Water and Sewage Works

MUNICIPAL ENGINEERING

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Municipal Engineering

The World's Leading Municipal Publication

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ACTIVITY IN MUNICIPAL IMPROVEMENTS

We have the anomaly of plenty of money and rather high interest rates, the reasons for which are numerous and complicated. Foreign demand for capital is one, but the money is not yet going abroad as rapidly as it is coming here and probably will not until the war is over. The presidential campaign is on and produces a reducing effect upon the rate of construction, which thus far is not as pronounced as usual. Prospects for plenty of work are therefore certain, tho the fashion of the last two years continues and decisions are not made far in advance of beginning construction.

The municipal field is the most promising and the amount of work in public improvements, always slow in starting, promises to break all records. Municipal bonds, especially of the serial form, are the most popular investment and the sales for the first five months of 1916 break the record of municipal bond sales in the same period for all years except 1914. Activity was particularly great late in the month, promising further advance in municipal investments as the year goes by. Presidential elections do not have a retarding effect upon municipal expenditures, but rather the contrary.

Predictions for last year were so well borne out that Municipal Engineering again predicts almost a record-breaking year in the construction of municipal improvements. Contractors and dealers in materials and machinery will do well to concentrate upon this field this year.

ENGINEERING ADVICE

A committee of the Iowa State Engineering Society very much fears that the engineering periodicals are taking the bread out of their mouths by offers of advice on engineering subjects. It quotes from letters, circulars and advertisements of various publications in support of its claims but gives no examples of such robberies.

The need of education of communities on engineering matters is so great and the recognition of the need is so slight that the periodicals have been trying to fill it to the extent of their opportunities and have supplemented as well as they could the activities of the State in this direction. And, conscious of the fact that they are aiding the engineering profession and are not taking work away from individual engineers they will continue what they consider to be a valuable contribution to the advancement of the nation and the better recognition of the engineering profession.

Education of public officials to an appreciation of the need of engineering talent in designing and supervising the construction of their public works is a very different thing from doing the actual work. The engineer in practice is obliged to do much of it for which he never gets any compensation, and he should be thankful to have it done at no expense to him, even if it is done as extensively as is stated below. The writer has had experience in all lines of this educational work and can assure the committee that, so far as the technical journals go, it never goes beyond the educational stage and is always for the benefit of the practicing engineer and never to his detriment.

A quotation from an article by G. R. Bascom in one of the offending periodicals will show what the University of Wisconsin is doing in this line, and will show that such institutions are going farther than the periodicals would dream of going, even if their equipment and business methods would permit, tho they commend such efforts when properly limited as proposed:

The general scope of this engineering service is in the form of advice to communities and individuals. The service is intended to be limited to the field covered by the usual "preliminary survey" as furnished by experts in advising generally upon engineering subjects. Finished plans and specifications will not be submitted. If necessary the department will send a competent engineer to investigate and make a report on the problem at hand. These services are free except in cases when an engineer must make trips to study the conditions; in such cases the community is expected to reimburse the department for the traveling expenses of the engineer. The plan may be further explained, if desired, in an address by the engineer to the taxpayers of the village. Here the work of the Extension Division ends. If the village officials decide to go ahead with the plan, a consulting engineer in private practice is employed by them to work out detailed plans and specifications and supervise the construction. It can thus be seen that in this service we are advising, guiding, and inspiring rather than serving in an engineering capacity in its fullest sense. We believe that we are filling a real need, for the work has thus far clearly demonstrated the fact that communities will take the impartial advice of the university departments where the overtures made by individuals in the promotion of public improvements might be viewed with suspicion.

CENTRAL STATION STEAM HEATING

BY MILES CITY, MONTANA, MUNICIPAL PLANT

By G. C. Pruett, City Engineer.

Steam heating as a by-product of a municipal light and power plant is not so common but that a description of this successful plant will be of interest. The principles and data upon which the design was based are given in some detail and also details of construction so that the article will be of value to many whether city officials or connected with private light and power plants.

MILES CITY acquired its light and power plant in 1892 by purchasing the holdings of the Miles City Light & Water Co., a corporation holding a twenty-year franchise, but which at that time was involved in a receivership.

After making some slight changes and additions, the city struggled along with this dilapidated and antiquated plant until 1900, when a number of other changes and additions were made, which placed the plant in a fairly good condition so far as economical operation was concerned, but it could not be classed as a model plant by any means. It was, however, the most which could be done at that time with the finances available.

Between 1900 and 1910 other changes and additions were made to the boiler and generating plant, leaving a plant at the beginning of 1910 consisting of one 150-h.p. slow speed Corliss engine, one 150-h.p. Chuse high speed engine, three 150-h.p. return tubular boilers, two 120-kv.a. single-phase alternators, and a Brush arc machine with a capacity for 100 lamps.

Two more 150-h.p. return tubular boilers and a stack 6x100 feet were added to the boiler equipment in 1910, and a 300-h.p. high speed Corliss engine connected to a 250-kv.a. 3-phase alternator was added to the generating equipment. The two 120-kv.a. generators were changed to 3-phase machines, and the whole was enclosed in a new building.

This gave the city quite a modern plant, and one of sufficient capacity for the time being, but, owing to the rapid increase in the demand for light and power, this plant reached its capacity last winter and steps are now being taken to increase the boiler equipment with a 300-h.p. Franklin water-tube boiler with stoker equipment, and the generating equipment with a 300-h.p. high speed Corliss engine direct connected to a 250-kv.a. 3-phase alternator. When the installation of this equipment is complete the plant will then have a boiler capacity of 1,050-h.p., an engine capacity of 900-h.p. and an electrical capacity of 770-kv.a.

Owing to the favorable location of the plant to the center of the business district and the unfavorable location for installing condensers, an agitation was started in 1910 for the installation of a district steam heating system in order to make use of the exhaust steam which was going to waste. Lack of finances, however, prevented going ahead with this at that time, and the matter was continued until 1914 when it appeared that a sufficient reserve had been accumulated from the operation of the light plant to permit going ahead with the work.

Contracts for the first section of the heating plant were let in August of that year and completed about the first of October. This section included the laying of a 14-inch line from the light plant to Main street and all the valves and other equipment required to be installed in the light plant for the proper control and regulation of the steam for heating.

Owing to the lateness of the season it was deemed advisable to discontinue the work for the balance of the system until the following year. Contracts were let early in 1915 for the balance of the material to complete the plant. About the time the material began to arrive the city was served with a restraining order on the basis that the statutes for the state of Montana did not specifically state that a municipality could engage in the steam heating business. This came from an offended citizen who was refused a permit to install a competing plant. The case was tried in the district court and resulted in a decision favorable to the enjoiner. On appeal the city won, the supreme court holding in effect that a municipality could engage in any business whether specifically stated in the statutes or not, if by engaging in the business it would result in a benefit to the community. The case was sent back to the district court to determine whether or not such an enterprise would be a benefit to the community. The city won again and the work was started immediately and is now practically completed.

Design—The first matter taken up for consideration in the design of the plant was to make a survey of the entire district proposed to be heated. This was done, and the cubical contents of all the buildings within the district were found to be 5,150,000 cubic feet.

Without going to the refinement of measuring all the openings and exposures for the entire district, the next step was to select a representative half block bordering on the proposed steam main and make complete measurements for this. The following data were obtained:

Cubical contents	515,780 cu. ft.
Exposed wall surface	32,500 sq. ft.
Glass surface	4,100 sq. ft.

In the figures allowance was made for poorly constructed walls and all other items which would add to the heat requirements of the buildings. Doors and other similar openings were figured as glass, and the roofs, where there was an attic space between the ceiling and roof, were figured at 0.5 wall exposure.

The Weather Office records were next consulted, and it was found that the heating season taken from the average of a number of years back would be 230 days, or 5,520 hours. Also that the average temperature for the heating season would be 34.3 degrees F., and the average minimum monthly temperature 19 degrees F.

A number of buildings were next investigated where heat had been installed on the basis of Prof. Carpenter's formula,

$$h = \frac{nC}{55} + \frac{W}{4} + G$$

Where h equals the B.t.u. required per hour per 1-degree difference in temperature between the outside and inside.

C equals the cubical contents of the building to be heated.

n equals the number of air changes in the building per hour.

W equals the exposed wall surface or equivalent.

G equals the exposed glass surface or equivalent.

It was found that where a minimum temperature of —20 degrees F. had been used, this formula had given satisfactory results.

Using this as a basis it was found that 1,000 cubic feet space required 3,927 pounds of steam per season, using the season temperature of 34.3 F., one air change per hour, 70 degrees room temperature, and on the assumption that 1 pound of steam will give up 1,000 B.t.u.

Similarly 100 square feet of wall surface was found to require 4,910 pounds of steam per season, and 100 square feet of glass, 19,640 pounds.

Using the data for the representative half block as given above, it was found that 1.6 pounds of steam per 1,000 cubic feet per hour would be required at the average season temperature, 2.3 pounds for the maximum monthly, i. e., with a difference of 51 degrees, and 4 pounds for the maximum daily with a difference of 90 degrees.

Consequently. 5,150,000 cubic feet would require

$4 \times 5{,}150 = 20{,}600$ pounds of steam per hour as a maximum.

Using the formula $p = .000131 \left(1 + \frac{3.6}{d}\right) \left(\frac{w^2 L}{D d^5}\right)$

to obtain the size of pipe and pressure drop, where

p equals drop in the pressure per sq. in.

d equals diameter of pipe.

w equals weight of steam in lbs per minute = 343 lbs.

D equals weight of steam per cu. ft. = 0.0425 lb.

L equals length of pipe in feet, taken as 1,000 ft. in these calculations,

$$p = 0.875 \text{ lb.}$$

This is not an unreasonable rate of drop for the district proposed and, inasmuch as the quantity of steam given in the calculations is the maximum daily average, and would not be required except during very severe weather, it was considered a reasonable allowance.

It will also be noted that the lowest monthly average temperature is only 60 per cent. of that used in the above calculation, and inasmuch as the heat requirements vary directly as the temperature difference, and the pressure drop inversely as the square of the weight delivered, the pressure drop for the average monthly rate was found to be 0.31 pound per square inch.

The greatest distance of distribution from the plant with any future extensions which are now being considered is 3,000 feet, incurring a drop of 1 pound pressure per square inch on the basis of the lowest average monthly temperature, from the plant to the consumers service. With a plant pressure of 3 pounds per square inch this will leave 2 pounds at the consumers' service, a very desirable pressure with a properly installed system. For severe weather this pressure can be boosted up to 5 pounds in order to maintain a constant pressure at the consumers premises.

It is not desirable, however, to use this higher pressure on account of the back pressure put on the engines, but inasmuch as it will not be a frequent occurrence, and only for short periods of time, it is permissible. Furthermore, it is not likely that more than 75 per cent. of the buildings along the main will connect, in which event there is ample capacity to allow for probable future building developments.

