresh B solution added, but it should be discarded when it becomes so alkaline as to affect the film.

It will be found that the toning is influenced somewhat by the character of the negative used, different degrees of density in the negative affecting the silver deposit on the print and the subsequent action of the toning solution.

It will also appear that matt papers tone more readily than the glossy, and that purple tones are easiest secured on glossy papers.

It must be confessed that the laws governing the action of this bath are not as thoroughly known as could be desired. Sometimes it will work quite rapidly, and again under apparently the same conditions it works much slower.

Further experiments have shown that its certainty of action could be greatly improved by mixing with it hypo alum toning solution, made according to the following formula:

C.

Hypo	10 ounces
Water	50 ounces
Heat to boiling and add	
Powdered common alum.....	2 ounces

Allow to stand until cold. It improves by standing.

Bath No. 2.

A	½ ounce
C	½ ounce
Water	3 ounces
B	1 drachm

When B is added the solution is clouded by the precipitated aluminium hydroxide. This precipitate does not interfere with the toning action.

This latter bath (No. 2) yields tones equal to and quite often superior to the former bath (No. 1).

It also smells more strongly of hydrogen sulphide, and it is not advisable to use it where the ventilation is poor. As its action ceases, more of B can be added.

The latter bath has also better lasting qualities. I have known it to tone without adding an additional quantity of B after it has stood over night.

AS A PRELIMINARY BATH.

Prints from some negatives when bleached and redeveloped with sulphide solution sometimes incline more to the yellow than is desirable. Having ascertained this fact, colder tones can be obtained on subsequent prints to be toned by using bath No. 1 as a preliminary bath. How long the print should remain in bath No. 1 cannot be stated with exactness, as there are several factors to be taken into consideration; chief among these are, 1, how much the color given by the bleach and redeveloping method differs from the desired color; 2, how fresh bath No. 1 is. The fresher the bath, the quicker it works. Other things being equal, the longer the print remains in bath No. 1 the colder the tone. In a freshly-prepared bath at the ordinary temperature, even fifteen seconds is enough to effect a change in color in the finished print.

As a general thing, any immersion, even one falling far short of the time necessary to produce a visible effect, is quickly made apparent by the print refusing to bleach as much as it would have done were it untreated, when placed in the bleaching solution.

Prints should be well washed before placing in bleaching solution, and should remain in it from 5 to 10 minutes or until it is certain that the bleaching is completed.

After bleaching, prints should be rinsed free from bleaching solution and redeveloped as recommended in the Velox redeveloper instruction.

What chemical reactions take place in what I would call the sulphide sulphocyanate method of toning I have not investigated far enough to state.

However, hydrogen sulphide is released, and this in its nascent condition no doubt has power enough to attack the silver of the image. It is also certain that other reactions have an effect, for if the ammonium sulphocyanate is replaced by an equal weight of the potassium salt, the toning action is *very* much slower.

To the question, Why does this method give a different color from that obtained by simple bleaching and redeveloping with sulphide solution? it might be answered, Because the conversion of the silver is not so complete as in the latter process. In reply would say that it would be hard to imagine the colors obtained on some prints as resulting from a combination of sepia and black.

As they are, the processes described are practical, but there is room for improvement.

To the photographic chemists the reactions involved will also prove worthy of investigation. Bearing on this subject three other experiments which were made are, without doubt, worth mentioning. A developed gaslight paper print partially immersed in a dilute solution of sodium sulphide, toned only on the parts which were exposed to the combined influence of the solution and the air. A print wet with water and used as a cover to a glass containing a sodium sulphide solution toned in the parts exposed to the fumes. When hydrogen peroxide was used to wet the print in place of water, quicker and better results were obtained. With the necessary fuming box this method might prove a commercial possibility.

To Dredge Nevada Placers.

Plans have just been perfected to dredge placers in Nevada on a colossal scale. The purpose is to operate placer mines at Osceola, Nevada. An immense pumping plant and gasoline hoist will be purchased; also two large dredges, capable of removing 2,500 yards of earth a day, are to be installed. Churn drills will also be employed to ascertain the extent of ground that is capable of being worked by dredges.

SCIENCE NOTES.

What is known as the poisonous bean of Java, which caused a number of serious accidents, was studied not long ago by M. Guignard. It appears that a poisonous grain has also been found in France by M. Bertrand, and this is the grain of vetch (*Vicia angustifolia*) which is used in the Medoc region for feeding cattle. This variety is different from the ordinary vetch (*Vicia sativa*) and gives a grain which shows an odor revealing the presence of hydrocyanic acid when ground up in water. To isolate the active body, which appears to be a glucoside known as *vicianine*, the grains are exhausted by cold alcohol. The extract is then treated by ether, which takes off the chlorophyls and the fatty matters. There remains a pasty mass which is taken up by alcohol and the latter deposits crystals of the vicianine. After re-crystallizing in water this body is seen in the form of brilliant colorless needle-like crystals which melt at 166 deg. C. The aqueous solution has a certain action upon polarized light. It appears that the grains of *Vicia angustifolia* which M. Bertrand observed can furnish about 0.75 part per thousand of hydrocyanic acid. Accordingly it is not safe to use it for feeding domestic animals.

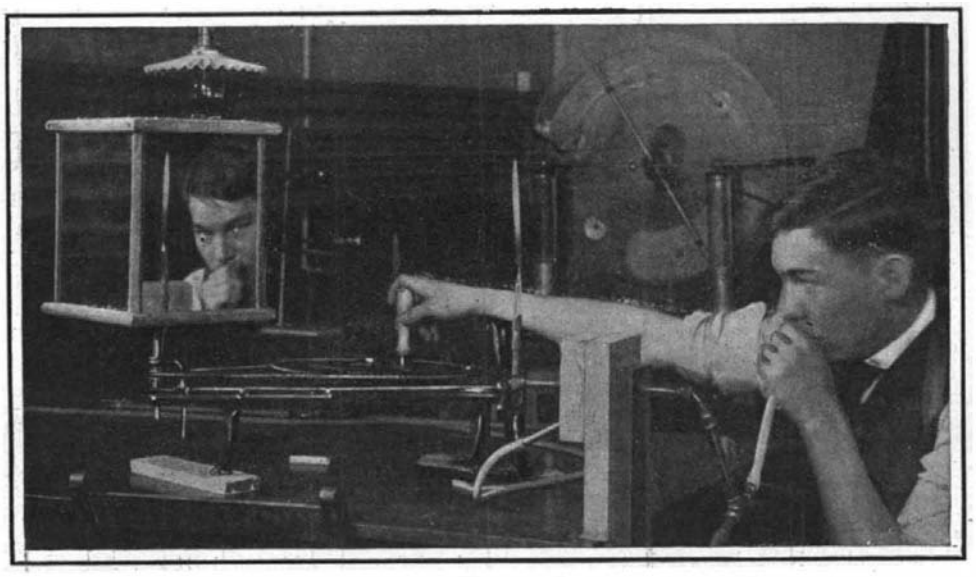
In order to eliminate the disturbing effect of the severe vibrations set up by the London County Council's electric generating plant at Greenwich upon the adjustment of the transit telescope at the adjacent observatory, an ingenious modification of the device generally adopted for such purposes has been evolved. Earth tremors such as are set up by vehicular and railroad traffic are damped, as is well known, by means of a mercury trough with an amalgamated metal bottom. But the vibrations caused by the four engines installed in this station are of a much more serious nature, the image reflected in the mercury trough moving in such a manner as to show that the mercury is being subjected to forced oscillations, while the period agrees with the impulses due to the inertia of the reciprocating masses in the generating engines. Consequently, the ordinary means for damping these oscillations are abortive. The tremors formerly arising were more or less intermittent, whereas the present tremors are never wholly absent. Instead of using the saucer-shaped trough, a receptacle is adopted in which the mercury assumes the form of a thin film lying on an amalgamated metal surface, the curvature of which is so slight that the depth of mercury is less than 0.5 millimeter at the center of a circle 15 millimeters in diameter. By this means a perfectly steady surface is presented, in which the reflection is not disturbed by the heaviest vibrations set up when the four engines at the generating station are running simultaneously. The viscosity of the thin film is so great that even these long-period oscillations are completely damped out, and a satisfactory solution enabling observations to be effected by reflection in a mercury surface is assured. The film though still sufficiently fluid to assume the form of a horizontal plane participates in the motion of the ground like a rigid body, so that there is no relative displacement of the image with respect to the telescope. The committee of investigation, comprising the Earl of Rosse, the distinguished astronomer, the late Sir Benjamin Baker, and Mr. J. A. Ewing, appointed to inquire into the effect of this generating station upon the work of the observatory instruments, while satisfied with the efficiency of the above solution of a difficult problem, were not fully convinced as to whether the vibrations exercise any other injurious influences upon the utilization of the instruments, and suggested that a period of two years should elapse before a definite opinion is expressed, the question as to the extent of obstruction through the chimneys or discharge therefrom being similarly deferred. The committee, however, pointed out that the oscillations might have been reduced to the minimum, had the engines installed at the generating station been perfectly balanced, the type of plant adopted being eminently adapted to complete balance; but this precaution had not been adopted, and to rectify this error would be somewhat costly. When the outcry arose as to the work of the observatory being seriously affected, only one half of the designed generating plant had been installed, and the committee point out that the second section should comprise turbines, which with their attendant generators must be of the perfectly balanced type. The height of the chimneys is also restricted to the maximum of 204 feet above ordnance datum. The discharge of the gases from the chimneys is also to be carefully maintained, and must not materially exceed 250 deg. Fahr., while the capacity of the station is not to be extended beyond the contemplated 20,000 kilowatts of the second portion. In this way the committee hoped that the troubles which have arisen, while not entirely eliminated, may at all events be reduced to the minimum; and although they deprecated the fact that the site was ever selected for the generating station, they were of opinion that provided all precautions are observed, the work of the observatory will not be appreciably disturbed.

SIMPLE APPARATUS FOR PRODUCING THE MANOMETRIC FLAME.

BY W. W. MILLS.

The manometric flame is a very attractive experiment in the study of sound. The apparatus and manipulation of this experiment are generally too difficult for high school pupils, but with some notes may be satisfactorily performed even by pupils of that age. Take four pieces of good mirror glass about 8 x 10 inches (French plate is preferred) and fit them nicely into horizontal grooves above and below on the four faces of a block of wood of the same dimensions (whitewood is suitable). The four edges of the block where the glass plates meet are now *passe-partouted* with gold tape, which sets off the apparatus to good effect. In the base of the block is fitted a square plug of wood large enough to prevent it from working loose, and this is glued into place. In the center of this plug the upright end of the whirling machine or an ordinary centrifugal machine of the laboratory is fitted, so that as the block whirls it will do so evenly. This will be found to cover the mirror part of the apparatus. With this preparation the idea is to throw the image of the vibrating flame into the mirror, so a diaphragm is necessary. Take two pieces of smooth whitewood about 6 inches by 18 inches by 1 inch, and near the top end of them take out a circle of 4 inches in diameter by ½ inch deep, so that when the two are fitted together you will have a space there of 1 inch depth. Between the two now place a very thin piece of dental rubber cloth, usually termed dam rubber. Glue it to the wood around the edges and bring it up rather taut. Now place the pieces of wood together with four suitable screws, and glue the seam up, so the chamber will be hermetically sealed. We will now name these two apartments separated by the rubber the "front" one and the "rear" one as we face the mirror block. The flame coming from the flame apparatus should strike the mirrors about midway of their height. Through the front chamber at an angle of 45 deg. with the table to which the apparatus is fastened, run a 3/16-inch hole, into which insert a piece of gas pipe 3 inches long. On this fasten the gas hose from the gas cock. Upward from the front chamber run a 3-inch gas pipe, on which fasten a small piece of rubber tubing in which is fitted tightly a 2-inch glass tube, one end of which is drawn out to a 1/16-inch hole. Now if the gas is turned on and lighted, its height may be adjusted to strike the middle of the mirrors. The distance separating the two may be varied, depending on what is desired. From the center of the rear chamber backward run another 3/16-inch gas pipe 4 inches in length, on which fasten a rubber tube about 3 inches in length. Now if one person is intended to talk or sing into the chamber, this will be enough; but if two or more persons are to do it, a T is necessary, or if more, a three-way or four-way tube will be needed. Generally, a two-way tube will be found sufficient. Now have the singers take their places and sing into the chamber through the tubes, but be careful that the necessary jar is communicated to the rubber diaphragm by the air column, and this may be best effected by allowing the singers or speakers to set their teeth against the tube held in the mouth. If this is not done, the necessary jar will not be communicated to the diaphragm, and the flame will not be made to jar or vibrate, and consequently the flame will not vibrate. Now darken the room so that the flames may be clearly seen, and slowly turn the mirrored block. Sing into the chamber, and a notched band of light will appear across the mirror's face. The lower the pitch the coarser the notch will be, and the reverse. The tip of the notches will bend away from the direction of motion. If two pitches are shown at once, they will be represented on the mirror. As many effects may be shown as figures by the Chladni plates. A little experiment will overcome obstacles.

One of the accompanying illustrations shows the apparatus in use, and the other, reproduced from Ganot's "Physics," shows the vowel E sung in two notes an octave apart.



SIMPLE APPARATUS FOR PRODUCING THE MANOMETRIC FLAME.

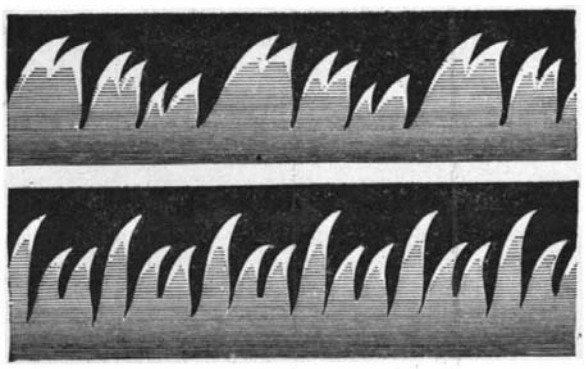
A Two-Cycle Motor Test.

The Automobile Club of France has awakened to the fact that the two-cycle gasoline motor, on account of its extreme simplicity, is valuable for automobiles. In order to promote its use for this purpose, the club will hold an international competition for two-cycle automobile motors next October. These motors must develop 8 horse-power as a minimum and 24 horse-power as a maximum; and each motor must develop its maximum horse-power at a speed of not less than 800 revolutions per minute and not more than 1,500 revolutions per minute. The tests will comprise:

I. A six-hour test of the motors at full load.

II. A three-hour test at half load.

III. A three-hour test at no load, at the same speed at which the motor ran at full load.

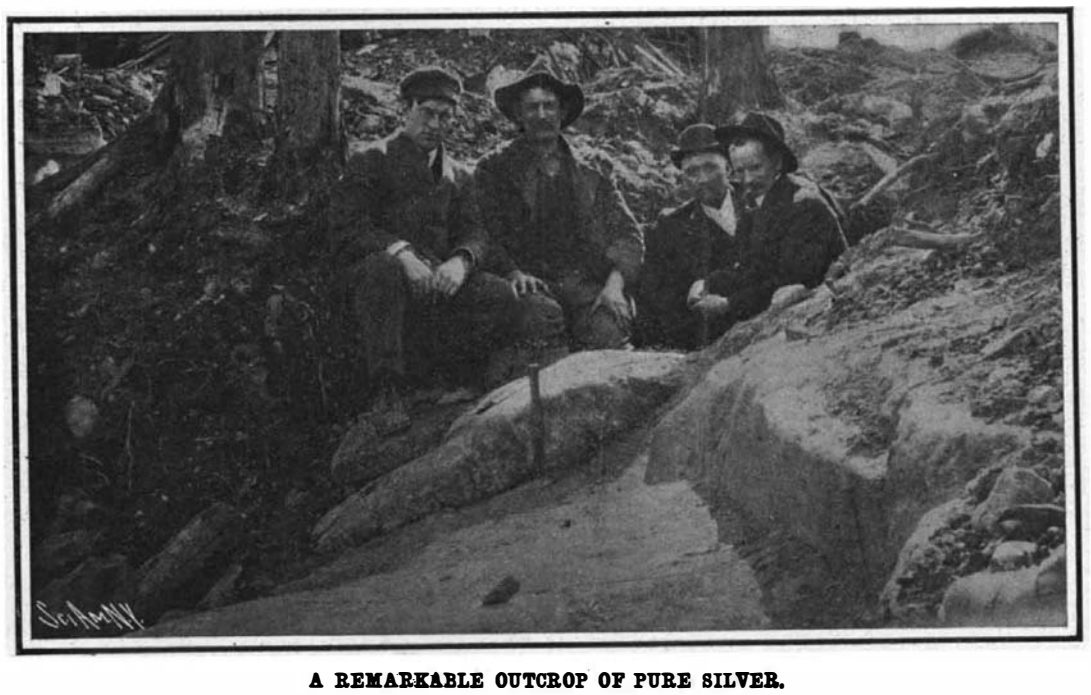


NOTCHED BANDS PRODUCED BY SINGING THE VOWEL E.

The fuel consumption will be noted during these three tests. Any suitable liquid fuel may be used. The specific cost of consumption will be figured in francs per horse-power-hour, according to the cost of the various fuels at Paris, exclusive of the duty on said fuels.

The basis of valuation will be:

I. The massique power of the motor under the best conditions of operation, in horse-power per kilogramme.



A REMARKABLE OUTCROP OF PURE SILVER.

II. The specific cost of consumption in francs per horse-power-hour, corresponding to the maximum power.

These two bases of valuation will be used for classification with equal coefficients. The motor which shows the least specific consumption will receive the maximum number of points (100); the others will receive a number of points proportionately less, the minimum specific consumption being taken as unity. The same will be the case with the motor which obtains the maximum power with the least weight; this motor will be given the maximum number of points (100), the others receiving a number of points proportionately less. All motors will be weighed with their carbureters or atomizers and with their complete ignition outfits, but without mufflers, fuel, oil, or grease.

The motor which receives the maximum number of points will be the winner, the others following in the order of points obtained.

Any motor which does not go through all three trials under the conditions given, will not be classed. The consumption tests at half-load and no-load will not serve as a basis of classification, unless several competitors obtain the same number of points. The trials cannot be adjourned and, once begun, must be continuous. Competitors will be allowed one day for suitably mounting the motors on the testing benches, and a second day for any preliminary trials which they wish to make. The third day they must carry out the first test of six hours' duration, the fourth day the two tests of three hours, and on the fifth day the motor must be taken away.

Competitors will be given notice of the date of their test fifteen days in advance.

The entrance fee will be twenty dollars per motor.