The whole system is proportioned as outlined above, i. e., the probable steam consumption is computed for the point under consideration, the drop figured and pipe proportioned as outlined. By this system it is not likely that the mains will be found too small for proper distribution, as is so often the case, unless there should be some abnormal growth at some point which has not been taken into consideration.

The next thing was to find out if the exhaust steam from the light plant was sufficient to supply the demand, and if not, to find out the approximate amount of live steam which would be necessary, and how much the additional cost could be.

Estimates, as outlined, were made of the requirements for each month, using the average monthly temperatures as found in the records of the Weather Office. The following table gives these monthly requirements together with the percentages of the total for the season:

Month	Lbs. of Steam Required	% of Total
September	885,464	2
October	3,099,124	7
November	4,870,054	11
December	8,411,912	19
January	8,411,912	19
February	8,411,912	19
March	6,198,250	14
April	3,099,124	7
May	885,464	2
Total	44,273,216 lbs.	100%

Reference to the records of the light plant showed that only three months, December, January and February approached dangerously near these figures, and that the water evaporated during these months, after allowing for feed-wtaer heat, pipe condensation, and steam for other auxiliaries would slightly exceed the demands.

A detailed examination of the load curves, however, revealed the fact that at certain periods of the day, especially during severe weather, there would be an insufficiency of steam. The remedy for this was to make a rearrangement of the load demand, which was easily done by rearranging the pumping schedule for the water plant, it being electrically operated with power from the light plant. This overcame the difficulty to a certain extent, but not entirely, hut will be sufficient for some time from the fact that the total demand will not be thrown on the plant immediately. In the meantime there will probably come other load demands which can be thrown in the valleys and the quantity of exhaust steam built up to the requirements. If such should not be the case it will then be necessary to use some live steam, the maximum which is likely ever to be required being estimated at 10 per cent. for the three months mentioned, i. e., 2,523,736 pounds. This would require 160 tons of coal, if the evaporation rate is taken at 8 pounds of water evaporated per pound of coal, which is not an unreasonable assumption. The average evaporation for the year as taken from the records of the light plant gives approximately 6½ pounds, and as the fires are banked during the period that this excess heat would be required, it would not seem that the rate of 8 pounds per pound of coal was too much.

Construction—The pipe for the distribution system is extra strong w. i., insulated with a double wrapping of asbestos paper which is bound with copper wire. The pipe is encased in tin-lined wood casings having a 4-inch wall. These casings have an inside diameter 2 inches greater than the outside diameter of the pipe. The pipe is held concentrically with the casings by means of cast iron chairs installed one to each length of pipe. These chairs have rolls to allow the pipe to expand and contract without causing an undue strain on the pipe.

Expansion and contraction is taken care of by means of variators installed at proper locations. These variators are generally equipped with openings in the top diameter for the service connections. This furnishes dry steam to the service. All variators and other specials are enclosed in concrete chambers which are filled with sawdust and covered with a 3-inch plank cover which is topped off with 6 inches of concrete.

Valves and traps for collecting and disposing of the main

condensation are located in concrete manholes which are also filled with sawdust and equipped with double packed covers.

The log for the pipe insulation is made with bell and spigot joints. They are driven together to a tight fit and the joints are sealed with asphalt. All places where the coating has been knocked off the logs are also given a good coat of asphalt, and the whole is covered with a layer of tarred felt with lap joints.

Water is kept away from the log by means of a double line of 4-inch open-joint drain-tile laid to proper grade with the top 6 inches below the bottom of the log. This is surrounded and covered with screened gravel, which is carried 6 inches over the top of the log. The tile is connected to the city sewers at proper intervals. The pipe condensation is also piped to the nearest city sewer.

The depth to the top of the log is generally about 4 feet, but this varies with the grade of the street and the obstructions encountered. Generally speaking, however, there has been little trouble from the interference of street obstructions, because of the fact that these are carefully referenced and in making the lay-out for the pipe line these records were carefully consulted.

What has been said with reference to the main lines applies equally to the service pipes, except that logs 2 inches thick are used for insulating them. The city runs the services to the curb and installs the control valve. The services are run at the time the mains are laid.

Costs—The cost of constructing the heating system was $14,000 for the first section, which consisted of 725 feet of 14-inch main from the light plant to the center of Main street at a point which is approximately in the center of distribution, 300 feet of services, and all piping and valves in the light plant for the operation and control of the heating.

The second section, which consists of 1,610 feet of main line, 6, 8 and 10 inches in diameter, and 1,400 feet of services will cost, when fully completed, about $16,000.

In addition to this there will be an expenditure of about $2,000 for meters and other equipment to be used on the consumers premises, bringing the total expenses to approximately $32,000. This is all being paid from an accumulated surplus in the light fund, which is sufficient.

Expected Revenues—It is estimated that the cost for maintenance and operation will not increase the ordinary operating cost of the light plant by more than $2,000 per annum, and that the revenue for the first year will be $6,000. As a matter of fact, those using steam for the past two seasons together with the contracts already signed up will easily exceed this. The estimated revenue for the second year is $10,000 and for the third year $12,000. Succeeding years will probably show a slow increase, but the amount to be expected is hard to estimate.

It is the intention to make a further reduction in light rates as soon as the heating system is firmly established on an operating basis; this on top of a rate which is already as law as any in the state, notwithstanding the fact that the majority of the cities of the state are supplied with electricity from the large hydro-electric plants, speaks well for municipal ownership which is kept out of politics and given a thoroly business administration.

Business Methods and Rates—The business methods and rates adopted for this heating system merit some consideration. Usually the first question asked by a prospective consumer when approached is "How much will it cost?" This question is forestalled, generally, by having measured up the premises and having an estimate of his requirements at hand. These estimates are made such that they are conservative, if reasonable judgment is used in the operation of the plant, and the plant is put in proper condition. He is also advised in what manner he can make improvements to his premises in order to cut down the amount of heat which will be required.

It is generally found that the requirements will not much exceed what he has been used to paying for coal, not to say anything about the expense and annoyance connected with operating the coal plant. I say generally, because there are conditions when the requirements will be vastly different.

The rates as established and which were approved by the Public Service Commision for Montana, are as follows:

1st 10,000 lbs., per month	$0.90	per 1,000 lbs.
2nd 10,000 lbs., per month	.83	per 1,000 lbs.
3rd 10,000 lbs., per month	.76	per 1,000 lbs.
4th 10,000 lbs., per month	.69	per 1,000 lbs.
5th 10,000 lbs., per month	.62	per 1,000 lbs.
Over 50,000 lbs., per month	.55	per 1,000 lbs.
Minimum charge	$5.00	per month

Discount, 20 per cent. on all bills paid on or before the 25th of the month following that in which the service was received.

It is needless to say that economy will be exercised in the use of the steam, as all services now connected are, and those to be connected, will be on meters.

The material for this work was furnished by the American District Steam Heating Co., of North Tonawanda, N. Y., thru their sales agent, the R. B. Whitacre Co., of St. Paul, Minn. The first section was laid by the forces of the American District Steam Heating Co., but the last one is being done with city forces.

Chicago City Manual

Francis A. Eastman, city statistician of Chicago, has completed a bound volume, entitled "Chicago City Manual," covering the municipal statistics of that city for the year ending 1915.

This manual contains very interesting historical chapters as well as statistics relating to the various annexations to the city of Chicago, Chicago Plan Commission, the growth of the leading cities of the world, consuls in Chicago, department operations, Eastland disaster, volunteer fire companies, the great Chicago fire, as well as the origin and growth of the different municipal departments.

This valuable book also goes into detail relative to street railway strikes, Sunday closing orders, vice district, unmarked graves, etc. The manual is by no means a dull book. It has its solid matter and its tables and other things which it is necessary that official publications shall have to be exact and to present figures so they can be compassed quickly, but it also has its stories of fighting fires before even horses were used to haul the engines and when man power was the pumping agency. Statistician Eastman ought to know something about sizable fires, for he was postmaster of Chicago when the city was all but destroyed, in October, 1871. It was to Mr. Eastman that a great number of the official messages of sorrow and of promises of relief were sent in those stricken October days.

The growth of Chicago is followed by Mr. Eastman. He personally has seen much of the progress of the town, for here he has lived for a good many years. He is one of the very young veterans of whom Chicago has so many and is glad that she has them. The annexations of territory which have been made from time to time are given wit hthe date of acquirement and with the measures of the taken territory. It is a useful book, prepared by a man who knew how.

STREET LIGHTING INSTALLATION

IN PORT JERVIS, NEW YORK

By H. A. Tinson and D. M. Diggs.

The following article comprises an interesting and well arranged description of a recent installation of Edison Mazda series lamps for street lighting. Pertinent details of the cost, layout, construction, operation, and appearance of the installation are included. This lighting system in Port Jervis has proved so satisfactory that it will afford a good typical pattern for other towns having similar requirements. It is from the "General Electric Review," to which we are indebted for the illustrations.

SINCE the introduction of the Edison Mazda lamp in high candle-power sizes and more efficient types, there has been created a great amount of interest in regard to street lighting on the part of the layman. In practically all cities and towns there is more or less demand for better street illumination and very many of them have been provided during the past year with new street lamps and equipment. A larger number are either in process of making changes or actively considering the subject.

It is of timely interest, therefore, to record in detail what has just been accomplished in Port Jervis, New York—a city that has made such improvements in a very complete manner.

Port Jervis is a typical city of New York state, of about 10,000 inhabitants, situated far enough away from the metropolis to have ideas and standards of its own. It is a very progressive city in many ways, has well paved brick and macadam streets, and many local manufacturing enterprises. The city government is conducted on the commission plan and the cordial relations and co-operation which existed between the city commissioners, the local lighting company (Port Jervis Light & Power Company) and the manufacturers and installation contractors for the new street lighting equipment, have resulted in the best and most approved units of the correct sizes and types being employed and installed at relatively proper spacings and proper heights.

General Layout—The business district of Port Jervis Is more or less divided into two distinct sections. On referring to the plan, Fig. 1, it will be noted that the ornamental system of lighting is installed in what might be termed the "down town" section, with units extending on Pike street to East Main street. Pike street itself for some little distance is residential, but it leads to another business street, where trading is done, so that the ornamental units are installed thruout the part of this street connecting the two trading sections. The fixtures installed in this district comprise ornamental novalux units with 600-c.p. 20-ampere Edison Mazda lamps mounted on ornamental iron standards. (See Fig. 2.)

On Main street a smaller amount of retail business is carried on, but as this street is important as the principal thorofare connecting to Kingston avenue (one of the main roads of travel in and out of town) it is lighted with 400-c-p. Edison Mazda novalux pendant units, suspended on span wires over the center of the street.