The expense of mounting the motor on the testing bench and the cost of the fuel used must be borne by the competitors.

The competition will take place in the laboratory of the Automobile Club of France. Applications for entrance of motors in this test must be received before July 31, and must be accompanied with the plans, cross-sections, and descriptions of the motors.

A REMARKABLE OUTCROP OF SILVER.

The accompanying photograph pictures one of the most wonderful outcrops of pure silver that has ever come to our notice. The vein was discovered last May near Cobalt, Ontario. Projecting about nine inches above the bed rock, as will be seen by the foot-rule in the picture, it measures six feet in length, while in width it varies from a maximum of nine inches to about four or five inches. A nugget weighing 500 pounds has already been taken out. For our photograph we are indebted to Mr. J. F. Gillis, of Cobalt, Ontario.

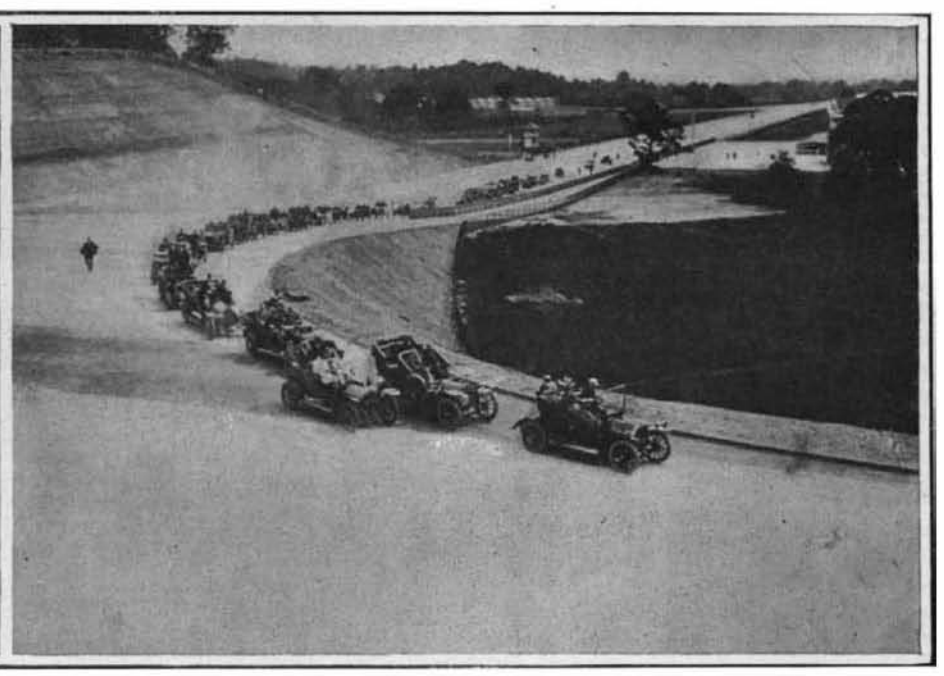
London Fires.

From the official return just issued by the London Fire Brigade, we regret to find that the inexcusably thoughtless practice of dropping matches and other lights was responsible for more than 21 per cent of the 3,843 fires which occurred last year in the County of London. Children playing with fire and matches are far less dangerous members of the community, for their antics resulted in no more than 6 per cent of the total number of outbreaks. Unprotected lights gave rise in one way or another to 257 fires, and oil lamps to 148 outbreaks. The continuance of improperly fixed stoves is again demonstrated by 67 fires, to which we must add 98 due to hot ashes and 235 to sparks from grates, giving fireplaces the unenviable responsibility for no fewer than 300 fires. Escapes of gas aided by the insane habit of searching for leakage with lights were the occasion of 134 fires, and defective electric circuits are debited with 100 outbreaks. That faulty wiring, and especially the use of ineffective casing, constitutes a real danger has been recognized by the revised regulations of the Institution of Electrical Engineers, and we hope that architects will insist upon the adoption of these in all installations with which they are concerned. The disastrous fire a few days ago in Camden Church, Camberwell, is one of the most recent examples of the danger lurking in apparently harmless electric wires, and which are absolutely harmless if only the necessary safeguards are provided.—The Builder.

A NEW AUTOMOBILE RACE TRACK.

The oval race track shown in the large illustration on this page has just been completed at Weybridge, England, and opened for automobile and aeronautical tests. This is the first race track especially constructed for automobile racing anywhere in the world. It was built by the Brooklands Automobile Racing Club at a total cost of about $500,000. The distance around the track is 3¼ miles. The track is constructed of concrete, and so banked at the turns as to be perfectly safe for a car traveling at a speed of 90 miles an hour.

The First Racing Car on the New Track, Making Nearly 100 Miles an Hour.



The Opening of the New Weybridge Automobile Racing Track.

In the construction of this motor race course, no less than 350,000 cubic yards of earth had to be removed or shifted, and 35,000 cubic yards of concrete had to be laid. The width of the track is 90 feet. The track is open for the testing of all cars which do not exceed a weight of 2,700 pounds. Such cars can be tested, upon days when there is no special race meet, at their maximum speed for a distance not to exceed 5 miles. No automobile is allowed to stop upon the track. In the event of a breakdown, the machine must be run to one of the refuges provided at different points along the track, where repairs or adjustments can be made. All cars must enter the track by passing through the weighing court, where their weight is taken. A fee of £1 is charged non-subscribers for the privilege of weighing and testing a car.

The opening of this track is an important event in the aeronautical world also, as a cash prize of $12,500 has been offered for the first heavier-than-air flying machine to circle it at a speed of not less than 10 miles an hour and at a height of 40 or 50 feet above it.

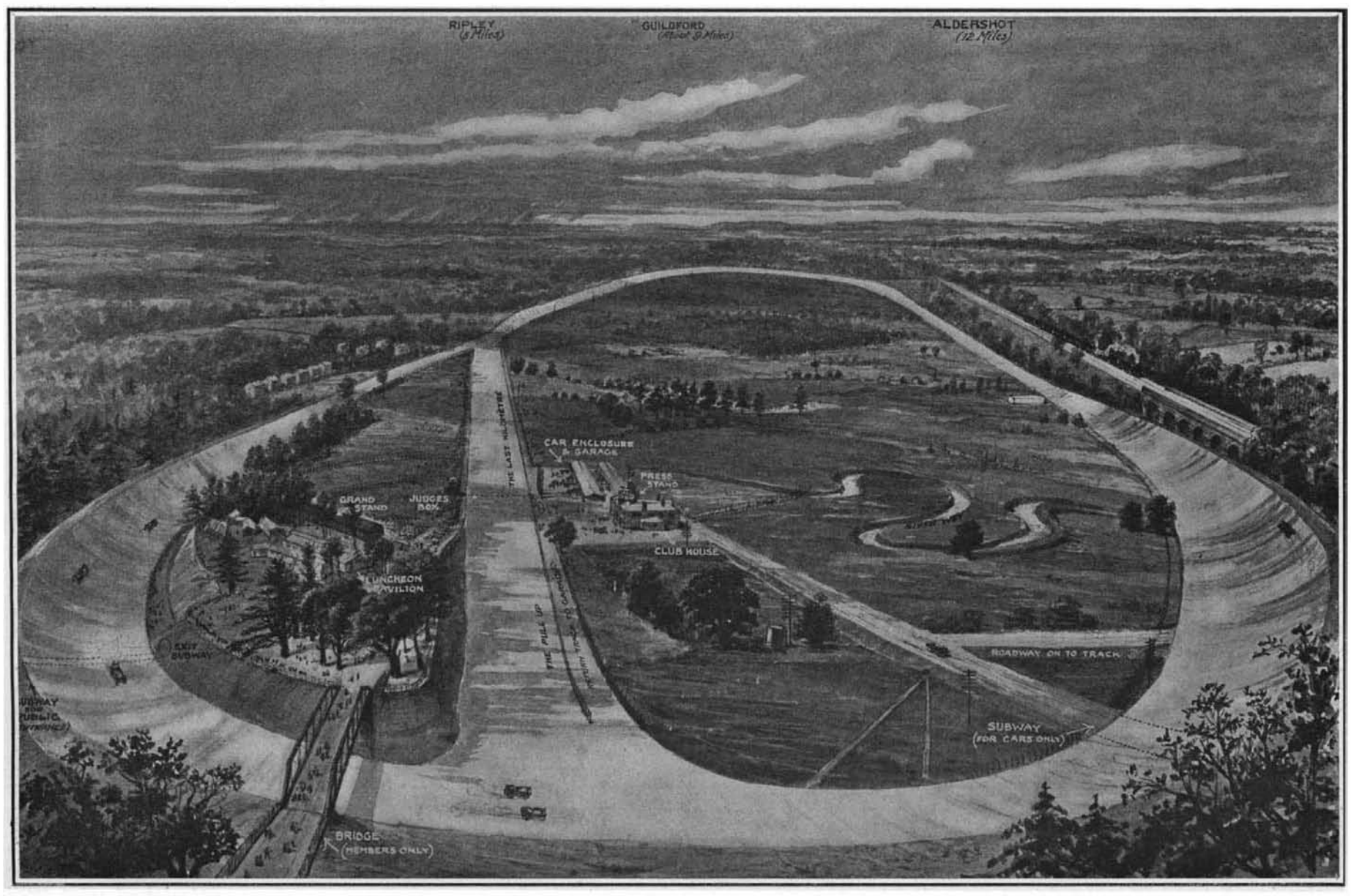
The Use of a Double Bath in Electro-Gilding.

Almost any solution which contains gold in any great proportion may be used in electro-plating; but to get the best color effect requires experience and knowledge. Even the most intelligent workman often has, despite all his care, trouble with his bath. Getting a coating is easy enough; but the color is the thing.

One of the most frequent causes of trouble in gilding is, according to a writer in the Deutsche Metall Industrie Zeitung, the employment of only one bath. Gold being so dear, naturally must be used with care; but exactly for this reason is it better to have two baths, because they give a better result than only one.

The principal constituents of a gold bath are gold and a solution of potassium cyanide. If copper, brass, or German silver (which the Germans call "new silver") is introduced therein to be plated, some of them will be dissolved off; and although this quantity is but small for each object plated, every time a new article is put into the bath, some of its outer surface is dissolved; so that at last the solution contains considerable other material than gold.

But while every electro-plater knows the evil influence of copper or silver on the gold coating, and endeavors to get as pure gold as possible to dissolve, so as to be assured of the color, few are careful to have the outer surface of the plated object composed of gold that is without any admixture of the baser metal. Such a result can be attained only by first employing an ordinary bath, which, as it dissolves some of the baser metal from the objects to be plated and redeposits a part thereof with the gold, does not deliver a perfectly pure gold coating. If, however, the articles, after having been plated with an alloy containing an infinitesimal quantity of copper or silver, be then placed in a second bath containing nothing but pure gold, this second solution will be able to dissolve little or none of the copper or silver from the surface of the half-plated article; it will remain much purer than the first, and the coat which it gives will consist of gold so pure that it may be said to be practically free from alloy.



From the Illustrated London News.

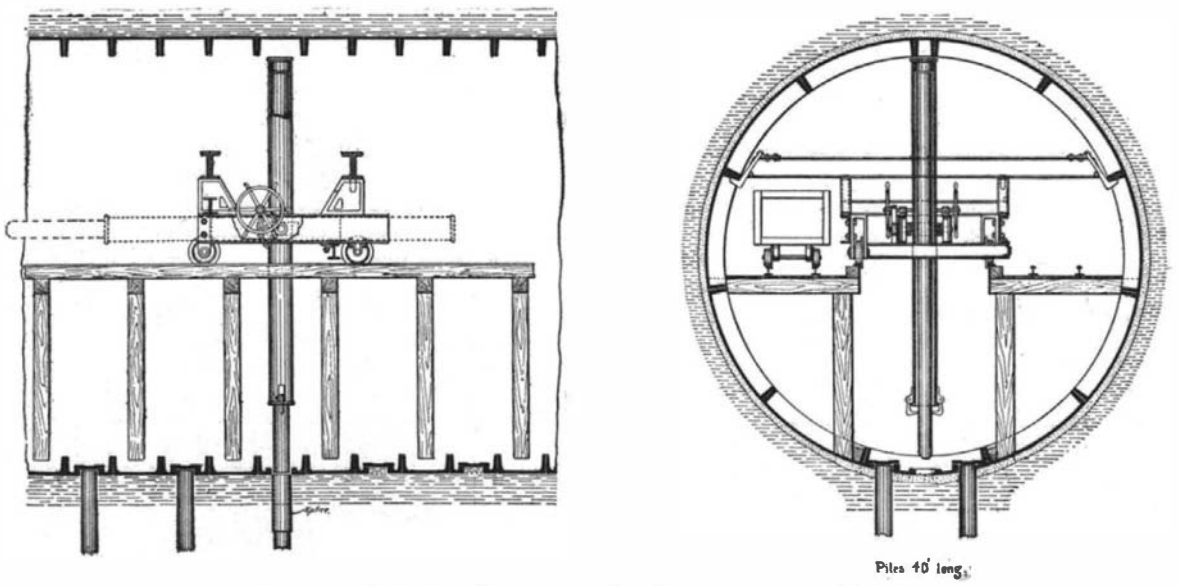
A NEW AUTOMOBILE RACE TRACK.

PILE FOUNDATIONS FOR TUNNEL TUBES.

In a recent editorial on "Tunnel Tubes in Soft Material," we pointed out the necessity of providing adequate foundations for the railway tunnels which are now being built in New York city under the North and East rivers. The question is not by any means a recent one with engineers, although it is only of late that the public has begun to appreciate its importance, particularly with regard to the Rapid Transit tubes below the East River. In this connection, we are glad to note that the condition of these tubes is to be made the subject of special investigation, both with regard to their strength to resist distortion and the necessity of providing for their vertical stability.

Among others who have carefully studied the problem of tunneling through the soft material of our river bottoms is Mr. J. W. Reno, of this city, whose project for double-deck subway construction has more than once formed the subject of illustration in this journal. Mr. Reno is of the opinion that some form of anchorage and support is necessary for any tubes that may be built through the mud and silt of these rivers; and he believes that, since it is desirable to avoid the heavy vertical reactions and horizontal torque, which are inseparable from the driving of iron screw-piles of large diameter, as proposed, better results would be secured by driving ordinary 12-inch piling in the manner described below.

The screw-piles proposed for the Pennsylvania tunnel tubes below the Hudson River are 5 feet in diameter at the screw and 27 inches at the shaft, and they are to be spaced 15 feet apart from center to center along the center line of the tunnel. It is proposed to put them down by a machine operated by hydraulic pressure which, at the same time that it rotates the pile, also bears down upon it with enormous pressure. The vertical hydraulic pressure upon the head of the pile must have its corresponding reaction against the roof of the tunnel. Moreover, the torsional reaction in a horizontal plane, necessary to rotate the pile in screwing it down, will tend to force the tunnel out of line laterally, just as the vertical reaction would tend to lift the tunnel. This will be the more appreciated, when it is remembered that before the tunnel has been lined with two feet of concrete it has a theoretical tendency to rise because of its buoyancy; for its weight is only about 15,000 pounds per running foot, whereas the semi-fluid material it displaces weighs 43,000 pounds per running foot, which gives a buoyancy in the tunnel itself of 14 tons per foot.



REACTION TRUSS FRAME, RENO HYDRAULIC PILE DRIVER.

In the plan herewith illustrated, it is proposed to use 12-inch wooden piles, three or four abreast, at every 5 feet of the tunnel's length, instead of using a large-diameter, cast-iron pile at every 15 feet. The pressure required to force down a standard wooden pile would probably not exceed 20 tons per pile, as compared with a necessary pressure of 100 tons for the cast-iron screw pile—this last being the pressure determined as necessary in the case of test piles, which were sunk by the company's engineers.

For the driving of the wooden piles, Mr. Reno has designed the compact and effective apparatus shown in the accompanying engraving. The pile driver consists of a steel cylinder, large enough to contain a 12-inch pile. The cylinder is provided with trunnions and a hand wheel, by which it can be moved from the vertical into the horizontal position, as shown in the drawing. When in this position the first 20-foot section of the pile is inserted, and the cylinder is then rotated back to its normal vertical position. A pressure of 375 pounds to the square inch, capable of producing 25 tons total pressure on the head of the pile, is then available on a short piston above the pile, within the cylinder, this pressure being secured by an electrically-driven hydraulic pump. When the head of the pile has been sunk to the floor of the tunnel, the second section is spliced on and driven in like manner, on the top of the first pile.

The carriage containing the pile driver is so constructed that the hydraulic cylinder may be moved laterally and three piles driven, side by side, in each bent. It will not be a difficult matter to cut the circular holes for the piles in the thin cast-iron shell forming the floor of the tunnel; and after the piles have been driven, the holes would be securely plugged by the pile and by the concrete capping, 2 feet thick, with which the tunnel is to be lined. In order to locate the pile driver in the most convenient position, an elevated timber platform is provided along the middle line and on either side of the tunnel, to which are bolted a pair of heavy beams, which serve as tracks for the pile driver carriage. The importance of designing a machine which will rapidly handle a heavy stick of timber, such as a pile, in the limited space found in the interior of a tunnel, will be understood when it is stated that, in this plan, 7,200 piles 40 feet long would be required in the foundation of the two Hudson River tunnels.

An important feature of the side platforms is the space which they provide for a pair of narrow-gage railway tracks, which serve the material cars in such a way, that the pile driver will not interfere with the passing of cars loaded with concreting or other material. By means of this arrangement, a pile foundation can be constructed simultaneously with the lining of the tunnel with concrete, with the result that there will be a considerable economy of time.

It would, of course, be undesirable that the vertical reaction of the downward pressure of the pile should be concentrated at one point of the tunnel roof; and, in order to distribute this pressure, two heavy I-beams are provided as part of the pile-driving outfit, which extend across the tunnel, and, by engaging the flanges at the points indicated, distribute the pressure over a large area of the roof. One of these beams is pivoted to the carriage, and can be moved out of the way, when the pile cylinder is rotated into a horizontal position.

By the method here described it is practicable to put down nine, or even as many as eighteen, piles, should it be so desired, in lieu of one large screw pile. Mr. J. A. Bensel, Chief Engineer of Docks, has made some valuable tests upon the supporting power of wooden piles, driven in 40 feet of Hudson River silt, which show that the piles, as here proposed for the Hudson River tunnel, will support a maximum load of 40 tons each. The Pennsylvania Railway Company will haul its trains through the tunnel with an electric engine weighing 105 tons, this weight being concentrated upon a wheel base of aproximately 24 feet. For this distance the proposed plan of using three-pile bents would provide twelve piles, and if we assume the maximum supporting power at 40 tons per pile, as stated by Mr. Bensel, there would be a total maximum support of 480 tons under the electric locomotive. It is, of course, obvious that piles could be driven under every segment of the tunnel lining, instead of under alternate segments, in which case the foundation would have a supporting power of nearly 1,000 tons for a length of 24 feet of tunnel. Finally, it should be noted that the strains upon the tunnel structure incidental to driving the piles is enormously reduced, for it is a fact that a pile can be forced down into the silt by a pressure of 15 to 20 tons, which, after it has stood for a few days, will remain firm under a pressure of from two to three times as great.