The principal main roads leading to the city are Kingston avenue, Jersey avenue and Fowler street, the two latter being

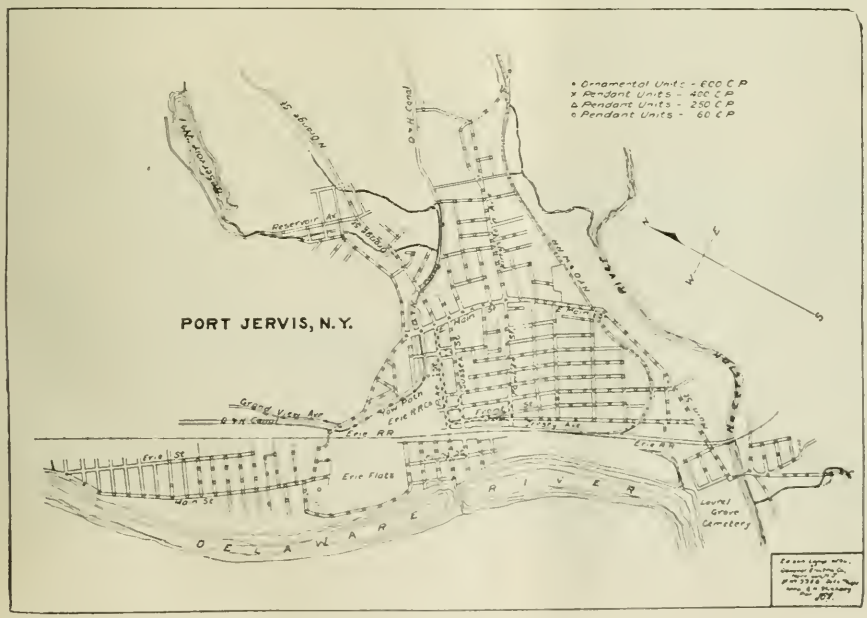


FIG. 1.
MAP OF PORT JERVIS, N. Y., SHOWING THE LAY-OUT OF THE STREET-LIGHTING SYSTEM.

FIG. 2. DAY VIEW IN PORT JERVIS, SHOWING NOVALUX UNITS WITH 600-C.P., 20-AMP. EDISON MAZDA SERIES LAMPS.

lighted by means of 250-c.p. Edison Mazda lamps, on center span suspensions. A typical illustration of this type of unit is shown in Fig. 3.

All other streets in the city are illuminated by 60-c.p. Edison Mazda lamps; some on center span suspensions and some on brackets fastened to the wooden poles.

There are now installed in Port Jervis a total of 460 units, made up as follows:

59	600-c.p. units on ornamental posts.
8	400-c.p. units on span suspensions.
19	250-c.p. units on span suspensions.
374	60-c.p. units on span suspensions and brackets.

Character of Streets—The streets in general are well paved and well kept. In the main business sections the paving is of brick and on the main thorofares macadam. The retail area is typical of a city of this size, the buildings being of brick and of moderate height. In the residential sections of town the houses are mostly of frame construction with grass plots in front. The foliage is dense in many cases and, therefore, the span suspension system adopted is well chosen to meet this condition.

In the down-town section, where the ornamental units are installed, the maximum width between curbs is 44 feet and the minimum 32 feet, with an average of about 37 feet. From building line to building line the width runs from 75 to 55 feet. In the other sections of the city the average width is approximately 50 to 55 feet between building lines. Parts of the city are hilly and, as will be noted from the plan, Fig. 1, the general layout is somewhat irregular, which made it necessary in many instances to vary the spacing of the lighting units.

There are a few points of general interest that might be noted; i. e., at the junction of Jersey avenue and Front street, and the intersection of Pike and East Main streets are located drinking fountains for horses. At both these places ornamental iron posts were mounted on top of the fountains, which illuminate the surrounding spaces at these points. The ornamental posts are located with special reference to the local conditions of traffic, rather than to secure equal spacing. A number of posts of various descriptions were removed from the business section and thus helped to clear the street and make it appear more attractive.

With the exception of the ornamental post installation, all the units are provided with prismatic refractors.

Ornamental Post Units—The ornamental post units comprise a cast-iron pole, finished in bronze, made from a special design by the Mott Iron Works, of New York, and a Novalux unit equipped with an Edison Mazda series lamp of 600-c.p. The lamp is of the 20 ampere type, operated thru an auto-transformer (or compensator) mounted in the casing of the unit. The height to the center of the diffusing globe is 14 feet 6 inches.

The posts are staggered, the spacing on one side varying between 110 and 150 feet, with an average of 130 feet. Each post is provided with an absolute cutout. The posts were made in two pieces and are 12 feet in length from the ground line to the lamp-casing holder. In the base a door 10½ by 20 inches is provided and inside are provided two lugs on which the cut-out is mounted. The posts were especially designed so as to appear slim and ornate, and after they were set they received a second coat of red lead and then two coats of dark Venetian bronze, the high lights being finished in copper bronze. The posts were all mounted in position so that the door faced squarely towards the building line. The concrete foundations are 16 by 18 inches, and not less than 24 inches in depth, depending on the soil conditions.

Underground Construction—The series line is carried overhead to the ornamental system and is then taken underground. A No. 8 B. & S. solid gage armored cable is used, insulated with 30 per cent Para rubber which is secured with overlapping rubber-filled cotton tape of 0.012 inches in thickness, and over this 1/16 inch lead sheath. The cable is then served with a layer of jute yarn asphalted and wrapped with two layers of steel tape. Over this again is laid more jute yarn and it is then thoroly saturated with asphalt compound and coated with soapstone to prevent sticking when reeling or handling. The cable is laid in a trench 12 inches below the surface of the ground immediately behind the curbing, but where it enters the conduit elbows, set in the concrete foundations of the posts, the depth is increased to avoid too short bends. In crossing the intersecting streets the cable is laid in a duct.

FIG. 3. DAY VIEW IN PORT JERVIS, SHOWING AN EYE-SUSPENSION UNIT WITH 20-IN. CONCENTRIC REFLECTOR, PRISMATIC REFRACTOR, AND 250-C.P. EDISON MAZDA SERIES LAMP.

FIG. 4. NIGHT VIEW OF MAIN STREET, SHOWING NOVALUX ORNAMENTAL UNITS EQUIPPED WITH 600-C.P., 20-AMP. EDISON MAZDA SERIES LAMPS.

The total amount of underground cable used approximated 5,000 feet. The leads from the cut-out to the lamp are of No. 8 B. & S. gage stranded wire, being two conductor, 4/32 inches 30 per cent Para rubber covered and double braided; a water loop is made at each cut-out.

The underground system is bonded together with bare copper wire in the base of each post, bonding both the steel armor and the lead sheath; the pole being also properly grounded. The armored conductors, at the points where they are joined to the overhead system, are continued to the pole carrying the overbead system and then run up a 2-inch lateral to a height of 20 feet.

The contractors for the installation of the underground work and the ornamental posts assumed responsibility for one year after completion of the work for any defects occurring in the setting of the posts or settling of the street paving, if the cause should be attributable to work done on the installation of this system.

A typical night view looking towards the junction of Front street and Jersey avenue is shown in Fig. 4. The illumination on the street surface is very uniform and the general appearance of the street after dark is quite attractive. The fronts of all the buildings are illuminated from the ground line to roof and appear to stand out prominently against the dark background of the night.

In Fig. 5 is shown another night view taken on Pike street, looking towards the business section. Here the spacing is somewhat wider, owing to the residential character of the street. The use of medium density glassware has resulted in the elimination of excesive glare without too great an absorption of light.

Pendant Units—For the lighting of a section of East Main street, which, as previously described, is partly a business section, eight novalux pendant units are installed. These are equipped with 20-inch concentric porcelain enameled steel reflectors, prismatic refractors and 400-c-p. 15-ampere Edison Mazda serles lamps. These units are installed on span suspensions at a height of 20 feet above the roadway, and spaced approximately 200 feet apart.

For some distance leading from the center of the town, Jersey avenue and Fowler street are lighted with 250-c.p. units similarly suspended and spaced. The unit used comprises a span-suspension fixture equipped with a 20-inch concentric porcelain enameled steel reflector and prismatic refractor. In Fig. 3 is shown a day view of Jersey Avenue with one of these units in the foreground. These lamps are spaced approximately 200 feet apart and placed about 20 feet high. Figs. 6 and 7 depict night views taken with this unit. The former is on Jersey avenue, which is paved with brick, and the latter is a view of Fowler street, which is macadam paved.

It is very interesting to record how even the illumination appears on the street surface with these relatively low power units, and for the size of the unit employed, the illumination is of high intensity. The buildings, even between the units, stand out quite prominently. The lower parts are well illuminated, so that persons can very easily and safely approach their homes after dark. At the height these lamps are placed the cut-off is such that relatively little light is projected towards the upper story of the residences. It is a fact that any person or moving object can be quite readily perceived on any part of these streets for a distance of five or six blocks. To view this installation after dark affords a striking demonstration of the effective application of the prismatic refractor to this class of street lighting.

With the exception of the streets specifically mentioned and described above, all the other streets and thorofares within the city limits are lighted by 60-c.p. Edison Mazda series lamps. The equipment used is similar to that provided for the 250-c.p. lamps, except that 18-inch reflectors and the smaller size of prismatic refractor are used with these smaller lamps.

The spacings average 200 feet and the majority of the units are installed on span suspensions at about 15 feet above the roadway. In some instances, however, brackets are used affixed to the poles, at a height to bring the lamps about 15 feet above the ground. All of these lamps are operated from constant current transformers, which formerly were used to operate a.c. enclosed carbon arc lamps.

The replacing of the lamps and cleaning of the refractors on all the pendant units is accomplished by lowering the units on a cord permanently run to the pole for the purpose.

The entire ornamental installation, including all the necessary equipment and labor was paid for by the city at a cost of about $100 per unit. The construction work was done by the Central Station Equipment Company, of New York. All the pendant type units were provided and installed by the Port Jervis Light & Power Company.

FIG. 5. NIGHT VIEW OF PIKE STREET, SHOWING NOVALUX ORNAMENTAL UNITS EQUIPPED WITH 600-C.P., 20-AMP. EDISON MAZDA SERIES LAMPS.

In concluding this description of the street lighting at Port Jervis, it can be said that the satisfaction and appreciation shown by people of that city over this civic improvement is evident to any visitor. The utilization of street lighting equipment that has been scientifically designed and installed, is an important factor in the case, but co-operation between all the parties concerned has been of equal importance in securing these results in this installation.

FIG. 6. NIGHT VIEW OF JERSEY AVENUE, SHOWING EYE-SUSPENSION UNITS, EQUIPPED WITH 20-IN. CONCENTRIC REFLECTORS, PRISMATIC REFRACTORS AND 250-C.P. EDISON MAZDA SERIES LAMPS.

FIG. 7. NIGHT VIEW OF FOWLER STREET, SHOWING EYE-SUSPENSION UNITS, EQUIPPED WITH 20-IN. CONCENTRIC REFLECTORS, PRISMATIC REFRACTORS, AND 250-C.P. EDISON MAZDA SERIES LAMPS.

British Standard Nomenclature for Tar, Pitch, Bitumen and Asphalt

The eagerly awaited report of the Engineering Standards Committee, dealing with the vexed question of the nomenclature of tars, pitches, bitumens and asphalts, when used for road purposes, was issued May 22, and the definitions recommended should go far towards preventing the misunderstandings which at present occur in specifying materials belonging to the bitumen and asphaltic groups.

The report divides into three groups the materials now used in binding together the stones and other mineral aggregate used to form road crusts and road surfaces. These are:

1. The tars and pitches obtained by the destructive distillation of coal or similar substances.

2. The bitumens and asphalts which are found in nature, or are obtained artificially from asphaltic oils.

3. Chemical binders, including the Portland and natural cements which owe their cementing value as road binders to chemical action, and which are not dealt with in the present report.

Hitherto, as the London *Surveyor* points out in commenting upon this report, the term "bituminous material" has been loosely applied to tar products, as well as to bitumens and asphalts, but the committee have from the first considered that it was desirable from the road engineer's point of view, to maintain a sharp line of demarcation between the two groups. The views put forward in correspondence from America and by American engineers of standing and experience have been carefully considered, but the committee still adhere strongly to the view that the description "bituminous" should be applied only to the second group.

In England the first group of road binders, the coal-tars and pitches, have been in use for many years, and as the Road Board in 1911 issued specifications for the tars, tar oils and pitches which they recommend for road purposes, these materials have already, to some extent, been defined by those specifications. The Road Board, early in 1914, issued a second edition of these specifications. Only two classes of tar and one class of pitch are dealt with, and as these specifications, which form part of the report, are of such recent date, the committee recommend that they be adopted provisionally as the British standard specifications for tars and pitches used for road work.

The committee find that the choice of names for the second group of road binders is a matter of some difficulty. This difficulty is increased by the fact that, whilst it is desirable to obtain the concurrence of the American engineers to the nomenclature and definitions which the committee now propose, the adoption of the American nomenclature for the various materials composing this group would be liable to lead to confusion and misunderstanding in England.

The committee have been very anxious to secure uniformity with American practice, and have carefully and fully considered the definitions adopted by the American Society for Testing Materials, and by the committee of the American Society of Civil Engineers, put forward by the American corresponding members, but it is felt that the definitions now decided on are preferable from the road engineer's point of view, as they are based on those characteristics of the materials which can be most readily verified when employed for road making.

In accordance with this view the committee consider that it is desirable to make a sharp distinction between coal-tar and and paraffin oil derivatives on the one side and native bituminous substances and asphaltic oil residues on the other, and they are therefore unable to accept the American definition of bitumen—which would include the coal-tars.

The committee's report, the full title of which is "British Standard Nomenclature of Tars, Pitches, Bitumens and Asphalts, when used for Road Purposes, and British Standard Specifications for Tar and Pitch for Road Purposes," is obtainable at the price of 5s. 4d. (post free) either from the offices of the committee, 28 Victoria St. S. W., or from the publishers, Messrs. Crosby, Lockwood & Son, 7 Stationer's Hall Court, London, E. C.

The Municipal Supply Department III.

THE PURCHASING AGENT

By Hugh M. Foster, New York City.

The third article in this series is devoted to the purchasing agent, who is the most important person in the system and who must act as the central control of requisitions and the materials to supply their demands. The measure of success of the system depends almost entirely upon his ability to keep the balance between extravagance and niggardliness, and to keep in touch with departments closely enough to be able to foresee their wants and plan for their supply even before the inquiries are made which lead to the requisitions. Smooth sailing depends largely upon his personal characteristics and proper economy without pinching depends upon his strength of mind.

THE decentralized system, or rather lack of system, of purchasing supplies creates inefficiency which amounts to chaos. In that old-fashioned way of doing there is a purchasing officer, irrespective of whether his title be purchasing agent or merely clerk, for each department, commission, board or other minor division of the municipal government. Each buys independently of the other and there is a constant lack of uniformity of articles, prices, records and accounting, besides the knowledge and experiences of each one are unknown to the others. By a centralized supply department commissioners of the various operating departments would be relieved of the duties of purchasing supplies, and would consequently have more time to administer their departments, and that is their proper function.

Centralized purchasing, storing and distribution of supplies reduces opportunities for corruption by all purchases being concentrated in one officer subject to the check and criticism of the supply officers of all departments served. It increases promptness in settlement of claims and so gives the city an opportunity for cash discounts for prompt payment, and by the mere fact of promptness attracts a better and larger class of dealers, enhancing the service and tending to the reduction of prices. Centralized purchasing also gains the advantage of the ability and experience of all purchasing officers by constituting them as a board of assistant purchasing agents subordinate to the general purchasing agent.

The general purchasing agent and the general storekeeper are active checks upon one another, and the great advantage of this check is removed if either is made subordinate to the other.

The great advantage of the reduction in the number of contracts and purchase orders by the centralized system is an obvious advantage. In the city of New York there are one hundred twenty different officials who purchase supplies. As there are about fifty thousand vouchers for supplies passed each year and in clerical work alone it costs $1.35 to pass each voucher thru all the stages of official procedure, the reduction of this enormous number of purchasing all supplies thru one general purchasing agent and combining these heterogeneous vouchers would be an economy very much worth while, even if it were the only one.

An added economy, and many times larger than that of the actual reduction of purchasing transactions, would be the reduction in salaries due to the necessity for fewer clerical positions. As each minor purchasing agent of each department, commission, board or bureau now has a clerical staff under him, by assembling all these in one department the payroll for the purpose of purchasing supplies could be reduced to a minimum.

Any multiplication of purchasing offices causes delays in the transaction of business and leads to undesirable middlemen and vendors who have merely offices in their hats and it also leads inevitably to higher prices.

A good purchasing agent should make frequent investigations in the trade to keep in constant touch with the best current commercial usage. Also, he should acquire information from salesmen. Salesmen are habitually inclined to talk and this information from one may be checked by the opinions from another. The purchasing agent should subscribe to all trade and financial journals related to his work, and should maintain a file of government reports applicable.

In "The New City Government," by Henry Bruere, the advantages of centralized purchasing are roughly summarized as follows:

"It makes available to the city expertness in purchasing resulting from specialization in purchasing work;

It saves time, distraction and consequent loss of money and results for department heads and their subordinates by whom purchases must otherwise be made;

It permits of buying in large quantities instead of small quantities, thus securing uniformity of price and quality for the same article consumed in different departments;

It makes city business attractive to wholesalers or manufacturers, by increasing the size of orders;

It centralizes the point of contact between vendors and the city government, minimizing temptation to corrupt subordinates;

It locates responsibility for determining the price and quality of articles purchased and for the selection of reliable vendors;

It establishes an automatic check over deliveries in so far as supplies and materials bought by the purchasing agent are received and checked by the department which consume them;

It prompts the establishment of standards for various classes of supplies consumed by the city government;

It makes facile the enforcement of uniform business regulations with regard to requisitions, orders, invoices and vouchers."

The purchasing agent should also maintain a record of dealers, which should be an elaborately systematized card index showing general liability, established reputation, financial responsibility, qualities of goods and habits of delivery. From this record should be made his "black list" which alone should justify his rejection of bids from unworthy dealers. Such a record is almost as important as the indispensable records of invoices and prices.

The price record should be kept in card index form, with a separate card for every article; under the title of the article should follow a full technical trade description, below should

be columns for the name of the firm from whom prices were obtained, the date, the source of the price, whether bid, open market order, contract or unaccepted quotation by correspondence. With such a record, if it is made adequate and continued long enough, the purchasing agent is enabled to inform himself fully on the propriety of prices submitted.

(a) *Requisition*—The beginning of a purchase transaction is the requisition and for that reason adherence to standardization in the best modern practice should be insisted upon here. A requisition should be upon a standard form, one for general requisition and one for special purpose. It is better to have these two kinds on different colored papers so that attention may be drawn at once to the character of the need.

It is obvious that proper purchasing is defeated insofar as the requisition is improperly drawn. If it does not give full information of the requirement of the article needed the purchasing agent does not know what he is trying to buy. He is subject to the whims of dealers. And such improperly drawn requisitions should be returned immediately by the purchasing agent to the originator with a request that the desired information be given. Requisitions which do not specify accurately the grades of such goods as enameled ware, glass, butter, coffee or coal are practically worthless.

The high quality to be bought should not be necessarily the highest, but that which is best adapted for the purpose for which the article is needed. It should be remembered the city does not purchase on appearances as does a dealer. Ordinarily a dealer in any form of goods, whether he is wholesaler or retailer, buys on the prospect of selling and as appearances play a large part in that prospect, they are important to him. This factor will be readily appreciated if the articles of food or clothing are considered. A city, however, buys its supplies on an entirely different basis, that is, for its own consumption. The fact that canned goods or a particular brand of tea or coffee has not the fancy appearance of another should bear no weight in deciding purchase or inspection for city use. In fact, such a difference may be to the advantage of the city, as goods are sold largely on appearance in trade, the better appearing goods on a higher price, whereas the goods of inferior appearance may have quite as great intrinsic value and be far more economical to the city because of their lower price.

For such reasons it is important that requisitions give full description of qualities required. In all cases requisitions should indicate the serial number of standard specifications for articles which have been standardized. The purpose of standardization is defeated to the extent that exceptions are made to it.

(b) *Request for Bids*—Request for bids sent by purchasing agent to prospective bidders should show all the information given on the requisition which is necessary for a bidder to know to make an intelligent bid. It should also state all the terms under which the purchase will be made if consummated.

(c) *Bulletin Boards*—The best method of inviting informal bids periodically is the bulletin board. Upon the bulletin board in the purchasing agent's office are announced daily supply requirements, showing for each item the date when the bids will be opened. By this method all dealers interested are kept informed daily and know sufficiently in advance to make their bids profitable to themselves and fair to the city.

(d) *Assembling Requisitions for Periodic Buying*—The principal function of the purchasing agent is the purchase of supplies to maintain stock in the general storehouse. However, emergencies will arise in the best regulated system and special requirements cannot always be foreseen, consequently a constant stream of requisitions will be flowing into the purchasing agent's office. It is a waste of time and money for him to purchase supplies on these requisitions in the same rotation in which the requisitions are received. By assembling requisitions for the same supplies and buying periodically, even if such requirements do not amount to a sufficient quantity to warrant public letting and formal contract, still greater economies may be achieved by combination of many items into one purchase.

(e) *Relative Merits and Purposes of Open Market Orders, Contracts and Continuing Agreements*—The purchasing agent should receive daily reports from the general auditor or chief fiscal officer of the city, showing the condition of all appropriations for supplies. It is a waste of time to carry out all the preliminary procedure of a purchase only to have an order at the end returned by the auditor with the statement of insufficiency of funds. In return the purchasing agent should furnish the general auditor or chief fiscal officer of the city with a daily record of purchases and a monetary balance due on given appropriations. These two reports should harmonize.