The Velocity of the Invisible Rays of Light.

The Boyden appropriation of $1,000, offered nearly forty years ago by Urian A. Boyden, an eminent mechanical engineer of his day, has at last been awarded by the Franklin Institute to Dr. Paul R. Heyl, of the Central High School of Philadelphia, for determining by experiment whether all rays of light or other physical rays are or are not transmitted with the same velocity. The problem which Dr. Heyl has solved is not to-day a scientific problem of the first importance, and has not been for twenty-two years. That all rays of light are transmitted with the same velocity has been held on the basis of indirect and circumstantial evidence. Dr. Heyl has now supplied that direct evidence of experiment which every theory ultimately demands. Dr. Heyl's essay is referred to a special committee consisting of Hugo Bilgram, Prof. Arthur W. Goodspeed, of the Department of Physics of the University of Pennsylvania, and Dr. George Flowers Stradling, of the Northeast Manual Training School of Philadelphia. The committee reported unanimously in favor of the essayist who had written under the pseudonym "Algol," the real person being only discovered after the award had been made. The manner in which Dr. Heyl has solved the problem cannot be more briefly and clearly expressed than in the following abstract of the committee's report:

Dr. Heyl succeeded in demonstrating, by experiment, that those of the ultra-violet rays of light for which glass is transparent have the same velocity as the light rays proper. He reasoned that if the velocity of these rays were different they would not arrive from a distant source, at the same time. For his test he selected Algol, a well-known variable star in the constellation Perseus, as the source of light. By means of a diffraction grating he eliminated all but the ultra-violet rays of a known frequency, and by focusing them on a sensitive plate obtained photographs of the star.

For the purpose of identifying the rays so recorded with the visible rays, regarding the time of their emission, he selected for the time of his tests the time during which the light of this star shows the peculiar phenomenon of fading and recovering. The period of this variation is known to be about six hours. During this period he took a number of photographs, one-half hour apart, each exposure being twenty minutes, the remaining ten minutes being employed for making the necessary preparations for the next exposure. He thus obtained a number of exposures of the star on the same sensitive plate, but shifted in position.

After developing the plate the successive images plainly showed a fading and recovering, although the exact location of the minimum brightness could not be absolutely determined, the approximate coincidence of the time of the minimum brightness of the visible and the photographed rays was obvious. These tests were repeated a number of times to eliminate the possibility of error and also to take in a certain range of the ultra-violet rays, and since favorable opportunity for making these tests is not frequent, the investigation extended over a period of two years.

The applicant then reasoned as follows: Assuming that the photographic minimum did not exactly coincide with the observed visual minimum, their difference did certainly not exceed an hour, and since the distance of Algol is no less than forty light years the difference of the velocities of the ultra-violet and the visual rays could not exceed one part in 250,000. This close approximation established equality to all intents and purposes.

Cody Kites for the British Army.

Capt. Cody, whose man-lifting kites have been acquired by the British government, and whose services have been retained by the army balloon department, is at present engaged in experiments with a kite similar in design to those already in operation, but which is propelled by a gasoline motor. For the purposes of his investigations the large balloon shed has been placed at his disposal. During the recent visit of Prince Fushimi and King Edward to Aldershot a series of maneuvers and demonstrations were carried out with the apparatus under cover, which proved eminently successful. On this occasion the apparatus was held in check by slipping tackle to a rope running at 30 deg. from the ground from one end of the building to the other. When the motor was set in operation the kite traveled from end to end of the building steadily and evenly. So far it has been possible to carry out successful flights for a distance of 1,200 feet, the limit of the experimental range of operations, with two trail ropes and loaded with two 56-pound weights, which approximately coincide with the weight of the average man. During the present summer a number of larger flights over a greater range in the open air are to be carried out.

The foreign trade of the United States for the eleven months ended May 31 for the first time passed the $3,000,000,000 mark in such a period and exceeded by $320,351,760 the total for the corresponding months of the prior fiscal year.

Correspondence.

Guard Rails for Rational Railroad Track.

To the Editor of the SCIENTIFIC AMERICAN:

Your first article in last week's paper, "Needed, a Rational Railroad Track," is sound. Have you ever noticed (in this State anyhow) how the law compels the railroads to guard-rail all railroad bridges? Would it not be a wise plan to compel all railroads to use all worn-out rails to guard-rail the main line, especially at high embankments, and clear through as soon as they can? LEROY TOBEY.

Penn Yan, N. Y., May 26, 1907.

Reformed Scientific Spelling.

To the Editor of the SCIENTIFIC AMERICAN:

In several recent articles in your valued paper, in which chemical terms are used, I notice that you adhere to the old spelling of some of these words. Thus you retain the unnecessary *e* in words ending in *ide* and *ine*, such as *oxide, chloride, iodine, bromine*. The improved method of spelling these words is *oxid, chlorid, iodin, bromin*. Also *ph*, instead of *f*, in such words as *sulphur, sulphate, sulphide*. (*Sulfur, sulfate, sulfid.*)

This improved form of spelling chemical terms was introduced years before Mr. Carnegie's "fonetic" spelling was first heard of, and should not be confounded with it. This spelling is now being used by progressive chemists; books in chemical technology have been published in which the improved spelling is used, and it is gradually coming into general use.

In this connection, I cannot do better than to quote the following from the Standard Dictionary:

"The rules for the spelling of words in chemistry, as *bromin, chlorid, morphin, sulfid*, were adopted in compliance with a resolution passed by the Chemical Section of the American Association for the Advancement of Science, advising that the report of the committee of that association on spelling and pronunciation of chemical terms be followed. This action has received the approbation of many eminent chemists in the United States. Referring to this subject, H. W. Wiley, M.D., Ph.D., chemist of the United States Department of Agriculture and president of the American Chemical Society, has written to the editor: 'I consider the plan a great improvement over the old methods of spelling and pronouncing chemical terms'; and many other recognized authorities have written, strongly commending the reform." C. B. ROWLINGSON.

Syracuse, N. Y.

Lubricate the Outer Rail on Curves.

To the Editor of the SCIENTIFIC AMERICAN:

As everyone is interested in the safety of railroad travel, it seems to me that it behooves the public in general to give this matter all the thought possible.

Acting upon this idea I have formulated a plan in my mind, which, though simple, will, I think, tend to lessen derailing of trains on curves. In my limited experience with railroads I have found that the wheels rub very hard against the outer rail of a curve, so hard that the rail wears quite rapidly from the friction induced thereby. Your valuable paper gave an article not long ago, also cuts showing the proper elevation for outside rail of curve.

In my opinion these conditions are met with in very few curves, whether because it will tilt the cars too much, or for some other reason, I know not; but the fact remains, as may be readily seen by looking at any curve's outer rail, that it sustains great friction. Now in running a small railroad, used for hauling logs, I found that when it was raining we had very little trouble in the curves, and when dry, with heavy loads on trucks, a great deal. In view of this, my plan is to have pipes so arranged that they would throw a jet of water or cheap oil against the side of the outer rail when the locomotive struck the curve, thereby lubricating same and reducing the tendency the wheels have to climb.

It would be a very simple matter to arrange the feed valves for the control of lubricant so that they would open only when engine struck the curve, closing again when straight track was reached. By a system of this kind, and a practice of bolting the two rails together in curves, so that they could not spread, I think the public would hear less of wrecks in such places.

Morgan City, La. F. M. O'BRIEN.

[The suggestions of our correspondent are sound. The practice of directing a fine stream of water against the outer rail was tried in the West some years ago with good results.—ED.]

Sound from a Moving Source.

To the Editor of the SCIENTIFIC AMERICAN:

The following is an extract from pages 51 and 52 of "Recreations in Astronomy," by H. W. Warren, D.D., 1879. It is a good explanation of the effect of sound waves on the ear as the distance of the source of the sounds in increased or diminished, and adds to what has been said in explanation of the experiment of the boys with the bell illustrated in your issue of March 16.

"One of the most difficult and delicate problems solved by the spectroscope is the approach or departure of a light-giving body in the line of sight. Stand before a locomotive a mile away; you cannot tell whether it approaches or recedes, yet it will dash by in a minute. How can the movements of the stars be comprehended when they are at such an immeasurable distance?

"It can best be illustrated by music. The note C of the G clef is made by two hundred and fifty-seven vibrations of air per second. Twice as many vibrations per second would give us the note C an octave above. Sound travels at the rate of three hundred and sixty-four yards per second. If the source of these two hundred and fifty-seven vibrations could approach us at three hundred and sixty-four yards per second, it is obvious that twice as many waves would be put into a given space, and we should hear the upper C when only waves enough were made for the lower C. The same result would appear if we carried our ear toward the sound fast enough to take up twice as many waves as though we stood still. This is apparent to every observer in a railroad train. The whistle of an approaching locomotive gives one tone; it passes, and we instantly detect another. Let two trains running at a speed of thirty-six yards a second approach each other. Let the whistle of one sound the note E, three hundred and twenty-three vibrations per second. It will be heard on the other as the note G, three hundred and eighty-eight vibrations per second; for the speed of each train crowds the vibrations into one-tenth less room, adding 32+ vibrations per second, making three hundred and eighty-eight in all. The trains pass. The vibrations are put into one-tenth more space by the whistle making them, and the other train allows only nine-tenths of what there are to overtake the ear. Each subtracts 32+ vibrations from three hundred and twenty-three, leaving only two hundred and fifty-eight, which is the note C. Yet the note E was constantly uttered."

Klamath Falls, Oregon. F. M. PRIEST.

The Gila Monster.

To the Editor of the SCIENTIFIC AMERICAN:

Referring to Dr. Goodfellow's article in the SCIENTIFIC AMERICAN of March 30, concerning the poisonous qualities of the bite of the Gila monster, I desire to call attention to the reputed antagonism existing between the monster and the rattlesnake. A two years' residence in Arizona made me quite familiar with both of these reptiles; for a good part of the time I had one of the former tied to the leg of my office table by a string. In his native habitat the monster is credited with being the enemy of the rattlesnake and is said to kill him. Chancing to have both reptiles on hand at the same time, I put them in a large box together and awaited results. The rattler coiled in one end of the box; the monster would waddle up to him, root under his coils with his nose and finally nip down on a coil near the tail. The rattler would then spring to the other end of the box and recoil. After this had happened a number of times, the monster finally succeeded in seizing the snake by the neck just back of the head and held a firm grip until the snake was choked to death. The monster sickened, vomited, and died a couple of days afterward. On removing his skin I found two punctured wounds on his back, evidently the result of the snake's having struck him once.

Although the Gila monster shows an undoubted disposition to attack the rattlesnake in captivity, I am unable to understand how it would be possible for the monster to injure the snake in the state of nature. The former is very sluggish and slow in his movements, and if unconfined the snake should have no trouble in avoiding his attack.

JAMES B. BULLITT, M.D.

Louisville, Ky., May 17, 1907.

The Need of an Inventors' Aid Institution.

To the Editor of the SCIENTIFIC AMERICAN:

We are marvelously impressed with the rapidity of invention. Work has been transferred from hand to horse-power, and from horse-power to steam and electricity by countless labor-saving devices. And yet the march of human progress is not as fast as it should be. As we read the lives of inventors, we see how wofully they have been hampered by want of means to make experiments. Many of them have fallen by the wayside, and others have been sadly hindered by poverty. Although the patent system is a great stimulus, yet it fails in the most critical place.

Some multi-millionaire should found a great institution to aid the worthy inventor; and this institution should be provided with a competent board of examiners. Then whenever an inventor wishes help, he can appear either personally or in writing before this intelligent board, and set forth his invention so far as he has developed it, and state what course of experiments he would like to try in completing it. Then this board could investigate the matter as fully as would the examiner in the Patent Office to determine whether he has an invention that will justify him and the institution in perfecting.

If so, it can be reduced to writing and sworn to and subscribed by the inventor. Then a contract can be entered into by the inventor and the institution. The institution can furnish the tools, machinery, materials and mechanics to develop the invention. The inventor can give such mental and mechanical aid as he is able to do. The experimenting can be systematically done, and duly recorded in the archives of the institution, for the benefit of this invention and future ones.

When the invention is perfected, then the inventor can, with the aid of the institution, apply for patents in the various countries. When the patents are obtained, the institution can further aid the inventor who lacks funds and perhaps business ability by advertising and selling or licensing the rights to persons who will manufacture and sell the goods. For these great aids to the inventor, the institution can reserve a certain share of the revenues, and this will generally pay it well for its services.

As many thousand inventors would soon apply for help, the institution should be well equipped with experimental farms, mines, buildings, tools, and machinery. It could lease these until it could become able to buy them. It should have competent officers, examiners, workmen, attorneys, and agents, so that it could furnish the most prompt, efficient, and economical aid possible to the inventive ingenuity of the world.

Many of the inventions would be much more thoroughly perfected in a few months by the institution than they would otherwise be in as many years. Then the institution could exhibit them at the fairs and expositions throughout the world on such a scale as few inventors could do, and that far more economically than could the individuals, because it could ship and show many at the same time. Further, it could soon build up a great reputation for good inventions and fair dealing, that would induce the manufacturer to make and the public to buy. Moreover, the institution with its systematic records and its able attorneys could defend the rights so vigorously that unscrupulous persons would hesitate much to infringe the patents under its control. All of these things would greatly benefit the inventors, the institution, the manufacturers and the public, and wonderfully accelerate human progress.

The institution could protect itself against fakers and unworthy schemes by accepting no invention from any one for development, until it be examined and recommended by a board of examiners competent in that special field of inquiry. Of course, some of the inventions would fail to reward the institution; but the great majority of them would bring in revenues, and some of them would prove so highly remunerative that they would far more than reimburse the institution for all of its outlays. Consequently it could well afford to provide libraries and evening schools for its inventors and workmen, so that they would become more intelligent, do better work, and produce still greater inventions.

Such an institution would make inventing a pleasant and profitable profession for those having inventive genius, for they could then devote themselves to pure invention, and leave the manufacturing and business part to those who are better fitted for such purposes. Then the reward all around would generally be much greater. Of course, such an institution could be started by capitalists for profit. But it would be a temptation for them to take undue advantage of the needy inventors and the public, so that the institution would not be such a grand blessing to the world.

So some wealthy person would render his name immortal and greatly benefit mankind by giving ten millions to establish an institution for aiding poverty-stricken inventors in their noble work for humanity.

New York, June 5, 1907. G. W. WISHARD.

The Current Supplement.

The modern gold dredge is one of the most important factors in gold mining of to-day. It is rapidly changing conditions in mining districts where the bedrock is soft and the gold finds are easily amalgamated. Mr. George E. Walsh thoroughly describes these new devices in the current SUPPLEMENT, No. 1644. It is not generally known by amateurs and others who have occasion to use direct current for experimental work that such a current can be easily and conveniently obtained from an alternating current by means of the aluminium cell electrolytic rectifier. Frederick E. Ward describes how such an electrolytic rectifier can be made at home. Complete drawings accompany his text. Of technological interest are articles on varnish for wicker work and soldering. Harold J. Shepstone writes on the Nile-Red Sea railroad. Mr. H. Henriet contributes a very exhaustive discussion on the atmosphere of cities. Venomous fishes are described by Dr. A. Calmet in an article which gives much curious information. A. D. Hall's paper on "Artificial Fertilizers: Their Nature and Functions," is concluded. The usual engineering notes, electrical notes, and trade notes and formulas are published.

NEW RAILROAD CONSTRUCTION IN CANADA AND THE NORTHWEST.

BY DAY ALLEN WILLEY.

The United States west of the Mississippi River is the principal field for railway builders, as might be expected. The most important undertaking in the Western States, however, is the extension of the Chicago, Milwaukee & St. Paul Railway from its present western terminus to the Pacific coast. This is one of the most extensive individual projects ever undertaken in railroad building in the United States, as it represents no less than 1,700 miles of new line. The Western Pacific, which is being completed through California and Nevada, represents 750 miles, and will form the western extension of a system reaching across the continent, since it will form a portion of the Gould lines which now extend from the eastern terminus of the Western Pacific as far east as the city of Buffalo, New York. In the Pacific Northwest the Great Northern Railway Company is building an extension from the city of Spokane in eastern Washington by way of the Columbia River Valley to Portland, Ore. By the completion of this work the Great Northern will secure a second seaport on the Pacific Ocean in addition to the one which it now has on Puget Sound.

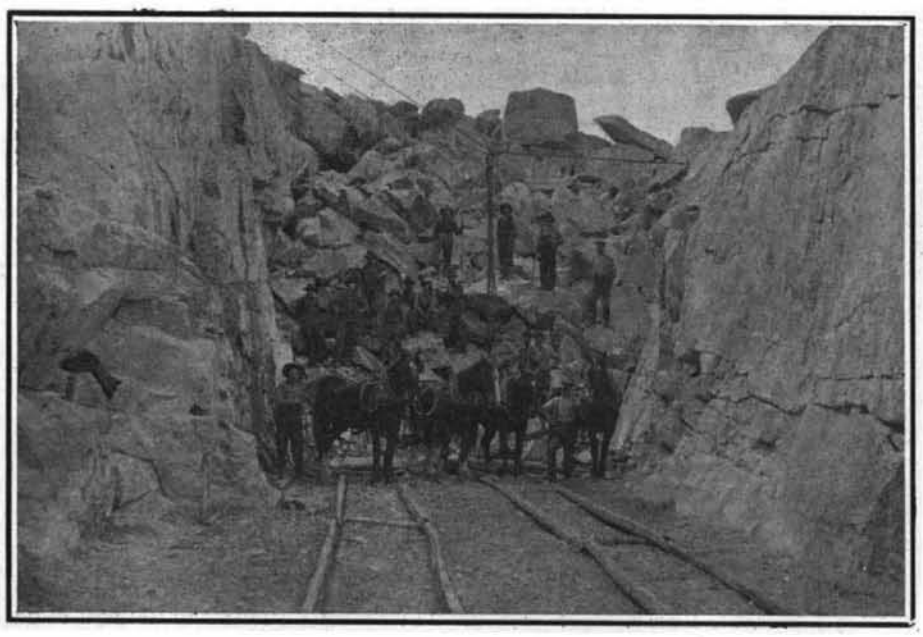
The work of the railroad builders in northwestern Canada, however, is remarkable for its extent, considering the comparatively small mileage which has been completed in this section. The new road is being built for the purpose of developing the immense territory available for agriculture which is embraced in the province of Manitoba, and the territories of Alberta, Assiniboia, and Saskatchewan. Until recently, one company had a practical monopoly of all the traffic from this section of Canada, but at the present time four large corporations are carrying out plans for railway extension, in addition to the number of what might be called local projects. The Canadian Pacific, which at the present time has the unique distinction of controlling the only railway which extends entirely across America, has found it necessary to let contracts for a number of extensions northwest from Winnipeg to reach the great wheat belt in this section of the Dominion. The longest of these extensions will terminate at Edmonton in the Saskatchewan Valley, 750 miles from Winnipeg. In addition to these projects, the company is expending $10,000,000 in enlarging the portion of its main line between Winnipeg and Fort William on Lake Superior. This section is termed the "Spout," for the reason that it is the principal route for the bulk of the grain which is shipped east from northwestern Canada and either stored in the elevators at Fort William and Port Arthur for shipment by lake, or sent by rail through Canada to the seaports on the St. Lawrence River for export. The grain traffic has increased to such an extent that a second track has become necessary, and work on this is now in progress. The construction of this additional mileage was begun in September, 1905, and it is expected that all of it will be completed within the next two years. In all, 425 miles of track will be laid. A portion of it will be built through a region in which an immense amount of excavation will be necessary in rock formation. The accompanying photographs give an idea of the difficulty of this work. In some places the rock cuts are over 25 feet deep. While steam drills are employed to some extent, much of the drilling is done by hand. A force of 1,600 men is employed on this section alone, which represents about 100 miles of the work.