The three general methods of purchasing supplies are by open market order, by contract and by continuing agreement. The extent to which the purchasing agent reduces the number of petty open market orders indicates his efficiency.

On the whole, it is generally advisable to enter into contracts for items exceeding $500 in one year, and continuing agreements for items of over $1,000.

There must, of course, be established a standard form of contract approved by the auditor or the comptroller or chief fiscal officer of the city and by the corporation counsel. Such a contract is entered into after public advertisement in addition to the bulletin board notices. Deposits for good faith are required of bidders and those of the unsuccessful bidders should be promptly returned. Upon the awarding of a contract, security is required for the full and faithful performance.

Supplies of the same general kind or classification should be included in one contract. The habit of putting a long list of miscellaneous supplies into one contract defeats the purposes of economical buying, because it encourages irresponsible middlemen who have no offices and carry no stock, but bid indiscriminately upon small and miscellaneous items. Upon being awarded such a contract, they simply transfer the order to various dealers and earn their living by commissions. Such method is a pure waste to the city.

All contracts should be awarded after line bids, that is, a separate bid for each item, based on the unit and total prices for each item. In this way the city can take advantage of the lowest price thruout a list of supplies, no matter how long, instead of awarding contracts to lump-sum bidders in the old-fashioned blind method in which unit prices were concealed. Lump-sum prices offer special facilities for unbalanced bids, by which, thru private information, a dealer bids low on an article which he knew would not be ordered except to a small extent, and bid high on an item which would be more extensively called for.

Seasonal contracts afford economies in certain classes of goods, such as fresh fruits and vegetables, and butter and eggs. Also, it is generally considered better policy to buy fresh fruits and vegetables by marketing and open market orders daily or weekly, according to the condition of the wholesale markets.

Continuing agreements have the advantage over contracts of being binding upon the vendor while they are not binding on the purchaser; that is, a dealer agrees to sell a given article at a given price during a given period to the city when the city is in the market for that article. Such an agreement is usually based on a percentage of price in advance of the lowest wholesale market for the raw materials, or upon a sliding scale of advances according to size and kind of such a thing as structural steel upon the quotation of steel at Pittsburgh. Continuing agreements may be terminated upon due notice from either party to the agreement.

A Municipal Commercial Club

By W. D. Hornaday, Houston, Texas.

The Municipal Commercial Club, which was advocated in an article in MUNICIPAL ENGINEERING *several years ago, has been established in Amarillo, Texas, under the title of "The Board of City Development," appointed by the Mayor and intended to be free from partisan or political influences or considerations and from the undue influences of particular business men or interests so often dominant in commercial organizations dependent entirely upon private subscriptions. This article gives a brief account of the success of the plan during the past two years.*

IT was on the well-founded theory that all of the people of a community should be required to bear their pro-rata of the cost of promoting the city's progress and general welfare, the same as they must do in the maintenance of all the other branches of the municipal government, that the Board of City Development was created by the city of Amarillo, Texas. It is a department of the city government of Amarillo and it performs the functions that are ordinarily delegated to commercial bodies that are maintained by private interests.

It is nearly two years since the city commission passed an ordinance creating this new branch of the municipal government. During that period the new plan has been thoroly tested and it is claimed that it has proved far superior in its working operations and actual accomplishments to the old method of privately conducted campaigns for the city's upbuilding.

The Board of City Development of Amarillo is supported by an annual public fund that is raised by means of a small tax rate that applies to every owner alike. It is not forced to favor any particular business man or interest, as is the case with many of the privately maintained commercial organizations that are dependent entirely for their support upon the subscriptions of local citizens. It is claimed here that the Board of City Development is as independent from the business interests of the town as any other branch of the municipal government. It endeavors to serve every man, woman and child in Amarillo alike. It is also stated that politics absolutely has no place in the department.

This breezy metropolis of the Panhandle not only has the unique distinction of having a Board of City Development but it was the fifth city in the country to adopt the city manager form of government. Assisting the city manager is a board of commissioners.

The ordinance provides that there shall be appointed by the city commission not to exceed fifteen directors of the Board of City Development. These directors "shall be citizens of Amarillo, of good and reputable standing, such appointments to be free from partisan or political influences or considerations." Each director is appointed for a term of two years and the terms of one-half of the membership expire every year.

One of the important stipulations of the ordinance is that any director who misses three regular consecutive meetings shall be automatically removed from office, unless, at the next regular meeting of the board after such absence, he shall submit in person or in writing legal excuses that are acceptable to the other directors.

Another provision says: "The Board of City Development of the city of Amarillo shall have general supervision over all matters pertaining to the work of the usual Chamber of Commerce or Commercial Club, such as the legitimate fostering, exploitation, encouragement and development of the agricultural, stock, industrial, manufacturing, jobbing, distributing, and wholesale and retail commercial resources, and securing of desirable immigration, encouraging social and commercial intercourse, improving transportation facilities, desirable publicity, more and better highways, and in furthering the advancement of existing agricultural, stock, industrial, manufacturing, jobbing, distributing and wholesale and retail interests, or any other matter that has for its purpose the upbuilding and growth of Amarillo or benefit of its citizenship."

The tax rate for the maintenance of the department is fixed to not exceed two mills on the one dollar of valuation of the taxable property in the city. While this tax is so low as to hardly be felt by any property owner, it brings in an annual fund that is much larger than that which is ordinarily raised by private subscription for similar work in towns of that size. The expense is evenly distributed among practically all of the people. The secretary of the Board of City Development is required to file with the city manager monthly reports of all receipts and expenditures. All warrants or vouchers for expense and work of the department shall be issued only on requisition of the city manager and by order and approval of the Finance Director of the department, and such warrants and vouchers shall be audited and approved by the city commission.

BUSINESS STREET IN AMARILLO, TEX.

The secretary of the Board of City Development is required to file with the city manager for the information of taxpayers monthly reports of work accomplished or in contemplation by that department. By following this method the people of the city are able at all times to learn for themselves just what is being done and in prospect by this branch of the municipal government. It is provided, however, in the ordinance that the city commission shall take no hand in the policies or work of the City Development department.

The Board of City Development must hold two regular meetings each month. The directors shall serve without pay. As an evidence of the public spiritedness of the citizens of Amarillo, no difficulty was experienced in enlisting the services of men of proved and well recognized ability in their respective lines of business to serve on the board without re-

muneration. The secretary and assistants are elected by the directors outside of their own number and these employes are paid salaries commensurate with the important duties that they perform.

The Board of City Development as now composed consists of S. F. Fullenberger, president; Porter A. Whaley, secretary; H. A. Nobles, financial director; Hamlin Palmer, traffic manager; Walter D. Allen, vice president; L. B. Newby, publicity; J. M. Walsh, transportation; J. Marvin Jones, legislation; E. W. Hardin, trade extension; W. S. Rule, industrial; Ford Brandenburg, entertainment; A. Eberstadt, immigration; Charles W. Ebel, insurance.

Thru the harmonious working of the different branches of the department, an enormous amount of material good has been accomplished for Amarillo during the last two years. Shippers and the business element generally of the city have received much benefit as a result of the well-directed activity of the bureau of transportation and rates. It is the duty of this particular unit of the Board of City Development to investigate the transportation questions, both freight and passenger, affecting Amarillo and its tributary country, not only as to rates, but also in all matters pertaining to railroads, or the State Railroad Commission, the Interstate Commerce Commission or any other executive or legislative body, for the purpose of obtaining information, or for securing assistance or relief, where unfavorable conditions exist.

The trade excursion bureau has succeeded in extending Amarillo's trade territory, and thru co-operation with local merchants, wholesalers, retailers and jobbers, the importance of the city as a trade center has been greatly enhanced. Trade excursions have been promoted and the people of the tributary country have been brought into much closer personal and business relations with local merchants than formerly.

Residence section of Amarillo, Tex.

The establishment there of a number of important new industries and commercial enterprises is directly traceable to the activities of the bureau of industries.

Every citizen of Amarillo takes pride in the wonderful progress that has been made in civic affairs during the last two years under the direction of the bureau of civic affairs of the Board of City Development. This branch of the department handles all matters pertaining to parks and playgrounds, sewerage, sanitation, street lights, water supply and various other things that have for their purpose the general welfare of the people. In this work the bureau has had the active co-operation of the local Federation of Women's Clubs.

The value of the right kind of publicity is well recognized by the publicity bureau of the department. It is its duty to disseminate statistics and information concerning the advantages and resources of Amarillo and surrounding country with the special view of soliciting and securing personal investigation on the part of persons seeking new locations.

That Amarillo is the center of a vast wheat growing and stock raising territory is well known to the outside world. The progress that is being made along these lines is said to be due, in part, to the work of the bureau of agriculture of the Board of City Development. It has gathered data bearing on the agricultural, live stock and dairy interests of the Panhandle and promoted the harmonious co-operation of the citizens, stockmen and farmers in the development of their common interests. It has encouraged the organization of farmers and allied interests for their mutual good.

When visiting homeseekers and prospective investors come to Amarillo they are taken in charge and entertained under the auspices of the bureau of reception and entertainment. This branch of the department also looks after all convention and public meeting matters, in conjunction with the bureau of conventions director.

An unusually large number of new settlers have come into the Panhandle region during the last several months, and this influx of homeseekers is due largely to the work of the director of immigration of the Board of City Development. One feature of the activities of this bureau has been to eliminate the reprehensible and dishonest methods of certain classes of land agents. It has also secured advantageous rates from railroads for immigrants and has co-operated along lines of mutual benefit with similar organizations in other towns and localities for the same general results.

The construction and improvement of the highways leading into Amarillo have received the attention of the bureau of highways. It co-operates with similar organizations in other counties and communities in the establishment and maintenance of local and overland automobile routes, and looks after the proper erection and maintenance of signs and signals for the convenience and guidance of travelers.

The bureau of legislation is charged with the duty of investigating and reporting to the Board of City Development upon all matters of local interest which should be acted upon, are being acted upon, or are under consideration for legislative action, whether city, state or national, for such action as the Board of City Development may designate.

Material reductions of the local fire insurance rates have been wrought thru the work of the insurance branch of the department by bringing about an improvement in the standard of fire protection.

It is the opinion of men who have investigated the practical workings of the Board of City Development of Amarillo that the wonderful success that it is meeting with in the operation of its different branches will ultimately attract wide attention on the part of the people of cities and towns where problems and dissatisfactions exist with privately maintained commercial organizations.

The Amarillo plan has already been placed in operation to a limited degree in Corpus Christi and one or two other towns in Texas.

A considerable number of the 18,000 people who make Amarillo their home are wealthy stockmen who have retired from their ranches and have built beautiful residences. The cleanly and well-kept appearance of the city is not confined to the residence portion but is specially noticeable in the streets of the business district.