As far as possible, the steam shovel is employed. On the division east of Winnipeg Mr. W. A. James, the engineer in charge, has used from ten to twelve power shovels when the weather would permit, the machines being provided with dippers holding 3½ cubic yards. During the winter season, however, the weather is such that very little work can be done upon the extra track, and most of the construction has to be performed during the six favorable months of the year, and this accounts for the length of time which will be required for its completion.

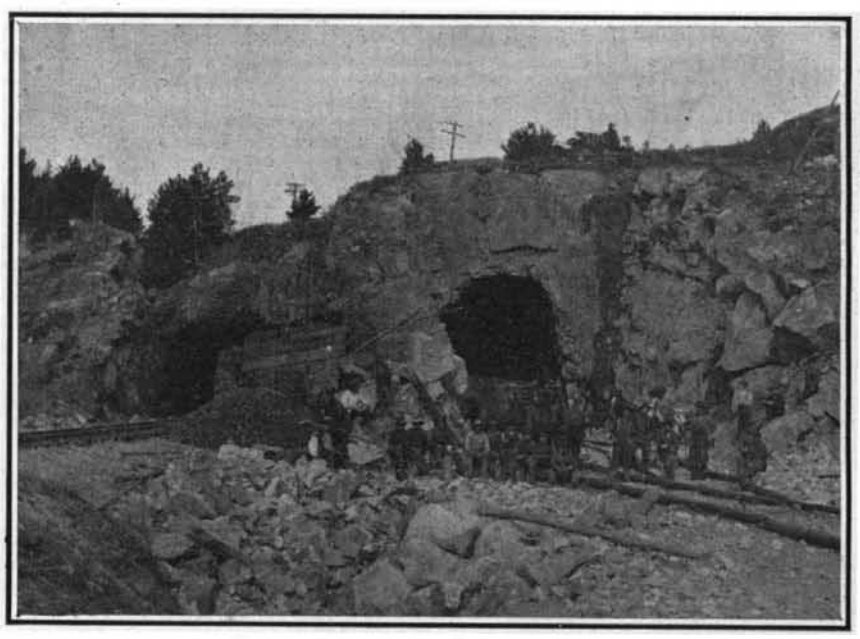
Another important extension of the Canadian Pacific, which has been completed in British Columbia, through one of the most mountainous sections of the Northwest, necessitated the building of numerous bridges, as well as much tunnel excavation. As will be noted by the illustrations, the work is of a very substantial character and includes some important viaduct and bridge work.

The enlargement of the Grand Trunk Railway into the Great Trunk Pacific means the completion of another transcontinental line, which will be fully 5,000 miles in length, reaching from Moncton, New Brunswick, to Port Simpson on the Pacific Coast. The surveys for this route required several years to complete, and the line lies farther north than any east-and-west railroad which has yet been planned in America, much of it traversing a section which at present is an unbroken wilderness. Contracts have been let and a considerable mileage of the Grand Trunk Pacific will be completed during the present year. Another ambitious project is that of the Canadian Northern, which already has built a network of lines in Manitoba and adjacent territory. Its track is finished to the city of Edmonton, and it also reaches Lake Superior at Fort William and Port Arthur. This company expects to utilize Hudson Bay as a route for exporting grain and other products from the Canadian Northwest. From the heart of the wheat belt to the Bay is about 700 miles, and surveys have been completed by the Canadian Northern for a practicable route. Recent investigation has shown that the water of Hudson Strait, which connects the bay with the Atlantic, is free from ice for fully one-third of the year, and it could be kept open fully two-thirds of the year by ice breakers, while there is open water in the bay itself all the year round. A glance at the map shows that this route is considerably the shortest to Europe from the Canadian Northwest, a haul of nearly 1,000 miles over land being avoided. Consequently, grain sent by this northeast gateway across the Atlantic can be transported at a much smaller expense than by any of the present routes through Canada or the United States. This is why the Canadian Northern has determined to build an extension through what is practically an uninhabited country. Several other independent companies have secured charters from the Dominion authorities to build lines northward to the same body of water.

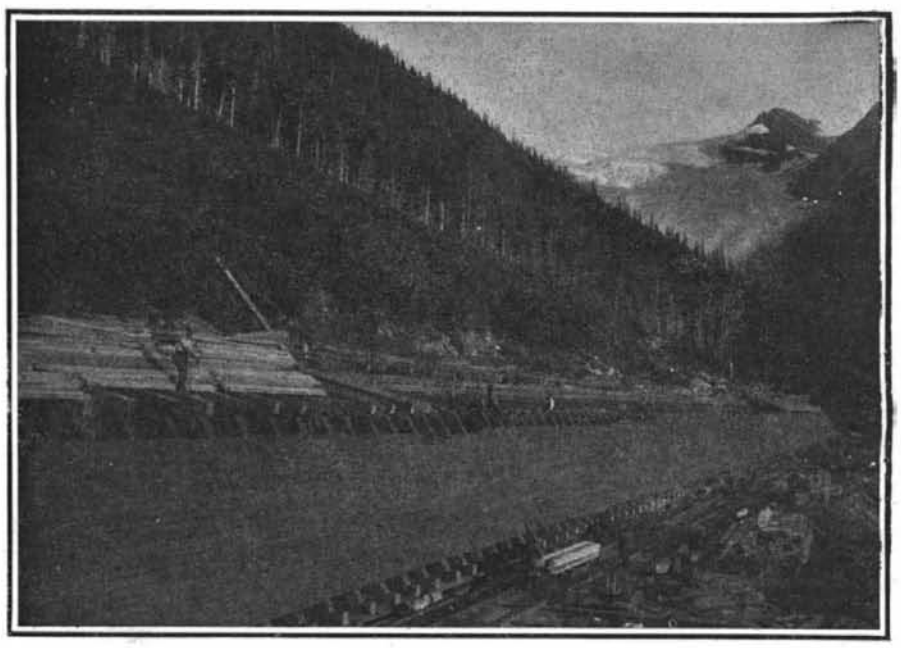
During the present year, work will be in progress on two more systems which will connect the city of Winnipeg with the Pacific coast. When these are completed three lines will traverse Northwestern Canada from eastern Manitoba to the ocean, for in addition to the Grand Trunk Pacific project, James J. Hill has completed arrangements for a line which will pass through southern Manitoba, Alberta, and British Columbia, terminating at the city of Vancouver. This will form a Canadian division of the Great Northern system and including branches will be 1,300 miles in length. The route surveyed is nearly parallel to the Canadian Pacific, and traverses not only the extensive



A Deep Rock Cut Near Busteed, Ontario.



A Tunnel for the Second Track Near Kolmar, Ontario.



Building Snow Sheds Near Glacier House, B. C.

Snow Sheds on the Canadian Pacific, Showing the Hermit Range.

NEW RAILROAD CONSTRUCTION IN CANADA AND THE NORTHWEST.

wheat-growing region, but the live stock country of Alberta, and that important section on which irrigation is being carried out on a large scale, as recently noted in the SCIENTIFIC AMERICAN.

THE ECONOMICAL SURFACE MINING OPERATIONS OF CUBA.

BY L. B. WARD.

In Cuba the natural mining facilities are such that the processes are extremely simple and free from the many dangers incidental to the usual mining operations. Because of the accessibility of the ore, and ease with which it is mined, Cuba's mines are fast becoming her chief source of wealth, and mining her chief industry. Gold, lead, zinc, and asphalt are known to exist; and copper and manganese are found in sufficient quantities to warrant their profitable exploitation; but iron is most abundant, and the ore is so accessible, that the iron mines are being developed rapidly and are yielding large profits.

The hilly province of Santiago abounds in minerals; and her iron ore deposits are as remarkable in their way as the fabulous mines of the Lake Superior region. Indeed, the ore is even easier of access. There is no shaft sinking, no tunneling (with the exception of an occasional exploration tunnel); in fact there is no underground work at all. Hence the miners are not exposed to the many dangers of the usual mines, such as cave-ins, floodings, fires, and explosions; nor is the expensive equipment used in the ordinary mines necessary.

The mining is all open-cut work and terracing. At Daiquiri, where the mines are already extensively developed, and new companies are starting operations, the iron ore occurs on the hillsides, and it is obtained by open-cut work and terracing. Viewed from some little distance, one would suppose the hill was being removed *in toto*, and never for an instant would the spectator imagine that he was viewing a mine in full operation.

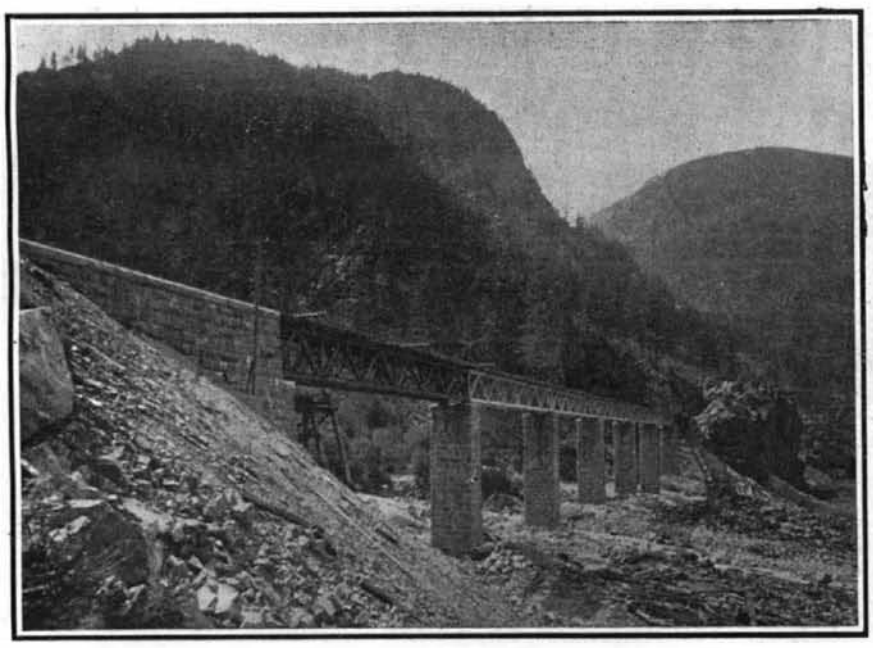
Each broad terrace ledge is laid with narrow-gage tracks, over which the ore is hauled to the regular main track and transported by rail to Santiago Bay, whence it is shipped to various points.

From the mines at Daiquiri 3,536,121 tons of ore were produced to December 31, 1906. The production for the year of 1906 was 510,500 tons. This ore has all been shipped to the United States, with the exception of 75,000 tons, which went to England, Germany, Belgium, and Cape Breton, Nova Scotia.

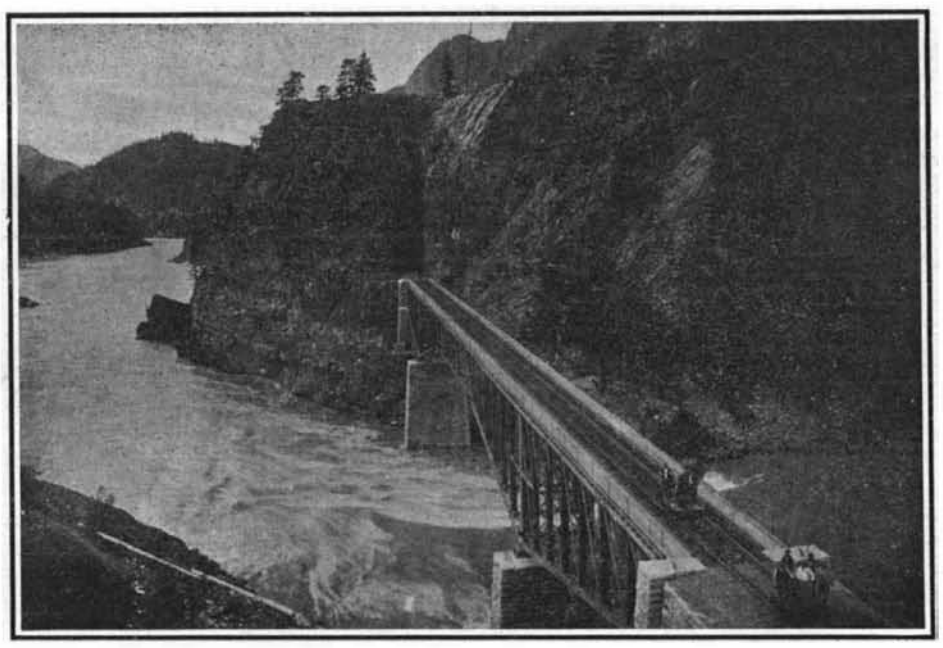
There are also several large iron mines on the north coast, in the Mayari Mountains back of Nipe Bay, that are being extensively developed, and a broad-gage railroad is under construction from the mines to the bay at Cagimaya, where are two wharves and other necessary equipment for handling the ore economically and shipping it to the United States. It is estimated the shipments from these mines will amount to over 1,000,000 tons annually.

An American company, operating not far from Daiquiri, shipped its first ore in 1884, since when 5,000,000 tons have been produced, and the bulk of this output has been shipped to the United States.

The copper mines of southern Santiago are of high value, and at one time they were worked extensively. During the war of 1898, however, the works were entirely destroyed. For the twenty-three years prior to that date the output of copper was valued at $50,000,000.



Canadian Pacific Bridge Across White's Creek, Fraser Canyon.



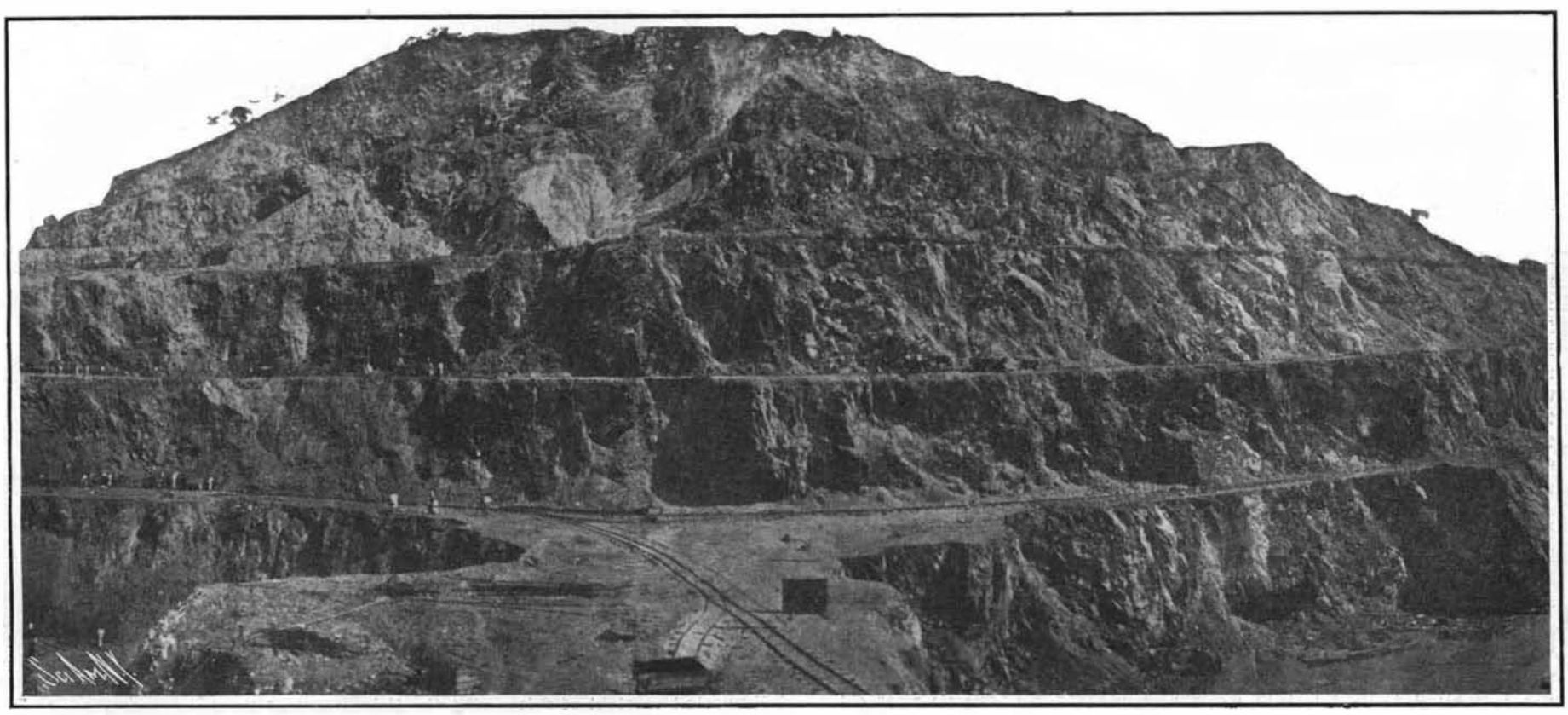
The Cisco Cantilever Bridge Across the Fraser River.

NEW RAILROAD CONSTRUCTION IN CANADA AND THE NORTHWEST.

An Electrolytic Transformer.

Alternating currents are at present used preferably in electric plants both for power and lighting purposes, and electric energy is usually distributed in Europe to consumers in this kind of current, though for certain special purposes, a conversion to continuous current is found desirable. As the devices constructed for this purpose are far from being satisfactory, endeavors have been made from time to time to design an electrolytic transformer based on the principle that in an electrolytic trough comprising an aluminium and a lead electrode. The current will be allowed to pass only in case the aluminium forms the cathode or negative electrode, while it is arrested in the opposite case by the layer of aluminium oxide formed by the current. A rather promising apparatus embodying this principle was demonstrated a short time ago by its inventor, O. de Faria, before the French Physical Society. The drawbacks inherent in all previous apparatus of the same kind, viz., polarization of the electrodes and excessive heating of the electrolyte, are eliminated by a convenient choice of the electrodes and liquid. Furthermore, an automatical circulation of the electrolyte is obtained by means of convection currents in the liquid mass. Sodium phosphate is used as the electrolyte, and pure commercial aluminium and antimony-lead as electrode mass. Owing to the circulation of the liquid, the temperature cannot exceed certain limits, while any polarization is entirely done away with. The efficiency of the apparatus varies between sixty-five and seventy-five per cent in watts. The main uses of the apparatus are the charging of accumulators and operation of induction coils, arc lamps, mercury lamps, continuous-current motors, electroplating plants, etc.

To Remove Oil Paint from Tin Goods.—In the case of fresh paint, rub off with oil of turpentine or petroleum. Otherwise, use hot, saturated solution of potash, hot water afterward. The most powerful means is caustic soda lye.



This Mountain of Rich Ore Is Being Mined by the Simple Process of Excavation in Terraces, Upon Which the Tracks Are Laid, and the Cars Loaded for Shipment Direct to the Docks.

THE REMARKABLE SURFACE MINES OF CUBA.

Household Tests for Oleomargarine and "Process" Butter.

Every householder should know how to distinguish between genuine butter on the one hand and oleomargarine and renovated, or "process," butter on the other, and also to distinguish between the two last named; for despite restrictive legislation, the public is often imposed upon. Renovated or "process" butter is often substituted for the genuine article, while oleomargarine is made to take the place of renovated butter. So clever have the manufacturers of these articles become, that in the absence of some tests the differences are difficult of detection.

The real harm begins when the "process" is sold as genuine butter, for they are not the same thing. While the fats in the two are practically the same chemically, the nitrogenous quantities are not. Moreover, since the article known now and for ages past as "butter" is an article the last step in whose manufacture is the churning of the cream, it is evident that the product of an elaborate subsequent process, a process entirely foreign to the manufacture of "butter," should be designated by a distinctive name, and many of the States have enacted laws which require the distinctive labeling or branding of the "process" product. The same requirements safeguard the sale of oleomargarine.

A boiling test has been found most practicable for household purposes in distinguishing between genuine butter and the renovated article. The test consists simply in boiling briskly a small portion of the sample and observing its behavior the while.

The test can be made in the kitchen, and requires only a few minutes' time. Using as the source of heat an ordinary kerosene lamp, turned low and with chimney off, or a gas jet turned low, melt the sample to be tested (a piece the size of a small marble) in an ordinary tablespoon and hasten the process by stirring with a sliver of wood. Then increase the heat and bring to as brisk a boil as possible, and after the boiling has begun, stir the contents of the spoon thoroughly two or three times at intervals during the boiling, always shortly before the boiling ceases.

Renovated or "process" butter boils noisily, sputtering (more or less) like a mixture of grease and water when boiled, and produces no foam, or but very little. Genuine butter boils usually with less noise, and produces an abundance of foam. The difference in regard to foam is very marked as a rule. Rarely is a butter found which yields an uncertain result; such a butter should receive the benefit of the doubt.

To distinguish oleomargarine from renovated and genuine butter, the required utensils are:

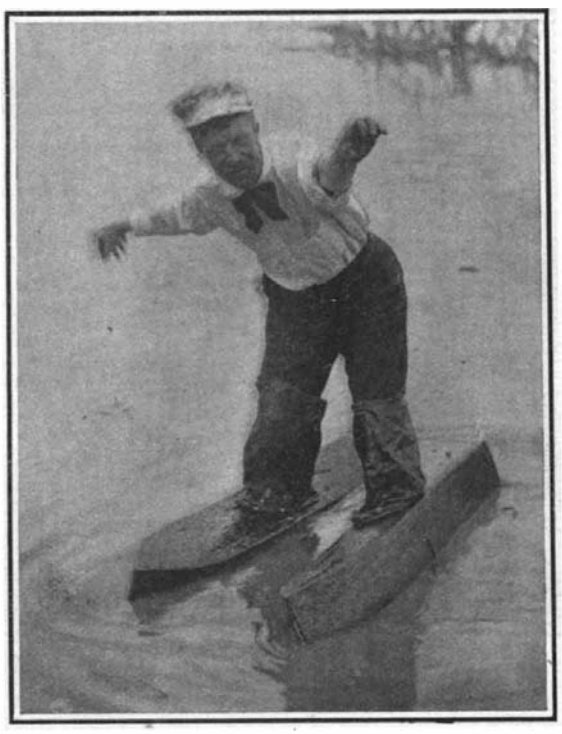
A half-pint tin "measuring cup," common in kitchen use, marked at the half and quarters, or a plain half-pint tin measure, ordinary narrow form; or an ordinary small tin cup, two and three-quarter inches in diameter and two inches in height, holding about one gill and a half; a common kitchen pan, about nine inches in diameter at the base; a small rod of wood, of convenient length for use in stirring; and a clock or watch. With this simple outfit proceed as follows:

Half fill with sweet skimmed milk the half-pint cup or measure, or two-thirds fill the smaller cup mentioned, measuring accurately to the gill of milk when possible; heat nearly to boiling, add a slightly rounded teaspoonful of the fat (butter or butter substitute), stir with the wooden rod, and continue heating until the milk "boils up." Remove it at once from the heat and place in the pan (arranged while the milk and butter or substitute are heating) containing pieces of ice with a very little ice water, the ice to be mostly in pieces of the size of one or two hen's eggs (not smaller, as small fragments melt too rapidly) and sufficient in quantity to cover two-thirds of the bottom of the pan; the water to be in quantity sufficient, when the cup is first placed in the pan, to reach on the side of the cup to only one-fourth the height of the milk within; any water in excess of that amount must be removed. (This is a cooling process, and refers to the condition at the beginning; later, as the ice melts, the water will naturally rise to a higher level.) Stir the contents of the cup rapidly, with a rotary and crosswise motion in turn, continuously throughout the test, excepting during the moment of time required for each stirring of the ice and water in the pan, which must be done thoroughly once every minute by the clock. This is done by moving the cup about, in a circle, following the edge of the pan. Proceed in this manner for ten minutes, unless before that time the fat has gathered or has allowed itself to be easily gathered, in a lump or a soft mass, soon hardening. If it so gathers, the sample is oleomargarine; if not, it is either genuine or renovated butter.

The boiling test ("spoon test") enables one to distinguish between genuine butter on the one hand and oleomargarine and renovated butter on the other; the test last given enables one to distinguish between oleomargarine and renovated butter; and so, by the use of the two tests, one can determine in every instance which of the three he has in hand. There are those who are able to recognize oleomargarine, almost without fail, by taste and smell alone. To those possessed of this power the "spoon test," which is performed with almost no trouble, will serve every needful purpose.

WATER-WALKING SHOES.

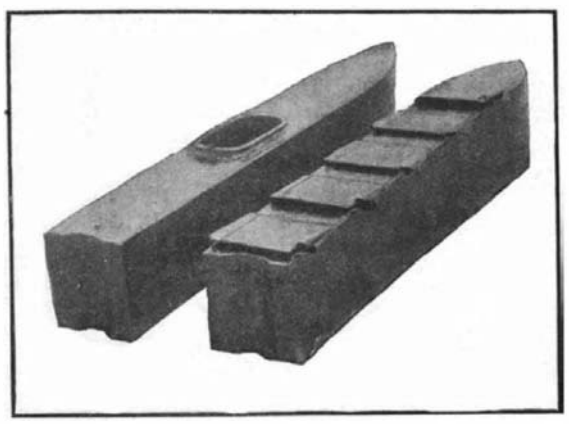
Frederick A. Oldfield, of Memphis, Tenn., has invented a pair of water-walking shoes with which he hopes to cross the English Channel some time during the present summer. Each shoe consists of a beechwood box four feet in length, eighteen inches in depth, and one foot in width. In order that the shoes may skim easily over the surface, five planes are secured to the bottom of each shoe. The shoes are fastened to the foot by means of clamps such as those used on roller skates, the foot being inserted through a hole in the top of the shoe, and the ordinary leather boot being clamped in place. A covering of rubber around



THE INVENTOR EXPERIMENTING ON THE MISSISSIPPI RIVER.

the opening protects the wearer of the shoe from splashing of water. The shoes weigh five pounds each.

Mr. Oldfield has just completed a trip from Cincinnati to New Orleans, which consumed forty-one days, twenty-four more than the time in which he expected to fulfill the task. In the photographs here presented, Mr. Oldfield is pictured in the Mississippi River off



THE WATER SHOES, SHOWING THE TOP AND BOTTOM. THE FIVE PLANES ON THE BOTTOM ACT AS HYDROPLANES.

Memphis. He has just completed the feat of turning a circle.

The Massachusetts automobile traffic is so heavy that it has caused marked wear on the State highways, and the commission having charge of these roads states in its last annual report that the destructive effect is "extraordinary." Practically all the main roads are thus affected. It has been noticed that the binder is swept from the road, and the stone from ½ to 1½ inch in size has been disturbed, in some cases standing on the surface, and in other cases being left in windrows along the roadside. The effect of wear of this sort is such that the commission is satisfied a material change in the methods of maintaining stone roads must be made. The report indicates that the commission believes some kind of treatment with tar will probably be successful.

Plant Lice Preventive.—Boil 250 parts by weight of quassia wood chips in 5,000 parts by weight of soft water and strain. 1,000 parts by weight of common soft soap dissolved in 5,000 parts of hot water. Mix both solutions, add 40,000 parts of water, and use it for washing leaves and stems.

SANTOS DUMONT'S COMBINED AEROPLANE AND AIRSHIP.

BY THE PARIS CORRESPONDENT OF THE SCIENTIFIC AMERICAN.

Aeronautic affairs have continued to be very active in and about Paris during the last three or four weeks, though the rainy weather which prevailed during the spring prevented the trials of aeroplanes and other fliers which are now constructed. Most active in the field of aeroplane work are MM. Santos Dumont, Bleriot, Vuia, and Delagrange, and we have already given an account of some of the newest fliers and the experiments which have been made with them. It will be remembered that Santos Dumont made several trials with an aeroplane which he built at St. Cyr, in the neighborhood of Paris, but up to the present he has not been very successful with it, and found that it would need to be remodeled according to the results of the tests he carried out. He expects eventually, however, to perfect it sufficiently to make long flights with it.

While waiting to do so, however, he decided to carry out some experiments which he had in view in regard to the stability of aeroplanes. For this purpose he set about constructing a new flier which differs from anything built up to the present in this line, since it is a combination of a balloon body with a couple of aeroplanes suspended beneath it. The whole machine is, however, heavier than air; and, should it succeed in flying, it will do so largely on the aeroplane principle. It is one of the smallest fliers which has yet been constructed, the balloon body having a capacity of but 99 cubic meters (3,496 cubic feet). The "Santos Dumont No. 16," as it is known, is merely an experimental apparatus, and as yet it has not made an actual flight, having had an accident which was not serious, and the damage resulting from which will soon be repaired. The balloon consists of a fusiform envelope having a length of but 21 meters (68.89 feet) and largest diameter of but 3 meters (9.84 feet). It has a long pointed shape, as can be seen from the diagram and photograph. The surface of the balloon is 151 square meters (1,620 square feet). As the total weight of the balloon body and the lower framework exceeds the lifting capacity by 120 kilogrammes (264½ pounds), the apparatus acts upon the "heavier than air" principle, and is of interest as a combination of a balloon body and an aeroplane. Inside the balloon is a small ballonet, *B*, of canvas, which measures 2 meters (6.56 feet) in diameter.

Instead of using suspension wires to hold the framework to the balloon, the frame is hung from a long bamboo pole attached directly to the bottom of the envelope by two overlapping flaps of canvas. The frame is very simple in character, consisting as it does of a series of steel tubes. The main piece forming the bottom of the frame is attached at either end to the bamboo pole and runs down to a point under the middle of the balloon, giving space for the two movable planes, the motor, and the aeronaut's seat. In the middle and widest part is mounted the motor with its propeller placed directly on the end of the crankshaft, and the frame gives just sufficient clearance to allow the propeller to revolve inside of it without touching the under side of the balloon. The frame of tubing is braced by steel wires.

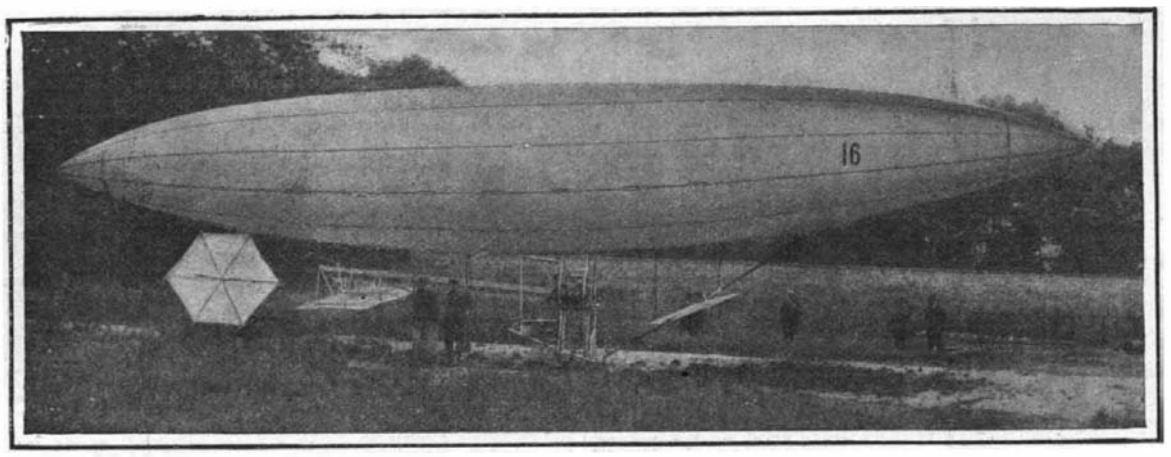
The motor, *M*, is an Antoinette 50 horse-power of the light-weight, eight-cylinder type, and is held somewhat above the center of the frame upon a light steel rod support. Directly against the motor and in front of it is fixed the paddle-shaped propeller, *H*, which measures 2.05 meters (6.72 feet) in diameter, and has a pitch of 1.70 meters (5.57 feet). At the rear of the motor is the radiator, which consists of two sets of long flat copper tubes placed at a slight angle and extending upward on each side of the motor. The aeronaut's seat is a simple motor-cycle saddle, *S*, fixed upon the lower part of the steel frame.

As to the aeroplane part of the apparatus, this is formed of two flat canvas-covered frames of same size mounted at either end of the main frame. These will be noticed at *P* and *R*. Both the frames can be inclined at the proper angle by means of wires within reach of the aeronaut. The frame *P*, in the front part, measures 3 meters (9.84 feet) in length across the balloon and 0.50 meter (1.64 feet) in width, having a surface of 1.5 square meters (16.14 square feet), while the second plane, *R*, measures 4 meters (13.12 feet) by 1.20 meters (3.93 feet) with a surface of 4.8 square meters (51.66 square feet). Mounted in the rear of the main frame and under the balloon is the rudder, *G*. It is of hexagonal form and covered with canvas in the usual way, the diameter being 2 meters (6.56 feet). It can be worked from the aeronaut's seat by a set of wires.

The whole apparatus is arranged to run upon the ground, and to enable it to do this, it is mounted upon a pair of bicycle wheels about two feet in diameter, so that the lower point of the frame nearly touches the ground.

This very curious flier has not as yet shown what it can do, inasmuch as the first experiment, which was made in the Bois de Boulogne on the 7th of June,

resulted in an accident which put the apparatus *hors de combat*, and it will take some time to make the repairs. Far from being discouraged, however, Santos Dumont expects to be soon in the field again. In this experiment the propeller was started up and the flier ran along the ground on its wheels at a moderate rate. The rear end was held by a mechanic, who let go after about a hundred feet. But owing to an accident, the flier did not rise as was expected, but ran head down upon the ground. The propeller struck the balloon and tore it, letting out the gas. It also struck the ground and was consequently somewhat injured. The upper bamboo pole broke, and the frame in general was damaged. Santos Dumont did not suffer from the fall. He explained the probable reason of the mishap, stating that he was not aware that the flier had been held in the rear, and in consequence thought it was free at the start. Thus he did not handle it properly, and it was owing to improper management of the planes that the machine acted as it did. On the other hand, it is thought that the accident was due to the fact that the column of air driven by the propeller was directed against the rear plane frame and also against the under side of the balloon in the rear, and that this caused the back end of the balloon to rise, tilting the front end downward. It will no doubt take a number of trials to find out the best conditions for running the machine, since there are several new conditions involved. The repairs are being made at the new shed which Santos Dumont recently erected on the same grounds as before, at Neuilly, near the Bois de Boulogne. At the same time his aeroplane No. 14 has been brought there and is being overhauled and strengthened after the last accident.

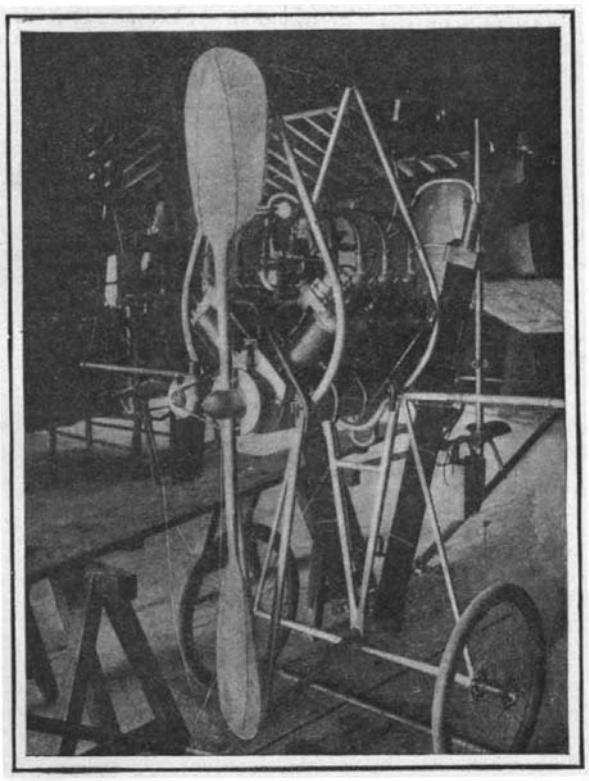


Santos Dumont's New Dirigible Balloon Fitted With Aeroplane.