Mysteries of Concrete Road Construction

By W. H. Reed, President of Washington State Association of County Commissioners

While we will not all agree with the author that all the reasons for disagreement over the details of concrete road construction which he enumerates are mysterious, his paper is one which supplies much food for thought and he puts his points in a manner which attracts attention. He demonstrates that he is an apt pupil if he has learned all he knows within the last three years. The Road Builders' Institute held at the University of Washington was fortunate in having so forceful a leader of its discussion of concrete for roads, however it may have agreed or disagreed with him.

MYSTERY No. 1; Sub-Grade: When I took office as county commissioner of Pierce county, in 1913, the value of a flat sub-base was not generally appreciated. I had been taught it in my road construction course in the Washington State University, by Prof. C. C. May. It happened in this way that I took the course: Being nominated for county commissioner, and knowing I was going to be elected —as all candidates do—I applied to obtain this instruction in an effort to fit myself, in a measure, for the commissioner's job. Fact was I didn't know anything about road work, and I didn't want the sheriff to nab me after I took office for obtaining money under false pretenses. In the spring of 1913 I recommended to our county engineer the flat sub-base. I had had no practical experience, and he and his chief deputy had, and they opposed it. So, I gave way to their experience. But next year, 1914, they both agreed with me that the flat sub-base was the better base up to a width of 20 feet. Now, the mystery is, that at this late date in pavement construction, highway engineers of acknowledged ability are differing on the question of a crown in the sub-grade or flat sub-grade, and some even advocate a dished sub-grade. The report of the committee on preparation of sub-grade, made to the second National Conference on Concrete Road Building, February, 1916, made no recommendation, neither did that conference. The committee reported: "The opinion seems to be gaining ground that a flat or dished sub-base, with the slab thickened at the center, is best suited to resist cracking, as well as to withstand heavy loads." Mr. Jos. W. Hunter, first deputy commissioner, Pennsylvania State Highway Department, says: "The camber or slope of the sub-grade should be the same as that of the finished pavement wherever practical." Mr. W. A. McIntyre, chief highway engineer of the Association of American Portland Cement Manufacturers, said, as published September, 1915: "Up to widths of 20 feet, the sub-base should be built flat." April 10, 1916, Engineer McIntyre wrote me in answering my suggestion for amendments to the specifications of his association: "It may not always be economical or advisable to have the sub-grade flat. If the road is reinforced, and in many cases where the sub-base is hard, a crowned base may do no harm. In fact, there are many, many concrete roads and streets built with a crowned sub-base giving entire satisfaction." And they continue to disagree—tho more unanimously.

Mystery No. 2; One or Two-Course Concrete: Until very recent years the leading highway engineers of this nation have recommended cement concrete pavements in two courses, and a two course pavement was generally built. So conflicting have been the opinions of road construction authorities, even including the last few years, that no national meeting, in this country, on road construction, has been willing to declare itself on this question, until the Second National Conference on Concrete Road Building was held in Chicago, February, 1916. That Conference passed this resolution: "When materials most readily available are such as to give good construction in one course pavement, this Conference recommends that the one course be used." The question naturally arises, Why wasn't it commonly known, by road builders, long ago, that a one course construction, with good materials conveniently located, was the best construction? As late as 1914 the Washington State Highway Board disapproved the specifications for a cement concrete pavement, sent them by Pierce County, under the Permanent highway law, because those specifications provided for a one course pavement. Mr. M. Roy Thompson, our very capable county engineer, and myself, as chairman of the Board of County Commissioners, went to Olympia and sufficiently weakened the Highway Board's opinion on this subject that they, doubtingly, approved of our one course type.

Mystery No. 3; Mineral Aggregate: Little attention has been given, until recent years, to the grading of the sand and gravel by graduating it from powder to a 1½ or 2½-inch rock, with density in view, with the object of reducing the voids to a minimum in cement concrete for pavements. In 1913 the Warren Brothers Co. obtained ownership of a patent then issued on the grading of the mineral aggregate, which they used in the construction of their Warrenite or Bitulithic roads. So valuable was this idea of grading their mineral aggregate in effecting a reduction of the voids in their pavement work to 21 per cent. and less—to even as low, I am told, as 11 per cent, that they have been and are able to sell the right to use this mineral grading idea, in laying a bituminous pavement, for a royalty of twenty cents and more per square yard. They are asking Pierce County today not less than 26 cents. In the face of this knowledge, for all these years, by all highway engineers, it is only in recent years that a comparative few have been and are availing themselves of it, as they can, without any royalty, in the construction of cement concrete pavements. That's mystery No. 3.

Mystery No. 4; Time of Mixing: It has been the common practice to churn the aggregate in the mixer for 45 seconds. That a longer time should be given to this churning or mixing, and that there was an economic time limit for mixing, was not known by more than a few until the last few years. And the majority don't act on it even now. Yet this was a knowledge easily obtainable. Taking the same material and proportions in coarse and fine aggregate and cement, inexpensive tests in mixing for various minutes and fractions of a minute of time, up to five minutes, would have supplied this valuable knowledge to *all* who had any disposition to be thoro and obtain the best possible results. Mr. William D. Uhler, chief engineer, Pennsylvania State Highway Department, reports upon a road now under construction:

> "Every batch of concrete is mixed for one and one-half minutes; the reason for this being that a number of experiments, made during the progress of the work, indicated that the greatest strength, commensurate with economy in cost of mixing, was obtained from a mix of this timing. The experiments which resulted in this conclusion were are follows:
>
> ½ min. mix 9 revolutions, 8 day test, 1,400 lbs. per sq. in.
> 1 min. mix 17 revolutions, 8 day test, 1,587 lbs. per sq. in.

A Concrete road in an Illinois river bottom. Floods ruined all previous roads.

1½ min. mix 26 revolutions, 8 day test, 1,926 lbs. per sq. in.
2 min. mix 36 revolutions, 8 day test, 1,661 lbs. per sq. in.
3 min. mix 51 revolutions, 8 day test, 1,673 lbs. per sq. in.

These figures demonstrate that a 1½-minute mixing, in a first class machine, is the maximum profitable time for mixing. On the Coleman-Dupont cement concrete road now building in Delaware, as a model concrete road, they require—having proven its advantages by testing—that each batch of concrete be mixed for 1½ minutes. But why have we delayed to 1915 and '16 before intelligently investigating and solving this question? Even yet it is a disputed question.

The "Standard Specifications for One Course Concrete Highway," issued by the National Association of Cement Users, says of mixing: "Mixing shall continue after all materials are in the drum for at least one minute at a minimum speed of twelve revolutions per minute." I wrote them last March recommending some eight changes in their printed specifications, which included a change to a 1½-minute mix. It is really an association not of "users" but the "Association of American Portland Cement Manufacturers." Their Chief Highway Engineer, Mr. W. A. McIntyre, replied: "Your comment regarding the mix is an excellent one. * * We realize fully that a minute and a half or probably longer, is very desirable." Nevertheless he adds: "We believe that the increase in strength obtained by mixing longer than one minute will not warrant the extra time." Refering back to the Pennsylvania Highway Engineer's figures we have evidence that the increase of strength from a half minute mix to a minute mix is 167 lbs. to the square inch for this additional half minute, and that the increase from a minute mix to a minute and a half mix is 339 lbs. per square inch for this additional half minute. Without attempting to criticise Engineer McIntyre's recommendation of a one-minute mix (for he must be a more capable man on this subject of cement concrete road construction than am I, by reason of his much greater experience) I marvel at the possibility of a disagreement, in this year 1916, wherein the Chief Engineer of the Pennsylvania Highway Department, with Mr. Chas. M. Upham, the chief engineer on the Coleman-Dupont model cement concrete road, require a 1½-minute mix, and so prominent an authority as Enginer McIntyre recommends a one-minute mix. Six months, or less time, devoted to careful, intelligent, innumerable tests, can solve this question so that no builders of cement concrete pavements can thereafter be of two opinions on this question of the maximum economic time for a mix. Hence, why isn't it solved? Possibly it is because it is part of the universal effort not to think. Obviously it would pay the Association of American Portland Cement Manufacturers to have this mystery solved.

Mystery No. 5; Steel Plates: Among my eight suggestions for amendment of these "Standard Specifications" of the Association of Portland Cementn Manufacturers, I advised that they omit their recommendation of steel plates for joint protection, for the reason that it was not "now approved by the best practice." Their Chief Highway Engineer, Mr. McIntyre, replied: "We must disagree with you in your statement that according to the best practice steel plates have been abandoned. Probably more steel plates are used today than previously." My objection to protection plates is because of the considerable difficulty, usually experienced, in getting these plates properly installed. Contractors and their men will seldom give the time necessary to proper installation. If they are placed low they are of no benefit. If placed too high they are a bump in the road. Moreover, a quarter inch of a prepared-pulp-tarred-joint filler is cheaper, and is, I believe, much better, with the adjoining edges of the concrete thoroly troweled and rounded. In my investigation of a cement concrete road constructed by the U. S. Government, at Presidio, near San Francisco, I learned that the edges next to the joint filler had been sprinkled with iron oxide. This hardened the edges against the possibility of their breaking off by traffic. The Second National Conference on Concrete Road Building, held February, 1916, in their resolutions said: "The tendency of present practice is toward the omission of metal protection plates for joints."

There you are! Suspended, mentally dangling in the air, even on the question of joint protection plates. We don't appear to know what we know when we know it. What's the reason? What's the solution of this mystery?

Mystery No. 6; Curing and Protection: I suggested to the Association of Portland Cement Manufacturers that their stated time for curing should be increased from 14 to 30 days. Their specifications read: "Under the most favorable conditions for hardening in hot weather, the pavement shall be closed to traffic for at least fourteen (14) days, and in cold weather for an additional time, to be determined by the engineer." To my advice that the road should undergo a curing for at least thirty days before being opened for traffic, their Chief Engineer wrote me: "We agree with your suggestion that the roads should be closed 30 days and we endeavor to secure this wherever we are in touch with any piece of work. In a great many places, however, there are no cut-off roads and the pressure brought to bear on the engineer and the contractor by the general public is so great that the result is the road is opened prior to the 30-day limit." I know, from my own experience of the road construction of Pierce County, that the public is always seeing only their immediate convenience, without any consideration for the life of the pavement and their future convenience and welfare as taxpayers: When you get right intimate with the public you find it to be like a lot of children. I say this with apologies to the children—for I am very fond of children. Engineer McIntyre added: "In most cases 14 days can be obtained and under good weather conditions will be satisfactory. However, when the weather is cool the 30 day period must be insisted upon." For 14 days, at least, the concrete should be covered with earth to a depth

of two inches or more, and this earth kept wet for that period. Hence, for 14 days in summer, "weather conditions," either good or bad, are immaterial, as the weather is blanketed against.

That cement concrete is much stronger at the end of four weeks than at the end of two, has been repeatedly proven by tests. Therefore, "good weather conditions," or public clamor, should not induce the opening of a cement concrete pavement in 14 days. Of that I am certain. Practice in the curing construction of the Coleman-Dupont Model Concrete Road, is this: "Immediately after the concrete was finished wooden frames covered with canvas were placed over the concrete, to protect it from the sun or wind. These were kept over the concrete for 24 hours, after which the concrete was covered with earth for a depth of 2 in. and kept wet for a period of 14 days. After 30 days this covering was removed and the concrete allowed to harden for two weeks before traffic was allowed on it." Thus closed a total of 60 days after the concrete was laid. This, I believe, is the best practice, though it is the only instance I know of. Its a very difficult thing to keep a pavement closed against a short-sighted clamorous public. But it is far less difficult in the less settled and less improved West, where nearby temporary roadways can far more easily be obtained. It's a mystery to me why manufacturers of cement can't see that it is better, for them, in the long run, to lose a contract, occasionally, on the argument that a cement concrete pavement necessitates closing the road to traffic longer than with other types, rather than discredit their type of pavement by shortening its life.

Our experience in Pierce County was a valuable lesson on the importance of doing all parts of the cement concrete pavement work thoroly well. Let us tell you about it: We laid a cement concrete pavement, by contract, in 1913, which became infamously known as the "Ollar Road." We tried, but we couldn't solder it up, or putty it up, so it would stay stuck, as a solid should. In a very few months after completion it became known thruout the coast as the slowest speed track in the western circuit, though it was amply provided with parabolic curves. In some six or eight months time its condition had become so atrocious that drivers of automobiles hesitated—in the absence of traffic regulations—whether to undertake to go under, over or thru it. And yet—and herein is one of the allurements of a cement concrete road, which is always on tap—we charitably hid its shame by humanely spreading a sheet of asphalt over the residue and, Lo! there was a metamorphosis to a No. 1 sheet asphalt pavement. That's a miracle which can't be successfully performed on any other type of disintegrated pavement.

Mystery No. 7; Cracks: Mr. T. H. Johnson, City Engineer of Sioux City, Iowa, in a paper read before the Second National Conference on Concrete Road building, last February, stated that Sioux City had "continuous miles of this pavement *without a single cracked section*," * * "some of it 5 years old." "In other words," he said, "at Sioux City we are laying practically a crackless pavement." He gives as the cause: density of the materials, the working out of the moisture, and "reducing the future absorptive powers of the slab, by this finishing work." "7½ per cent of the volume of the aggregate," he states, "is free water—making 7½ per cent of voids in the mass when evaporated." He goes on to say: "After bringing this free water to the surface we apply a dry mixture of 1 part cement and 1 part fine aggregate, in sufficient quantity to absorb all free water." Mr. Jos. W. Hunter, First Deputy Commissioner of the Pennsylvania State Highway Department, in a paper read at the Thirteenth Annual Convention of the American Road Builders' Association, February, 1916, said: "Concrete as a pavement laid upon an old telford foundation (which gives perfect drainage) showed no cracks after being down for more than eight years." In the April, 1916, issue of a prominent magazine devoted to road construction, it is said: "Cracking is the feature most objected to in concrete roads; and it is coming to be the belief of practically all highway engineers that given good foundation and drainage, the most productive cause of cracking is the use of too much water in the mix." "Coming to be the belief." Therein is the mystery: Why is it that it has taken all these years for highway engineers to just begin to know this? The conclusion I have reached from my studies on the building of a cement concrete pavement is that *density* is of exceeding importance. Varying porosity means varying strength and varying cracking.

I don't deny the statement from the Engineer of Sioux City that there they have consecutive miles of cement concrete roads, four years old, without a crack. I don't undertake to question the statement of Pennsylvania's First Deputy Commissioner, that a cement concrete pavement laid, on an old telford foundation, eight years old, showed no cracks; but I do say, that a cement concrete pavement laid, as I have herein indicated and given authorities and reasons for its being laid, will develop very few cracks—so few as to be comparatively negligible in maintenance cost.

A cement concrete pavement properly constructed has the following recommendations: It is attractive in appearance; lowest in first cost; low in maintenance cost—and, I believe, the very lowest in the long run; smooth, yet non-slippery; easily cleaned—wind cleaned, as it requires no curbs; and is the one pavement which improves with age, by growing harder and stronger. If a cement concrete pavement could be constructed so as not to develop *any* cracks, thus eliminating *all* cost of maintenance, it would be in every respect superior to every other type of pavement, for country roads, excepting that it lacks resiliency for horse traffic—and this is becoming, rapidly, a horseless age.

The answer to all my seven listed mysteries, is concentrated in this: Lack of thoroughness in the American people—plus short-sightedness of the cement manufacturers in not more actively discouraging inferior workmanship. Because of said short-sightedness and the cement manufacturers' frequently evidenced disposition to boost the price of cement, I sometimes wish there was an *open season* for cement manufacturers.

LEGAL DECISIONS

Decisions of the Higher Courts of Interest to Municipalities

Re-assessment for Excess of Cost Over Original Estimate Not Legal.—Under the law existing in 1907 (Ballinger's Ann. Codes & St. § 943) and governing the procedure for levying assessments for street improvements in cities of the third class, there can be no re-assessment of property benefited in excess of the original estimate, even tho such estimate fall below the contract price or actual cost of the improvement. City of Chehalis (Wash.) v. Robinson et al., 152 Pac. 696.

Water Company Liable for Diversion of Stream Same as tho Lawfully Condemned.—Where a water company, vested with the power of eminent domain, appropriates water without exercising such power as the statutes require, it is answerable to the landowner in the same, measure of damages being the difference in market value of the land affected before and after the injury, as if appropriation had been lawfully made. Rider v. York Haven (Pa.) Water & Power Co., 95 Atl. 803.

Status of Contract Between City and Water Company under Public Utility Commission.—A contract between a municipality and water company, prescribing rates to be charged to private consumers, and providing also for hydrants and street sprinkling at the public expense, was not supplanted by a later contract relating to municipal water consumption alone, without reference to private consumption, assuming that the rule that a later statute covering the whole subject-matter will be deemed to repeal previous legislation on the subject, applies to contracts. Notwithstanding a contract between a municipality and a water company, prescribing rates to be charged private consumers, the board of public utility commissioners was acting within its jurisdiction in authorizing a higher rate, which was not unjust or unreasonably high, since the state, thru a specially constituted agency, assented to the change in rate, and the state may waive contract rights due to the public without impairing the obligation of contracts in violation of the Constitution. Boro of North Wildwood (N. J.) et al. v. Board of Public Utility Commissioners et al., 95 Atl. 749.

Liability of Contractor and Surety for Labor Certificates Issued.—Where a highway contractor's bond given under Burns' Ann. St. 1914, § 7723, contained only the provision of that statute that such a contractor "shall pay for any labor or material that shall have been furnished to him, any subcontractor, agent or superintendent," such bond did not secure repayment of money loaned to the contractor to pay his labor. Where a highway contractor's bond given under Burns' Ann. St. 1914, § 7723, contained the provision of that statute that the contractor "shall pay for any labor or material furnished to him, any sub-contractor, agent or superintendent," such bond did not inure to the benefit of persons who, in view of the financial embarrassment of the contractor, assumed to complete the work and furnish the necessary funds to carry out the highway construction. Where a highway contractor in embarrassed circumstances issues certificates to his labor, showing the amount of time each individual had worked and the amount due him, which were purchased from the laborers directly by third persons, and an assignment to such persons in writing taken by them, the certificates remained the debts of the contractor in the hands of the purchasers as if they had remained in the hands of the laborers, so that such persons could go against the contractor and his sureties on his bond securing the payment of his labor. Smiley et al. v. State (Ind.) ex rel. Truax et al., 110 N. E. 222.

Resurfacing Not Repair.—The work of improving a park boulevard was not repair work merely because the park commissioners proposed to use the base of the old pavement as the base of the pavement contemplated in the improvement, but was such a first improvement of the street as the park commissioners were authorized by Acts of June 16, 1871, and June 21, 1895, to make by means of special assessment. South Park Commissioners v. Wood et al. (Ill.), 110 N. E. 349.

Water Company Can Furnish Water Outside its Parent Municipality.—That a water company furnished a portion of the water appropriated to persons outside the limits of the territory in which it had a right to furnish water to the public did not render the appropriation unlawful, especially where only a small amount of water was so furnished, and the furnishing of same was a mere incident to the main purpose of the company; the company being answerable only to the commonwealth for an improper use of the water appropriated. Mier et al. v. Citizens Water Co. (Pa.), 95 Atl. 704.

Assessment of Cost of Water Service Connections is Valid.—Burns' Ann. St. 1914, Sec. 8655, declares that the common council shall have power to regulate private connections with water mains and to compel owners to make such connections before the permanent improvement of a street, and, on default, authorize the proper city officials to do so at the owner's expense. A municipality ordered the making of connections with water mains before the permanent improvement of a street, the ordinance providing that in case of default the connections would be made by the city. *Held* that, as the legislature had decided that such expense should become a lien on the property and as the city was acting under the police power, a property owner could not defeat the assessment on the ground that it was made in a summary way. City of Angola (Ind.) et al. v. Croxton, 112 N. E., 385.

Elevation of Flow Line Sufficient Description of Land to be taken for Reservoir.—Where the board of water commissioners of a city filed a taking of "the right to flow to an elevation not exceeding twenty (20) feet above mean low water in the Merrimac river such of the lands" described "as will be flowed as a result of the maintenance of a dam," duly described, from which the owner, previous to flooding, could not tell how much of his land was taken without the aid of a surveyor, such taking was sufficient. Lunt v. City of Newburyport (Mass.), 112 N. E., 481.

FIRE DEPARTMENT

Causes of Truck Tire Breakdown

The accompanying cuts were selected by A. H. Leavitt, of the B. F. Goodrich Co., Akron, O., to show the results of various abuses to solid truck tires.

Overloading—The first picture shows a photograph of an actual tire, which was overloaded in service. The dangerous effect of overloading cannot be overestimated. Tires are constructed to carry certain loads, which, if exceeded, will result in premature failure of the tire units. Rubber compressed beyond its safe limit of elasticity, will break down just as any other material will do. Rubber compressed to such a limit, is also much more susceptible to damage from road obstacles. Continued overloading is not required to ruin a tire, as one excessive load or a blow developing equivalent force from high speed may do it, and a permanent rupture to the structure is likely to follow. Avoidance of overload and proper care of tires are of first importance in the economy of operation.

Speeding—This shows a tire injured through overspeeding and you will note the results are similar to the injuries resulting from overloading. The effect of heat generated within the tire, due to rapid displacement and road friction, is too well known to require further comment. When striking obstacles at high speed, the possibility of rupture is much increased.