Length, 68.89 feet; diameter, 9.84 feet; capacity, 3,496 cubic feet. The excess weight to be lifted by the aeroplanes is 265 pounds.

M. Louis Bleriot, some of whose experiments we have already illustrated, is at present engaged in building a new flier, and has practically completed it. This apparatus is quite different from the one which he used in his last trial at Paris, constructed as it is according to the principles of the Langley flier, with some modifications of this type. It has two pairs of planes mounted in tandem. The total supporting surface is about 18 square meters (194 square feet). Upon the frame is mounted an Antoinette eight-cylinder motor of the 24-horse-power type. M. Bleriot expects to commence work with the new apparatus very shortly.

Somewhat of a sensation has been caused by the visit of Messrs. Wilbur and Orville Wright to Europe. It appears likely that they are carrying out negotiations both in Germany and France with the expectation of disposing of the rights for their aeroplane. They decline, however, to give any information about what they are doing, and the matter is more or less of a secret. It appears, nevertheless, that Mr. Wilbur Wright made the trip to Paris with Mr. Hart O. Berg, who is well known in automobile circles, in order to complete, if possible, negotiations begun in France as far back as 1905. It was known that they had made some propositions to the War Department in this connection, and it seems that they asked the sum of $200,000 for the rights to use their system, should its success be demonstrated upon actual trial, upon a flight of a certain length and duration. At present the affair seems to be making progress, although it is being kept very quiet and but little definite information is to be had about it. We may say, however, that the inventors have been making arrangements with several persons who are prominent in political circles, notably Senator Henri Deutsch, whose interest in aeronautic work is well known and who has been liberal in founding prizes and otherwise aiding the experiments of aeronauts. He may agree to furnish at least a part of the amount which is asked by the inventors for the rights in France. M. Henri Deutsch presented the matter before the Minister of the Marine, to whose department the apparatus will belong in case it succeeds. But the Wright brothers will not grant the exclusive rights of their system for Europe, and this will not prevent them from making negotiations with other governments. It is not known what is the result of their trip to Germany.



The 50 H. P., 8-Cylinder Motor, Showing Propeller and Radiator.

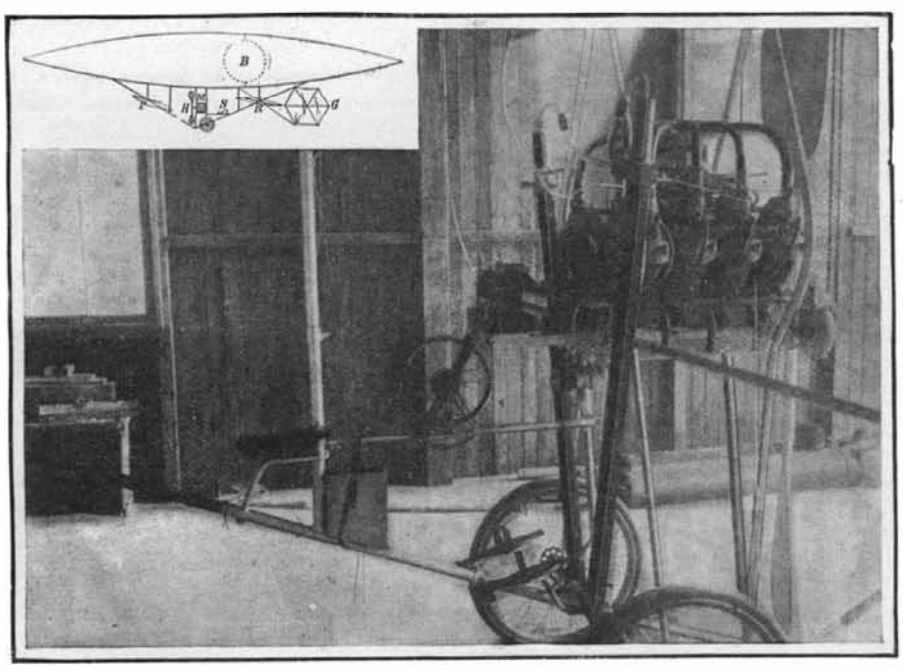
Comparative Efficiency of Various Electric Lights.

Comparative tests have been made between Moore tubes, Nernst lamps, and the usual type of incandescent electric lamps, says the Electrical World. The Moore tube used was 179 feet long and 1¾ inches in diameter. It was located 17 inches below the ceiling, which latter was 10 feet 11 inches from the floor. There were seven six-glower Nernst lamps, with opalescent globes of a bluish tint. The incandescents were 113 in number, 88 being of 8 candle power each, and 25 of 16 candle power. All were wired to molding on the ceiling, excepting 20 of the larger ones, which were used with opaque reflectors and had very little effect on the ultimate results. Measurements of illumination were made by means of a Weber photometer located successively at seven different points throughout the large room, and uniformly 34 inches above the floor.

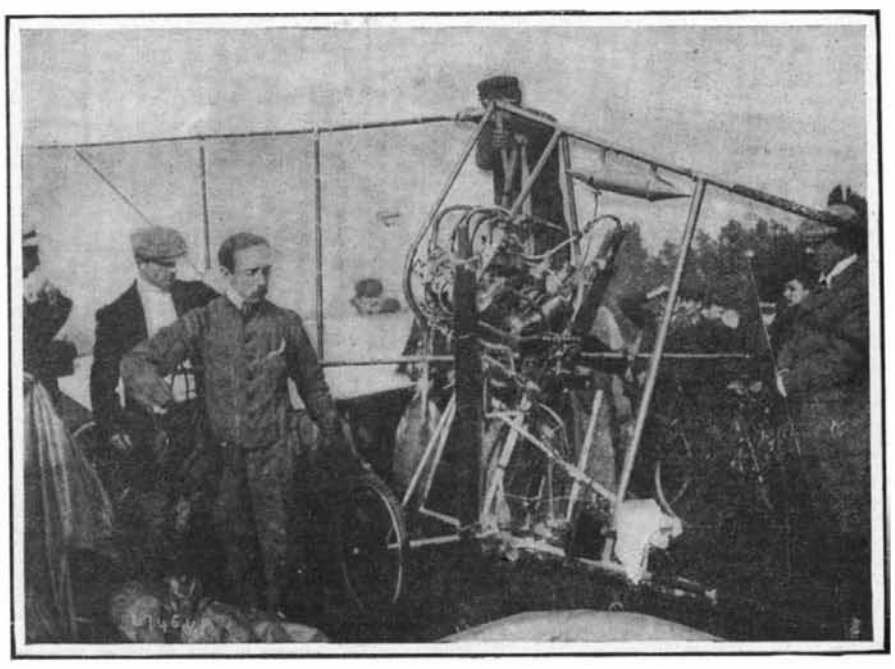
The unit of illumination used was the lux, which is the illumination produced on a plane surface by a source of 1 candle power at a distance of one meter, the rays striking the surface perpendicularly. The periodicity of the current was 60 cycles. The average voltage during the test was 243 for the Moore tubes, 244 for the Nernst lamps and 117 for the incandescents. The illuminants were located above the plane of illumination at different distances, being 6 feet 8 inches for the Moore, 6 feet for the Nernst, and 7 feet 10 inches for the incandescents. The current consumption in kilowatts was 3.15 for the Moore, 3.92 for the Nernst and 4.13 for the incandescents. The average intensity of horizontal illumination was 63 for the Moore, 44 for the Nernst and 15 for the incandescents. This made, per unit of power, an average of 20 luces for the Moore, 11.2 for the Nernst and 3.6 for the incandescents. To bring the illumination from the two latter up to the standard of the former, without altering the heights of the illuminants, would have required an output of 7 kilowatts for the Nernst lamps and 23 for the incandescents, as compared with 3.15 for the Moore. Placing all illuminants at the elevation of the Moore tube, and obtaining equivalent illumination from all, the required output would be 3.15 kilowatts for the Moore, 8.65 for the Nernst, and 16.65 for the incandescents.

In a paper read before the Society of Arts by Mr. Herbert Wright on "Rubber Cultivation," the author said that Ceylon alone had already planted land sufficent to supply London with about 7,000 tons of rubber per year in place of the 70 tons she sent in 1905. Land was being applied for and purchased at very high prices, and very soon a prominent and permanent position would be established. When one considered what had recently happened in Ceylon, the Federated Malay States, and India, it was obvious that the export in a few years would be as suddenly increased as had the planted acreage in these places, and for this we must be prepared.

Tin Varnish.—Asphalt 10 parts by weight, rosin 5 parts, linseed oil varnish 20 parts, oil of turpentine 8 parts.



View Showing the Aeronaut's Seat, Foot Rests, Control Wheel and Levers.



The Rear of the Motor. The Radiator Tubes Form a Letter V at the Back.

A COMBINED DIRIGIBLE BALLOON AND AEROPLANE.

RECENTLY PATENTED INVENTIONS.

Pertaining to Apparel.

HEAD FOR HAT-PINS AND THE LIKE.—W. J. Kittel, Jersey City, N. J. The purpose of the inventor is to provide a method of ornamenting and constructing the heads of hat pins and like articles, also decorating and constructing buttons and similar articles, whereby to economize in the manufacture and to render the decorations or coloring sparkling or luminous and at the same time to permit of comparatively severe usage with little liability of damage.

NECKTIE DEVICE.—C. I. Hoople, Anaheim, Cal. One purpose in this case is to provide a device with string ties to be made up in a bow, four-in-hand, or other styles of tying, which will enable a necktie to be easily tied and also enable the expeditious adjustment of the tie relatively to the front collar button, even when the closest type of turn-down collar is worn.

Of Interest to Farmers.

PLOW.—J. Rivara, Natchez, Miss. The object of the improvement is to provide a plow for turning a furrow, breaking up the sod, harrowing and pulverizing it and uprooting and destroying grass and weeds and grinding them into bits and bringing the land into order for planting, with much less labor than is usually employed.

SWEEP-RAKE.—F. Nelson, Driscoll, N. D. Of the intentions of this inventor, one is to provide a construction of rake wherein when the team is backed to discharge a load a sweep bar will be automatically drawn over the teeth to impart the initial movement to the load, and wherein further the moment the team is started forward or commences to pull the sweep bar will be automatically restored to its normal position close to a rake head.

Of General Interest.

KILN.—G. Wiegmann and C. Dörr, Berlin, Germany. The invention relates to the construction of kilns for heating, burning or smelting metals, metal alloys, combustible and non-combustible materials, as also for roasting and reducing ores, and is especially adapted for house-refuse and similar waste-materials. The combustion is complete, no ash is formed, the residues are recovered as molten slags adapted for various uses and only occupy a small percentage of the volume of the refuse.

EMULSIONING AND SOLIDIFICATION OF HYDROCARBONS.—W. Van Der Heyden, 21 Boulevard du Midi, Nanterre, Seine, near Paris, France. The deficiencies in this inventor's former patent are removed by the present improvement by the addition of different substances to the emulsion, that is an addition in order to prevent the loss of weight of which product 3-4 per cent are sufficient. The addition of salts of organic acids (tartaric, oxalic, and citric) effects a smokeless burning of the solidified blocks. The whole process secures a perfect emulsion and no constituent separates from it after the shaking ceases.

SCALE.—M. M. Schwartz, North Bergen, N. J. One object of the inventor is to provide a scale having a plurality of members adapted to be reversed and used interchangeably with each other, and so arranged as to be adapted to be held in complete contact with a drawing and give a proper angle of vision, to protect the divided surfaces of the members from friction with a drawing and the wear consequent thereto, and to avoid the necessity of raising the edges of the scale from a drawing, thereby obviating the unsteadiness due to lack of contact.

Hardware.

SAW-TOOL.—W. Bryson, Fifield, Wis. In the present patent the invention relates to improvements in tools employed in filing, jointing, side filing and setting saw teeth, and the object is to provide a device for this purpose by the aid of which the several operations on a saw may be quickly performed.

LOCK.—C. Calicchio, New York, N. Y. A key engages the sleeve bar and rotates it in the casing, the outer portion of the key ward bearing against a flange edge formed on the tumbler, which raises the latter's free end to release a lug from the back notches and permit the bolt to be shot in the casing by the end of the ward striking against the recess wall of the bolt's shank which projects the latter's arms partially through the casing rim, bringing a lip of the bolt shank close with the key to enable the end of the ward on second rotation of key to bear against the lip and project a bolt through the casing rim. Said bolts are retracted by reverse rotation.

Household Utilities.

IRONING-TABLE.—W. H. Tichborne, New Castle, Pa. In the present patent the invention has for its purpose the provision of an ironing board simple in construction, effective in operation and durable in use, and adapted to be attachable to tables of various heights, to be removed therefrom, and folded conveniently for storing when not in use.

SLEEPING-BAG.—H. W. Wilson, Springfield, S. D. The invention is more especially designed for children, combined with means for retaining the bag in place on the mattress and holding the child in the bag in proper position. Two straps extend downward from a yoke's back and front, meeting at depth of crotch, on the thigh, continuing as a single strap, avoiding entanglement of legs in the strap. The strap from thigh to foot of bed forms a perfect pivot, permitting shifting and turning at will. The strap is detachably connected. Straps holding the bag to the bed are fitted with a safety buckle, to enable them to be taut or loose as needed.

Machines and Mechanical Devices.

STICK-FEEDER.—W. H. Waldron, New Brunswick, N. J. The invention relates to drying machines such as used in the manufacture of wall paper and the like. The object is to provide a feeder, arranged to insure a positive and accurate feeding of the sticks onto an endless carrier which delivers the sticks to the drying machine for receiving and supporting the freshly printed or coated paper or other webbing.

POLE-CLIMBING SHOE.—C. F. Youngquist and C. G. Youngquist, San Francisco, Cal. The object of the invention is the production of a safe device which will require no particular skill to manipulate in the use intended and will positively grip a pole and become engaged at each step, enabling the climber to ascend and descend with greater facility and less exertion than with devices now of this kind in use.

ADJUSTABLE DRILL-SUPPORT. — A. Moirbacher, Cripple Creek, Col. It is sought in this case to provide in connection with an adjustable or extensible crop bar, a support for the stopping bar of an air drill for instance as the Ier, Ingersoll, Jap, Murphy, Hartsock, Shaw Eclipse, and similar machines that are made with self-air feeding stopping bars, the machine being operated by compressed air.

SPEED-REGULATOR FOR PUMPS.—W. W. Satterthwaite, Washington, N. C. In operation, when the pressure in the cylinder or reservoir becomes sufficient to overcome the tension of a spring arranged between two collars at the lower portion of a stem, the latter is elevated and through its connection with a valve stem the valve is partially closed, thus slowing the exhaust, and as a consequence slowing the pump. Further increase in the pressure in the cylinder tends to further close the exhaust, thus nicely regulating the speed of the pump by the pressure in the cylinder.

Prime Movers and Their Accessories.

VALVE.—H. S. Rankin, Cripple Creek, Col. This cock or valve is particularly adapted for use as a throttle valve in a pipe line adjacent or leading to a rock drill or the like, employing fluid pressure such as compressed air or steam. But it is not limited to such use, as it may be employed in various places, in fact, anywhere an angle valve is used, especially on lines transmitting considerable pressure. To its functions as a valve, it combines therewith the function of a lubricator.

CIRCUIT-BREAKER FOR GAS-ENGINES.—F. B. Packwood, Lincoln, Neb. The invention relates to novel and peculiar circuit-breaking means, for use in the ignition circuit of explosive engines, and consists of an automatically operated device, adapted upon reverse motion of the engine, to automatically break the primary or secondary ignition current, thus preventing continued reverse motion of the engine.

INTERNAL-COMBUSTION ENGINE. — W. Morey, Jr., New York, N. Y. The invention pertains to certain improvements in internal combustion engines, and more particularly to a new type of engine having all the advantages of the four-cycle engine, including the complete scavenging, and at the same time having all the advantages of the two-cycle engine, namely, an impulse for every revolution of the drive shaft.

HYDRAULIC MOTOR. — W. R. Tuttle, Asotin, Wash. The reference in this case is more especially to hydraulic motors of the kind actuated by the force of the current of a body or stream of water, upon the surface of which the motor is located, when anchored in position for effective operation. One of the principal objects is to provide a motor, of an embodiment to overcome numerous disadvantages and objections found in the use of many other motors.

Design.

DESIGN FOR A SPOON.—Lulu G. Blasier, Williamsburg, Iowa. This ornamental design for a spoon bears on the inner edges of the bowl the inscription Rebekah Degree I. O. O. F., Bloomfield, Iowa, Dec. 2, 1868. A linked chain, a flower, a dove, a crescent, seven stars, and a beehive are pictured on the handle. In the center of the bowl is delineated the scene of Rebecca at the well. The designer has patented another design for a spoon of somewhat similar form. The bowl of the spoon bears the words Pythian Sisters, and in the narrow part of the handle, Onward and Upward. A maltese cross with flowers, the letters F. C. B., a male head, and an end holding three stars constitute a very exquisite design.

Note.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

Notes and Queries.

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.

References to former articles or answers should give date of paper and page or number of question.

Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.

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(10585) E. C. T. says: I want to perform before our Sunday school an experiment to illustrate the effect of sin upon a life, and then the redeeming power. I know of such an experiment having been performed, and would like to know just what solutions to use. I prefer to start with a clear solution, and then by adding another preferably clear solution to get a bright and attractive color, then by adding more of the same or another solution to gradually darken it until it becomes black, then I want to add something that will bring it back to its original clearness. If you can suggest the solutions you will confer a great favor upon me. A. There are many ways of obtaining a dark precipitate from two colorless solutions, but none of these are easily or quickly cleared to a colorless state again. They do not answer your purpose as an illustration of sin and forgiveness. But why use a dark or black color at all? Scarlet or crimson are the colors given in Scripture (Isaiah i: 18). These can be produced and cleared off very easily. Make a strong alcoholic solution of phenolphthalein, and a strong solution of sodic hydrate in water. Add the first solution to the second slowly with shaking. At first as bright and delicate a rosy color as you may wish can be obtained. As the strength increases, the color deepens to any degree of darkness, deep enough for the verse referred to. Then add hydrochloric acid, and the red will immediately disappear. This would seem to meet your wishes. We give you also a process by which you can obtain a dark brown muddy deposit and dissolve it quickly. Take the phenolphthalein and sodium hydrate solutions as above, but more dilute, and proceed as above; then add to the bright red solution a few drops of solution of iron chloride, more or less to produce a thick muddy brown mixture. A solid is precipitated from the solution. It is hydrate of iron. To clear this away, add hydrochloric acid. This leaves a yellow liquid which, in a dim light, will look almost white or clear. Some practice may be needed to obtain the desired strength of solution, but when the solutions are right, the effect is surprising to those inexperienced in chemical manipulation.

(10586) A. C. says: We have a well 184 feet deep that we wish to force water out of to a tank 65 feet above ground. The water stands 16 feet from the top of ground, but we do not know how low it will go when pumping is commenced. The outside casing of well is 8 inches. The suction pipe and discharge pipe is 5 inches. It goes down in the well 163 feet. The air pipe is ¾ inch and goes down 157 feet. The air pressure is 100 pounds. The question is, how far can the water lower and still allow the pumping to go on successfully? In other words, how far must the air pipe be down in proportion to the amount of elevation of water? A. One hundred pounds air pressure will lift a column of water 230 feet high, neglecting friction. The amount of friction will depend on the mechanism used; if the friction is 30 per cent, the 100 pounds air pressure will lift a column of water 161 feet high, or from 96 feet below the ground to a tank 65 feet above it.

INDEX OF INVENTIONS

For which Letters Patent of the United States were Issued for the Week Ending June 25, 1907.

AND EACH BEARING THAT DATE

[See note at end of list about copies of these patents.]

Acid, methylene citryl salicylic, Berendes & Callsen 858,142
Acid, salts of methylene citryl salicylic, Berendes & Callsen 858,143
Adding machine, L. S. Munger 857,889
Addressing machine, Wise & Rhea 857,704
Advertising device, R. B. Powers 857,754
Agitator, L. M. Stern 857,683
Air brake system, L. Tucker 858,121
Air brake system, Tucker & Shunk 858,122
Alarm device, G. E. Rideout 857,906
Alloy and producing it, F. M. Becket 858,327
Amusement apparatus, A. J. Dayton 857,605
Amusement apparatus, J. H. & H. S. Porter 857,903
Amusement device, J. P. Wetherill 857,851
Anchor, J. E. Johannessen 857,881
Anchor, land, F. R. Parker 857,751
Animal trap, M. J. Hill 857,879
Animal trap, J. J. Nance 857,892
Anode, A. J. Deloye 858,160
Armature testing apparatus, V. Patton 858,016
Ash separator, H. M. Coats 857,722
Aspirator, J. Boekel 857,920
Automobile and car motor, M. Cazin 857,980
Automobile driving gear, R. S. McIntyre 858,202
Automobile frame, E. Sanchis 858,108
Automobile speed changing mechanism, F. J. Ziegler 858,050
Bag machine, J. L. Lowe 858,005
Ball feeding mechanism, W. C. Gilmore 857,993
Bandage receptacle, antiseptic, O. C. Schulz 857,680
Basin fixture, G. W. Gano 857,989
Basins and the like, attachment for wash, J. Treager 858,234
Battery. See Medical battery.
Battery, F. A. Decker 857,606
Bearing, engine, W. B. Mason 858,087
Bed springs with metal, machine for covering wooden rails for, Gangelhoff & Jordan 857,799
Bedstead corner fastening, C. Vallone 857,850
Bedstead lock, E. H. Burrage 858,259
Beer service apparatus, W. F. Stark 857,843
Beet thinner, J. A. Long 857,815
Blast furnace, trap for furnace top construction, Hitt & Black 858,182
Block machine, H. G. Grisier 857,995
Blocks, manufacture of, I. Lucas 858,192
Boat for ice breaking and other purposes, C. Stangebye 857,766
Boiler cleaner, L. M. Pettit 858,304
Boiler leveling device, F. I. Cass 858,332
Boiler setting, C. B. Risley 858,214
Boilers, apparatus for blowing off, washing, and recharging, W. L. Miller 858,198
Boilers, scummer and blow-off for steam, J. B. Barnes, reissue 12,663
Boilers, soot cleaner for, W. Eichelberger, et al 858,333
Bolt cutter, stay, J. W. Faessle 858,271
Book, balance, W. E. Prudhomme 857,904
Boring tool, J. H. Johnson 858,293
Bottle, antirefillable, H. Campbell 857,596
Bottle cap, E. Goltstein 858,174
Bottle refilling apparatus, J. C. A. Riecke 857,674
Bottle, mucilage, C. E. Barrett 857,975
Bottle, non-refillable, B. A. Chew 858,261
Bottle stopper, electrical fitting, and the like, A. Waltho 857,695
Bowl, O. S. Atterbolt 858,252
Bowling alley pin setting apparatus, E. E. Heath 857,939
Bowling pin setting apparatus, J. M. Stokes 858,229
Box covering machines, cutting attachment for, M. D. Knowlton 858,078
Boxes from pasteboard, dies for forming, J. Godfrey 858,172
Boxes from pasteboard, making, J. Godfrey 858,173
Brake and buffer, F. Moller 857,651
Brake shoe, J. D. Gallagher 858,067
Braking mechanism, J. E. Scheper 858,308
Branch box, A. F. Hills 858,288
Bread, meat, and vegetable cutting machine, C. J. Vann 857,913
Brewers' wort or the like, apparatus for heating or boiling, H. J. Worssam 857,779
Brick and tile cutting machines, wire attachment for, W. R. Cunningham 857,603
Brick kiln, H. J. Williams 857,702
Brick molding machine, T. C. Holt 857,624
Broom shield, B. F. Gasque 857,615
Bucket, N. M. Heller 857,622
Buckle, G. E. Rawson 858,104
Buckle, cross line, H. A. Bowyer 857,864
Buckle, harness, R. B. Centers 857,872
Buggy and the like, baby, M. Weinstein 857,696
Building construction, E. McClure 857,821
Building, high, J. Gernaert 858,170
Burial crypt, W. I. Hood 858,070
Busts, device for fastening beads to, E. T. Palmenberg 858,099
Button, emergency, U. S. Alz 857,917
Buttonhole cutting machine, S. Lewis 858,190
Calorimeter, steam, L. M. Ellison 857,984
Camera, photographic, L. Borsum 858,145
Can opener, H. J. Cassard 857,871
Cans, making sheet metal preserving, J. G. Hodgson 857,736
Candy pulling machine, C. Thibodeau 857,770
Car, S. Otis 858,013
Car brace, freight, Heard & Treanor 858,283
Car fender, E. Sherwood 858,225
Car, juvenile hand, S. D. & H. T. Latty 857,945
Car replacer, G. H. Sargent, reissue 12,667
Car seat, F. H. Henry 858,178
Car, sleeping, T. O. Abbott 858,130
Car, tank, J. M. Ames 857,571
Car ventilator, H. Van Ness 858,123
Car ventilator, E. N. Dillman 858,268
Card holder, G. T. H. Willing 858,315
Carding engine, traveling flat, Batten & Hayes 857,713
Carpet stretcher, V. O. White 857,777
Carriage, folding, A. J. Adams 857,971
Carrier. See Package carrier.
Carton filling machine, R. Sunderman 858,116
Cash register and attachment, H. T. Watson 858,237
Casing head, H. Auchu 858,321
Caster, J. E. Norwood 857,660
Caster, furniture, J. M. Collins 857,982
Casting metal sheets, apparatus for, J. F. Miller 857,885
Cement, apparatus for and method of molding hollow objects from, J. M. Royle 857,584
Cement, apparatus for molding hollow objects from, J. M. Boyle 857,582
Cement block machine, T. D. & C. W. P. Brock 857,977
Cement bricks, blocks, and the like, machine for molding, H. J. Hurd 857,737
Cement, molding hollow objects from, J. M. Boyle 857,581
Cement objects, core for molding hollow, J. M. Boyle 857,583
Chair fan attachment, J. F. A. Probst 857,669
Chair seat, reversible, R. N. B. Petersen 858,209
Chairs, tables, and the like, machine for levelling, A. Lyon 858,299
Change apparatus, B. F. Beasley 858,253
Channeling machine, W. Prellwitz 857,960
Channeling machines, roller guide for, W. Prellwitz 857,961
Check protector, J. M. Griffin 857,618
Cheese cutter, computing, Shutz & Kirkman 857,840
Chemical reductions and producing metals and alloys, effecting, F. M. Becket 858,329
Chuck, J. A. Leland 857,947
Churn and butter worker, combined, Christensen & Solbeck 858,060
Churn operating means, vibrating, W. P. Coleman 857,923
Cigar holder, B. N. Phillippi 858,349
Circuit breaker, automatic time, W. N. Martin, et al 858,301
Circuit controller, Massie & Hawkins 858,197
Circuit operating device, L. G. Woolley 857,708
Clamp or grip, H. Petersen 858,018
Clasp pin, G. E. Burns 857,867
Cleaning device, L. O. Howell 857,627
Cloth steaming apparatus, E. Senkbeil 858,032
Clothes drier, J. S. Bougher 857,714
Clothes drying reels, lifting device for, J. G. Wendling 858,126
Clothes hanger, M. Crane 857,602
Clutch, friction, C. Wust-Kunz 857,970
Coal handling apparatus, W. F. Klemp 858,076
Coal handling bridge, C. S. Williamson 858,314
Coal tipples, screen scraper for, W. E. Thoenen 858,312
Coaster brake, G. Zinter 857,855
Cock, angle, W. H. Woody, et al 857,915
Cock, gage, W. H. Kriner 857,634
Cock index, H. Mueller 857,957
Coffee making device, C. S. Rogers 857,676
Coffee pot, A. H. Stebbins 857,844

Coin separating or assorting machine, W. W. Broga 857,786
Coin tray and till, B. F. Brewster..... 858,331
Collar, horse, C. W. Campbell 857,594
Collar pad, C. W. Campbell 857,595
Collar pin and necktie fastener, G. A. Beidler 857,919
Colors, manufacture of antimony, L. Brunet 857,978
Combustion regulating apparatus, T. D. Pilcher 858,019
Communion or eucharistic device, H. C. Allen 858,051
Commutator truing and dressing tool, C. H. Frick 857,931
Composing. type casting, and other machines, record strip or controller for, W. Bancroft 857,974
Composition of matter, F. A. Lobert..... 858,084
Concrete beams and girders, construction of reinforcing steel for reinforced, G. Aus 857,973
Concrete construction, W. S. Shourds 858,227
Concrete construction, reinforced, C. P. Walter 857,775
Concrete mixing machine, G. M. Pence.... 858,017
Concrete, reinforcement for, W. W. Conard. 858,153
Concrete reinforcing bar, A. V. Reyburn, Jr. 857,671
Condenser, F. C. Roberts 857,675
Condenser apparatus, I. S. Davis 858,265
Conveyer, belt, E. G. Thomas.... 857,771, 857,772
Conveyers, etc., carrying roll for belt, R. W. Dull 857,610
Conveying apparatus, B. C. & S. Crandall 857,924
Cooler. See Water cooler.
Copies, producing multiple and backed, F. G. J. Post 858,023
Cork extractor, R. B. Gilchrist..... 857,992
Corn popper, G. B. & J. H. Young, 858,317, 858,318
Corset, E. B. Adams 858,319
Cover, receptacle, T. D. McCall..... 857,746
Crane, vertical charging, C. L. Taylor... 858,038
Cross tie, J. S. Schaeffer 857,907
Cuff holder, L. L. Mallard 858,300
Culinary utensil, Leykauf & Barth..... 857,812
Cupola charging mechanism, S. S. Knight. 858,004
Curling iron, electric, Allen & Hanlon.... 857,569
Current machine, alternating, R. D. Mershon 857,953
Curtain fixture, G. F. Livesay 857,743
Curtain pole, J. A. Powell..... 857,829
Curtain rod ornament, T. Newell..... 857,658
Curtain stretcher, Hoffheins & Stanfield.. 857,623
Cutting tool, Allen & Johnson 857,710
Damper controller, automatic, E. F. Miller. 857,648
Delivery mechanism, Baabe & Read..... 857,962
Dental chair, L. L. Mallard 858,193
Dipper mounting, A. L. Becker..... 857,577
Directory, telephone, G. C. Odor 857,662
Display holder for rugs, E. Brown 857,716
Display novelty, R. L. Wells 858,313
Display stand, H. E. Smith 857,763
Distilling apparatus, M. Llodra 858,346
Dock, floating dry, E. Gunnell 857,733
Door fastener, D. Wilde 858,244
Door fastener. sliding, R. Campbell 857,922
Door lock, latch knob, L. W. Woodburn.... 857,705
Door opener and closer, D. Wilde 858,243
Door or gate opening and closing device, R. B. Browne 858,147
Door, revolving, C. H. Roeckner 858,028
Draft equalizer, J. K. Woolcott..... 857,854
Drawing and other rolls, machine for raising flutes on, G. A. Bates..... 857,576
Drawing board, G. S. Manuel 858,194
Drawing kit. L. Forsyth 858,274
Dredge moving apparatus, Silver & Bunyan 858,033
Dress shield, V. G. Alexander..... 858,249
Driers, apparatus for maintaining uniform pressure in, W. B. Mason 858,089
Drying furnace. J. Caygill 858,260
Drill feed, E. F. Smith 858,113
Drill press, multiple, W. C. Toon..... 857,690
Drilling machine, J. S. Surbaugh..... 858,311
Dumping platform and elevator, combined. E. W. Harmon 857,936
Dye for lakes and making same, monoazo, Ernst & Gullbransson 858,065
Dyeing, bleaching, and sizing cotton warps, apparatus for, J. Hartley 858,068
Dynamo speed governor, E. B. Jacobson... 858,002
Electric brake, E. Franke 857,729
Electric circuit controller, M. Schuppe.... 858,222
Electric machine, direct current dynamo, E. C. Wright 858,246
Electric machine, dynamo, B. T. McCormick 858,097
Electric sparks. apparatus for producing, W. Marshall 858,196
Electrochemical apparatus, F. A. Decker... 857,607
Electrode, storage battery, T. A. Edison... 857,929
Electrolytic cell, A. O. Tate..... 857,909
Electrolytic work, lining tanks for, J. F. Miller 857,886
Electromedical appliance, D. R. Overman.. 857,664
Electroplating apparatus, D. F. Broderick. 858,059
Elevator guide shoe, H. Donohoe..... 857,725
Elevator safety device. R. E. Ackley..... 858,247
Engine, F. Hennebohle 857,802
Engine, J. M. Stadel 857,842
Engine cooling device, E. B. Harshbarger.. 857,620
Engine reversing mechanism, gas, W. A. Hansen 858,281
Engine starter, C. J. Coleman 857,599
Engine vaporizer, explosive, H. O. Westendarp 858,046
Engines. beating roll for paper pulp or other, H. Bennett 858,256
Excavating apparatus, W. Heffron..... 858,069
Excavator, W. R. Martin 857,817
Expansion tube. O. S. Pedersen..... 858,100
Explosive, F. E. W. Bowen..... 857,580
Explosive engine, L. Iversen 858,071
Extractor. See Cork extractor.
Eye guard, flexible, H. M. Tileston..... 857,689
Eyeglasses or spectacles. mounting for, P. Moews 857,650
Eyelet varnishing machine, Giles & Tobey.. 858,339
Eyescope. H. D. Reese 858,213
Fabric, L. Wertheim 857,968
Fans. oscillating device for motor driven, H. S. Brown 857,787
Farm rack, combination, Merrill & Randall 858,347
Fastener, L. J. Franklin 858,275
Fastener, metallic. G. W. McGill..... 857,749
Feeder, automatic stock, F. B. Platt..... 857,827
Felly, wheel, H. Pataud 858,015
Fence post. W. M. Ruggles 857,835
Fence post, G. H. Kaufman 858,345
Fences, concrete post and adjustable fastener for wire. A. J. Taylor 858,231
Fiber cleaning machine, J. Garcia...858,337, 858,338
File, H. Getaz 858,171
File for papers, E. Stebbings..... 858,115
Filter, J. Conversy 858,154
Fire alarm boxes, device for permitting the automatic operation of, L. G. Woolley 857,707
Fire escape, G. J. Pitts 858,210
Fire extinguishing apparatus, hand, A. G. Laurent 858,188
Firearms, single trigger mechanism for, G. H. & W. B. Parkin 857,895
Fireplace, W. S. Jackson 858,292
Fireproof door or shutter, H. T. Higinbotham 858,287
Fish scaling and slitting machine, J. M. Meredith, Jr. 857,884
Fishing bait, artificial minnow, J. D. Kreisser 857,883
Flat iron heating oven. J. G. Redford..... 857,670
Float, J. Willmann 857,703
Fluid pressure brake, Turner & Blackall.. 857,911
Fluid pressure brake. Turner & Clark..... 857,912
Folding rack for poultry, etc.. P. H. Deis.. 858,159
Forage treating apparatus, T. H. Mapp.. 858,302
Fruits and vegetables. apparatus for removing the skins of. C. D. Monte.... 858,094
Fuel economizer soot cleaner, W. Eichelberger 858,334
Furnace, J. F. Giroux 857,617
Furnace, C. E. Garner 858,169
Furnace, J. M. Heverly 858,286
Furnace construction, F. E. Stinchfield.... 857,685
Furnace fire pot, Hohenadel & Kline..... 857,806
Gage wheel. A. W. Howell 858,290
Game apparatus. W. S. Haynes 857,878
Game counter. G. B. Risley 858,027
Garden implement, C. S. Stevens 857,684
Garment hanger, E. Mayer 857,645
Garment, storm, I. V. Benoit 857,578
Gas apparatus, water, J. M. Rusby..... 857,760
Gas burner, natural, H. M. Leps..... 858,189
Gas engine, two cycle, F. von Handorff... 858,280
Gases, apparatus for treating noxious, A. C. Day 858,062
Gasket cutter, G. T. Miller 857,647
Gate, C. E. Rife 857,834
Gate, C. J. Van Valkenburg..... 858,042
Gear adjusting mechanism, A. J. Benton.. 857,783
Gear cutter framing, H. E. & E. G. Eberhardt 858,164
Gear, machine for making worm and spiral, W. K. Liggett 858,081
Gear, variable speed transmission, P. F. Foley 858,336
Gearing, changeable speed, A. L. Muren... 857,958
Gearing, speed changing, P. A. Bredsvold.. 858,058
Generating and carbureting apparatus, D. Millior 858,092
Glass, feed out device for molten, J. H. Lubbers 858,085
Glass holder, looking. F. B. La May 858,080
Glass pressing and blowing machine, Henning & Beeson 857,803
Governor, Andrews & Jackson..... 858,320
Grain bag holder, W. R. Mosher..... 857,820
Grain binders, back wing support for, C. Maul 857,950
Grain fender, Dean & Hall 857,874
Grain separator, W. Koester 858,294
Grease cup, J. Powell, reissue..... 12,666
Grease cups, device for filling, H. S. Erd.. 858,167
Greenhouse bench, R. O. King 858,187
Grinding mill, A. M. Dellinger 858,267
Gun fire, instrument for measuring and correcting errors of, J. L. Latimer.... 858,297
Hammer, pneumatic. J. C. McCaveny.... 858,200
Hammock support, W. H. Morehouse..... 857,819
Handle. See Tool handle.
Handling material, device for, T. B. Rice, Jr. 857,673
Hanger, R. W. Beaton 858,140
Harmonic horn, R. J. Smith 857,765
Harness, W. H. Sneed 858,114
Harness attachment, B. A. Adams 857,916
Harrow, J. E. Arnold 857,711
Harvester (trimmer), cane, J. D. Cooper.. 858,061
Hat, A. Mayer 857,644
Hat frame machine, W. B. Foster 858,168
Hat guard, L. Weaver, Jr..... 857,776
Hat pin, Gaskell & Vale 857,614
Hat pin, J. Thomas 858,118
Hay press, J. Dain 857,604
Heating apparatus, F. A. Delph..... 857,795
Heating appliance, domestic and industrial, C. J. Roux 858,105
Heel, spring, A. F. Luzzi 857,816
Hinge for window screens, B. F. Douglass. 858,269
Hoisting machine, D. Arthur 857,972
Holder, M. H. Hart 857,998
Hollow vessels. forming seamless metallic, J. H. Gault 857,616
Hooks and eyes, carrier plate for, J. W. Granger 857,731
Horse hoot, J. Fennell 858,272, 858,273
Hydraulic transmission device, W. C. Schwarz 858,109
Hydrocarbon burner, T. Muehleisen..... 857,652
Hydrocarbon burner system, B. F. Jackson. 857,808
Ice producing apparatus, D. D. & P. J. Sprague 857,841
Index or d[illegible] H. S. Harde..... 858,340
Indicator, [illegible] & Lake..... 857,857
Induction coil, M. W. Brinkmann..... 857,866
Injector, S. L. Kneass 857,882
Injector, hypodermic, D. S. Reese..... 858,025
Internal combustion engine, A. B. Goodspeed 857,730
Iron, bending cast, B. S. Cowles..... 857,983
Iron or steel, treating, F. M. Becket..... 858,326
Jail cell, J. B. Smith 858,309
Jewel mounting, A. A. Boismaure..... 858,057
Journal bearing and making same, D. H. Stewart 857,845
Journal box, S. H. Campbell 857,597
Journal box, adjustable, F. E. Buxton.... 857,788
Journal box lid, J. S. Patten 858,208
Key or wedge, tool head attaching, C. H. Booth 857,863
Knee pad, W. R. Chambers, et al..... 857,719
Knee protector, I. D. Larsen..... 858,296
Knitting machine, circular independent needle, C. A. Santmyers 857,836
Ladder, extension, F. A. Bobbitt 857,785
Lamp, O. S. Atterholt 858,251
Lamp and air carbureting apparatus therefor, safety, Suter & Wayman..... 857,769
Lamp fitting, electric, J. Dugdill 857,928
Latch, F. W. Merriweather 858,091
Lath boards, machine for making, H. R. Karstens 857,738
Lath, plaster, Farrington & Burchard..... 857,611
Lathe, F. J. Barnett 858,358
Laundry registering device, T. O. Branch.. 857,590
Legging, M. Rosenwasser 857,963
Lens grinding machine, F. M. Clark..... 857,791
Letter sheet, separable double, M. A. Howe 858,001
Level and plumb, combined, W. A. Gibson 857,991
Level and triangle, combination hand, W. Thorburn 857,687
Level and triangle, hand, W. Thorburn.... 857,688
Level, plumb, F. M. McLeroy..... 857,891
Life lines, means for projecting and anchoring, Meyer & Rogers 858,009
Lightning arrester, J. V. E. Titus..... 857,849
Linotype machine, R. M. Bedell 858,141
Liquid fuel burner, E. D. Schmucker..... 858,220
Liquid fuel burning apparatus, F. E. Nelson 857,657
Liquid separator, centrifugal, Decker & Shaw 857,794
Liquid weighing or measuring machine, F. O. Hague 857,996
Liquids by compressed air, method and apparatus for raising, R. Stirling 857,768
Liquids electrolytically, apparatus for treating, A. O. Tate 857,910
Loading apparatus, E. Rosenvall 858,218
Locomotive, electromagnetic, J. L. Potter. 858,211
Log loader, J. R. McGiffert 857,654
Log loader frame, J. R. McGiffert..... 857,655
Loom harness motion, C. H. Atkins..... 858,136
Loom, jacquard, S. Smith 858,035
Loom shuttle and bobbin tensioning means therefor, C. H. Atkins 858,137
Loom warp let off mechanism, C. H. Atkins 858,138
Loom warp stop motion, wire weaving, C. H. Atkins 858,139
Loom weft fork and slide, F. D. Chesborough 858,151
Looms, cloth take up mechanism for, C. H. Atkins 858,052
Looms, heddle for weaving, J. Grob..... 857,732
Loop and stud connection, J. H. Pilkington. 857,901
Loose materials, apparatus for reclaiming, E. H. Messiter 858,008
Lunch box, folding, M. A. Gilman..... 858,278
Mail matter, pick up table for, Gasman & Lynch 857,990
Malting and pneumatic drying apparatus, pneumatic, F. H. C. Mey..... 857,954
Manicure implement, W. J. Carroll..... 857,790
Marble working machine, J. R. Peirce.... 857,898
Massage apparatus, F. Schmidt 857,761
Match making machine, H. Beeg..... 857,861
Measuring and mixing machine, A. Lanquist 857,742
Measuring electrical resistance, apparatus for, S. Evershed 858,335
Mechanical movement, F. H. Richards.... 857,832
Mechanical movement, F. J. Ziegler..... 858,049
Medical battery, C. W. Taylor 858,117
Metal bending machine, H. M. Smith..... 857,764
Metal. rocker press for shaping, C. A. & C. F. Murdock 858,096
Metal sheet wrapper, H. E. Marks 857,744
Metals, apparatus for electrolytic deposition of, Harrison & Day 858,341
Meter, W. J. Mowbray 858,011
Micrometer gage, G. Kohlhaas 857,810
Mill. See Grinding mill.
Mining drill post, coal, P. Rommes..... 858,217
Mirror, hand, J. Komorous, Jr..... 858,079
Mirror support, F. N. Coffman 858,152
Molding machine. F. W. Hall 857,997
Monolithic hollow objects, apparatus for and method of continuously making, J. M. Boyle 857,588

Monolithic hollow objects, apparatus for continuously making, J. M. Boyle	857,587
Monolithic hollow objects, means and method for continuously making tube lined, J. M. Boyle	857,589
Monolithic objects, apparatus for continuously making, J. M. Boyle	857,586
Mop wringer, J. D. Carter	858,150
Motor control apparatus, G. W. Euker	857,797
Motors and other vehicles, means for prevention of skidding or side slipping of, H. Turner	857,774
Motors, fuel feeding device for internal combustion, H. J. & T. E. Podlesak	858,022
Motors, means for automatically timing the spark for producing ignition in explosion, A. E. Brillie	857,715
Motors or the like, apparatus for automatically starting explosive, L. A. C. Letombe	857,639
Music leaf turner, J. O'Connor	858,204
Musical chord indicator, C. A. Miller	857,955
Necktie fastener clasp, F. E. Wicking	857,701
Needle holder, L. C. McNeal	857,824
Nesting and brooding box, J. W. Bradford	857,921
Newspaper holder, J. J. Dettwyler	857,608
Nickel contained in basic nickel precipitate, recovering the, H. H. Dow, et al	857,927
Nose guard, W. H. Reisner	857,758
Numbering and dating machine, E. G. Bates	857,976
Numbering machine, hand, H. P. Hamburg	857,934
Nut lock, W. Atkins	857,573
Nut lock, J. B. Purl	857,755
Nut lock, R. D. Baker	857,782
Nut lock, J. J. Potter	857,828
Nut lock, H. C. Werner	858,045
Nut lock, A. J. Logan	858,191
Nut, lock, A. W. Carlson	857,869
Ore slimer, P. H. Craven	858,262
Organ pipe, F. I. White	857,960
Ornaments, machine for inserting, T. L. Sherman	857,839
Oven, baker's C. W. Heller	858,000
Oven door, F. J. Albrecht	858,132
Oven, rotary baking, F. R. Barnheisel	858,053
Ovens, combined bearing and steam feeding mechanism for rotary bake, F. R. Barnheisel	858,323
Oversboe, S. Schwarzschild	858,031
Package carrier, J. W. Clark	857,720
Package for implements, A. W. Stephens	857,767
Packing, metallic, H. Thompson	858,119
Packing, rod, W. Sudekum	858,037
Pad. See Collar pad.	
Padlock, permutation, H. Handler	857,935
Paper bag machine, E. C. Westervelt	858,047
Paper boxes, making, E. H. Taylor	858,233
Paper coating machine, M. Cantine	858,149
Paper fastener, metallic, G. W. McGill	857,748
Paper hanger's tool, W. U. Coltbar	857,600
Paper marbling machine, J. W. Newbery, et al	858,203
Parasol top, W. H. Perkins	857,665
Paring machine, fruit, D. F. Hunt	858,344
Pea shelling machine, A. S. Adam	858,248
Peat, etc., into blocks or cakes, machine for forming and compressing, M. C. Sharpneck	858,352
Peat machine, M. C. Sharpneck	858,353, 858,354
Pebble mill lining, M. F. Abbe	858,129
Peeling of fruits and vegetables, C. D. Monte	858,095
Pen and pencil clip, J. H. Pilkington	858,020
Pen, drawing, W. S. Phillips	858,350
Pencil sharpener, F. E. V. Baines	857,574
Perforator, loose leaf, L. M. Morden	857,888
Phonograph attachment, C. L. Holm	858,184
Photographs with any desired background, production of, F. J. Discbner	858,162
Photographic focal plane shutter, L. Borsum	858,146
Photographic printing machine, W. T. Mead	857,952
Piano pedal, O. Lestina	857,638
Piano pedal, self-playing grand, J. W. Darley, Jr.	858,263
Picture projecting machine, life motion, O. T. Weiser	857,697
Pie machine, F. Deuerling	857,609
Pipe connection, H. Mueller	857,956
Pipe couplings, clamping ring for, J. Clark	858,300
Pipe cutter, C. Wahnsiedler	857,694
Pipe joint, J. P. Putnam	857,905
Pipe wrench, G. Nicholson	857,825
Pipes, etc., magnetic drawing apparatus for, Baehr & Lynch	857,856
Pivot connection, F. H. Richards	857,831
Planer, floor, C. T. Leimbach	857,946
Planter, Fidler & Lingenfelter	857,798
Planter, corn, R. S. Carr	857,789
Planting machine, B. C. McCoy	858,201
Plastics, gravity tamping and molding machine for, Taylor & McClure	858,232
Plate lifter, A. E. Phillips	857,899
Plow, G. Wiard	857,852
Plow, S. V. Weeks	857,967
Plow beel, T. H. Hilley	857,804
Plug and receptacle, fused, Hatzel & Morley	857,735
Pole arm, wrought metal, M. E. Harrison	857,938
Post driver, C. Bandimere	858,322
Power brake, mechanic' L. Pfingst	857,752
Press releasing mechanism, bundling, C. F. Anderson	857,918
Pressure, apparatus for maintaining uniform, W. B. Mason	858,088
Primary battery, C. E. Hite	857,880
Printers' chases and forms, auxiliary support for, J. F. Horn	857,807
Printing films, inking, B. Day	858,158
Printing press, W. M. Clark	857,721
Printing presses, offset web feed mechanism for, G. H. Pierce	857,753
Propeller, boat, C. A. Moline	858,010
Propeller, marine, Robinson & Bennett	858,215
Propeller wheel, H. J. Perkins, reissue	12,665
Propelling and steering mechanism for air ships, A. H. Malloy	857,949
Propelling boats, means for, W. G. Busse	857,868
Pulverizing and grinding mills, air separator for, J. W. Fuller, Jr.	857,988
Pulverizing or grinding mill, J. W. Fuller, Jr.	857,932
Pump, air, F. E. Ten Eyck	858,039
Pump rod coupling, C. H. Nichols	857,659
Punching machine, W. Febr	858,066
Puzzle, R. W. Kemp, Jr.	858,074
Radiators, manufacturing, Briscoe & Anguish	858,258
Rail fastening device, Flamache & Gernaert	857,987
Rail joint, G. J. Becker	857,860
Rail joint and anticreeping device, F. M. Volk	858,235
Railway brake, H. A. Coleman	857,792
Railway frog, R. E. Einstein	857,930
Railway rail, A. King	857,741
Railway rail and rail base plate, combined, F. E. Abbott	857,781
Railway rails, bridge and gage plate for, F. E. Abbott	858,780
Railway switch, automatic, J. G. Ryan	858,219
Railway tie, metallic, D. P. McQueen	857,656
Railway track construction, J. H. F. Sbulze	858,110
Railway track fastener, W. H. Walden	858,124
Ratchet wrench, J. L. Schad	858,030
Razor blade holder, T. F. Curley	858,155
Razor strop and case, combined, J. L. Reed	858,307
Reamer, B. M. Nuzum	857,661
Reamers, apparatus for restoring worn out, R. S. Fetter	857,877
Receptacle closure, A. L. Weissenthanner	857,698
Refrigerator, R. E. Miller	857,887
Refrigerator and water cooler, combined, E. Keene	857,944
Rein holder, C. S. Chaffee	857,873
Roach trap, A. G. Day	858,157
Rock crusher, E. A. Hoff	857,940
Rock drill, J. B. Marshall	858,195
Roofs, gutter and valley trough for, H. Cooper	857,601
Rope thimble, G. C. Brown	857,717
Rotary engine, W. C. Kelly	858,073
Rotary engine, M. Bey	858,144
Ruler, blackboard, M. C. Benedict	858,254
Saddletree, J. Bevan	858,055
Safe lock, E. A. Siegfried	858,111
Safety elevator, G. L. Wheeler	857,699
Sap collecting apron and receptacle, sheet metal, E. R. Philip	858,305
Sap cup hook, T. A. McGregor	857,823
Sap receiving apron and receptacle, Stollberg & Philip	857,847

Sap receiving receptacle and apron, F. Rudolphi	857,964
Sap receptacle or vessel, sheet metal, C. Stollberg	857,846
Sash fastener, D. Wilde	858,245
Sash operating device, window, C. Brown	857,592
Saw guide, O. F. Giffin	858,277
Saw guide, band, J. J. Callahan	858,148
Saw swage, J. Hanchett	858,175
Sawmill set works, A. C. Osborn	857,663
Scale lever, J. B. Paige	858,014
Scale rack, adjustable, C. W. Worthington	858,316
Scarfing machine, C. F. Stackpole	857,682
Scissors, pocket tool, F. W. Klever	858,003
Screen. See Window screen.	
Screw lock, set, H. C. Werner	858,241
Screw machine, G. H. Newton	858,893
Seal, metallic envelop, A. Schorno	857,908
Sealing device, bottle, F. W. Hall	857,619
Seaming machine, pipe, W. F. Norman	857,750
Seed, treatment of cotton, I. Kitsee	858,075
Set ring, G. H. Best	857,862
Sewer pipe, J. M. Phelan	858,102
Sewing machine attachment, E. D. Harris	858,176
Sewing machine, buttonhole, E. B. Allen	858,133
Sewing machine, carpet, E. B. Allen	858,134
Sewing machine for producing scalloped tucks, A. H. De Voe	858,161
Sewing machine, hemstitch, J. C. O'Reilly	858,098
Shade roller mounting, J. J. Bloomer	858,056
Shaking bolt, W. B. Howard	857,942
Shears, A. N. Eastman	858,359
Shelf or rack, G. E. Dean	857,724
Shelf, window, R. B. Smart	858,112
Ships with coal or the like, appliance for loading, W. Bisset	857,784
Shoe, E. Hayes	857,999
Shoe fitting appliance, C. W. Schell	857,837
Shot, making, T. E. Reddy	857,756
Shoveling board, D. Wilde	858,242
Shut off, automatic, J. G. Hall	858,279
Sign, metal, M. Mayer	857,646
Signal, H. W. Eden	858,064
Signaling system for alternating currents, L. H. Thullen	858,120
Skate, B. A. Cure	857,925
Skimmer, J. F. Irby	858,291
Skirt hanger, J. C. Liberty	858,298
Skirt supporter, placket closer, and waist holder, combined, R. S. Valentine	858,041
Smoke consuming furnace, T. Murrin	858,012
Smoke in stoves and furnaces, apparatus for consuming, C. J. Roux	858,106
Snake, etc., artificial, J. N. Brown	857,593
Soap, manufacture of, P. Krebitz	858,295
Soap, tag rest for, L. C. Allen	857,570
Soldering caps on cans, machine for, Harfst & Prater	857,801
Soldering iron holder and heater, C. Sommer	858,036
Spark and soot arrester, R. Wagenschieffer	857,693
Sparking plug, W. B. Hayden	858,282
Spectacles, motor goggles, and the like, F. G. Shaw	857,838
Speed and power transmitting device, variable, T. Scheffler	857,679
Speed changing mechanism, C. J. Reed	858,024
Speed regulating mechanism, G. F. Leiger, 857,636,	857,637
Spring cushion work, M. A. Phelps	857,666
Stairway, F. B. Modjeski	858,199
Stamp or label affixing machine, T. C. Hook	857,625
Staple puller, H. Breiding	858,257
Station indicator, H. L. Keeler	857,630
Steam generator, M. Connor	857,723
Steel dies, producing, G. F. Diez	857,926
Steering engine, F. D. Patten	858,207
Steering gear, E. Huber	858,186
Stick feeder, W. H. Waldron	858,125
Stocking, F. W. Lum	858,006
Stone cutting bit, C. N. Johnson	858,072
Stone dressing machine, W. H. Van Sickel	857,692
Stove, L. Miller	857,649
Stove, heating, W. Heuermann	858,285
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