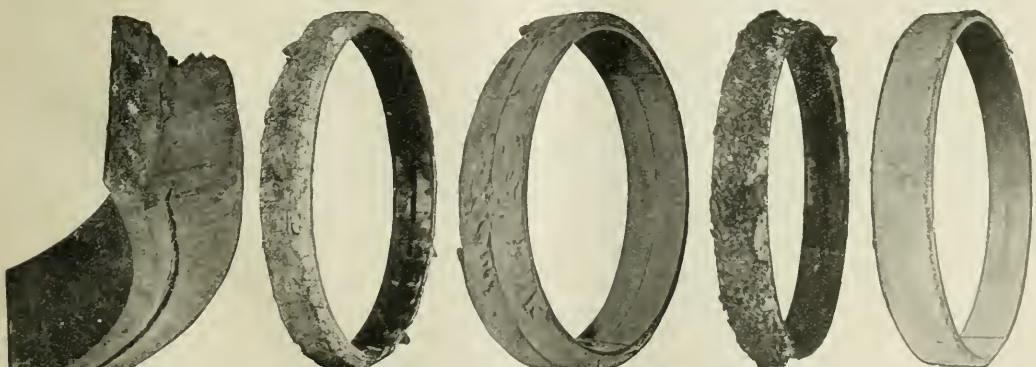
Speeding—This shows a tire injured thru overspeeding Skidding or locking the brakes and sliding the wheels results in serious and most uncalled for damage. This has a ruinous effect on the mechanism of the truck, as well as causing great damage to the tread of the tire.

These tires were practically new, from which the tread was completely torn away for a short distance, as a result of this skidding. It is a matter of fact that a truck will not stop as quickly by sudden application of the brakes as if the brakes were applied slowly and firmly. Another thing is the possibility of improperly adjusted brakes, which will sometimes permit one wheel to lock while the other runs freely. This same condition is also found on apparatus which turns corners at a high speed, which naturally increases the side strain and wear on the tires.

Bad Roads—One of the elements most destructive to solid tires is bad roads. You have already seen the results of overloading, excessive speeding, etc., but regardless of any precaution which you might take in respect to these, if a heavily loaded piece of apparatus is habitually used over bad roads, the tires receive abuse, such as will materially affect their life. In the past few years alone the city of Baltimore has spent $7,000,000 in street improvements which have resulted in greatly increased tire and car life.

This photograph shows a tire from a truck used for hauling building supplies and which was contiuually run over crushed stone, loose bricks, etc. In order to get maximum service, tires must be run under reasonable road conditions.

Wheels Out of Alinement—This tire looks as if it had been worn down perfectly smooth in service, but as a matter of fact, it only gave a few hundred miles of service. The cause of this quick wearing of the tire was due to one of the wheels of the apparatus being out of alinement. The effect on the truck, when a wheel is out of alinement, is that of continual



OVERLOADING. OVERSPEEDING. SKIDDING. BAD ROAD. WHEEL OUT OF ALIGNMENT.

NEGLECTED CUTS.

RUNNING IN CAR TRACKS

ANTI-SKID DEVICES

friction, as the wheel partly rolls and partly slides. Wheels should be inspected often and when this condition is found, immediate steps should be taken to remedy it.

Neglected Cuts—This photograph shows tires injured by cuts which have been neglected. Cuts on solid tires are more or less a common occurrence. This is, of course, governed largely by the road conditions. The ultimate effect of a cut depends upon the size and location, as cuts near and at the edge are most injurious, and if neglected may seriously affect the life of the time, as the tendency is always toward the cut enlarging, especially in circumferential direction. Some trucks are backed up a great deal and the cut consequently follows both ways from the injury.

The weakening of one unit of a dual tire in this manner naturally throws an overload on its mate at the point of injury, which may cause it to fail, as in this case.

To prevent the continuation of a cut on the edge, it should be trimmed.

Car Tracking—You have undoubtedly all seen not only the motor-truck driver, but also the horse-truck driver proceeding down the street with all wheels of the truck or wagon in the car tracks. It is unquestionably much more comfortable to ride in the car tracks on some streets than it would be on the streets themselves. However, this picture shows you the results of running solid tires in car tracks. The entire load is thrown onto one-half of the tire tread, with the result that it is rapidly worn or broken away on one side, eventually leaving the width of the tire reduced by one-half to carry the original full load. It is obvious that a tire will prematurely fail under these conditions.

Non-Skid Devices—This illustration shows the injuries resulting from the use of anti-skid devices, which were improperly applied. Unfortunately we know of no anti-skid device that does not, to some extent, injure solid tires. Some devices are more injurious than others. The loose chain has been found the least so because it works itself around the wheel and provides an equal distribution of the wear and strain. Stationary devices are most injurious, because the wear and strain are constantly confined to the points of bearing.

Chains of various design which pass circumferentially around the wheel and between dual tires place a strain on the tire base and are generally ineffective because dependent upon the compression of the tire tread to allow the device to secure traction.

The traction wheels are liable to spin more or less in slippery places, which produces a sharp blow on the tires where these devices are in contact. The force of such blows increases as the distance between the cross pieces of the devices increases, because of the momentum the wheel gains between these points. Less injury will result if such devices are only used temporarily. It is also advisable to use a device having numerous cross pieces.

Great injury results to tires from careless and continued use of anti-skid devices on pavements or hard roads where there is little or no need for them.

Fire Department Notes

JOHN W. CASE

M. S. PHILIP

H. W. PARKER

Chief H. W. Parker joined the fire department of Stamford, Conn., at the age of twenty-six, as a call man, when the department was changed from a volunteer organization to one with part paid and part call force. After two years' service, he was made call assistant chief in 1887, and on the death of Chief Bowman, he was made call chief in 1903, being promoted to chief of the department when he was put on full pay in 1905. Many improvements have been made under his administration, including new fire station and equipment in 1900, two new stations in 1909, a new three-story central fire station recently completed, a modern alarm system in 1906 and the motorizing of the department, which now includes a Pope-Hartford chief's car, a Locomobile chemical and hose combination, five years old, and three American-La France machines purchased at intervals of two years, being one gasoline pumper with hose, one gasoline pumper with hose and chemical and one new motor aerial truck. The department has thirty-five full-time men and covers an area of $7\frac{1}{2}$ square miles, of which 3 miles are within the fire limits.

M. S. Philip, chief of the fire department of Chicago Heights, Ill., has been nineteen years in the service, sixteen years as volunteer, serving in all grades, including assistant chief and three years as the first paid chief of the department. The force has grown to include thirteen paid men and twenty-two volunteers, and an increase of two captains and six men is recommended. An Ahrens-Fox booster pump combination hose auto truck, a new combination motor hose truck and the chief's auto are in use in addition to horse apparatus, consisting of two steamers, hose wagons, hook and ladder truck and two exercise wagons. The department is well drilled and is performing very efficient service, as shown by the annual report of numerous runs and the small fire loss.

John W. Case, chief of the central fire department of Jefferson City, Mo., is a young man who quickly demonstrated his capabilities, for he became a fireman August 1, 1911, and was promoted to chief on April 15, 1912, being reappointed last year. The department has a motor hose wagon and fully paid men who keep the fire loss below $10,000 a year, altho the number of calls was over 60, $87\frac{1}{2}$ per cent of the fires being extinguished by chemical.

ROADS AND PAVEMENTS

Road Paving Around Ashokan Reservoir

In a recent paper presented before the Municipal Engineers of the City of New York, Messrs. F. B. Marsh, J. D. Gross and Chas. E. Price have described in an interesting way the preliminary studies, construction and inspection of pavements built about the Ashokan Reservoir, now nearing completion under the administration of the Board of Water Supply of New York City.

Mr. Marsh says: "After careful consideration of all suggested types, conferences and correspondence with highway officials of many states and cities, and personal inspection of different pavements as laid elsewhere, it was decided that vitrified brick on a concrete foundation * * * would be the most suitable for Ashokan conditions."

The conclusions favorable to the use of vitrified brick for the Ashokan Reservoir paving were reached by the board's engineers after a careful preliminary study of various types of paving. They divided these types into two groups. First, those of low first cost, requiring from the beginning constant, intelligent, detailed maintenance, and occasionally more extensive repairs and replacements. Second, those of relatively high first cost but of a quality to require little or no repairs for a very long time. The method by which they analyzed the relative merits of these two groups is shown in the accompanying table. Upon the results shown by their study, the board's engineers recommended the use of vitrified brick.

Approximately four miles, located mainly on the dam and dikes of the reservoir and on some of the bridges, are now being paved with this material.

ASHOKAN PAVEMENTS—COMPARATIVE COST OF BITUMINOUS CONCRETE AND BRICK.

(Costs are per square yard of pavement, and do not include grading, drainage, fences, curbs, walks, etc.)

	Bituminous Concrete Contract 151		Brick Contract 152	
(1) Assumed period between resurfacing, years	16 2/3	25	25	50
(2) First cost, wearing surface alone	$1.01	$1.01	$1.67	$1.67
(3) First cost, macadam or concrete foundation	0.43	0.43	0.64	0.64
(4) Total first cost (2)+(3)	1.44	1.44	2.31	2.31
(5) Interest (4¼ per cent) and sinking fund (3 per cent) 50-year bonds, for (4), or 5.14 per cent total per annum	0.074	0.074	0.119	0.119
(6) Annual cost of up-keep, maintenance and ordinary repairs	0.06	0.06	0.01	0.01

KOEHRING PAVER LAYING CONCRETE BASE AND CURB, ASHOKAN RESERVOIR PAVEMENTS.

(7) Cost of resurfacing entire pavement, assumed by direct taxation instead of bond issue. See (1).....	1.08	1.08	1.71	1.71
(8) Average annual cost of upkeep and resurfacing, for first 50 years. (6) + Number of renewals × (7).. / 50	0.104	0.082	0.044	0.010
(9) Total average annual cost, first 50 years (5)+(8).....	0.178	0.156	0.163	0.129

The brick pavements are generally 18 feet wide, including a 2-foot flush concrete edge on the one side and a 2-foot concrete gutter on the other. They are not crowned in the center, but slope 3 inches in 16 feet transversely toward the land side of the dike with an additional 2-inch drop in the 2-foot concrete gutter.

Neither pavement nor gutter has any longitudinal slope, but no trouble is anticipated from this, since the exposed situation on top of the dikes should tend to dry the pavements quickly. The drain inlets for surface water are all on the land side of the dike, 400 to 500 feet apart.

As constructed, the width available for vehicular traffic on the brick pavements is 22 feet with an additional four-foot walk between substantial blue-stone guard walls on the edges of the dikes.

The pavements are constructed upon a 5-inch concrete foundation and a 1½-inch sand cushion.

Portland cement grout is used for the filler as specified by the National Paving Brick Manufacturers' Association.

To prevent excessive temperature stresses in the pavement, it is specified that no grouting of the joints shall be done when the air temperature is likely to be below 40 degrees F.

Construction Methods on the Paseo, Kansas City

Military critics have said that the failure of the Germans to reach Paris in their first great drive into France was due not so much to the recognized bravery of the opposing army as to the superb boulevard system around the city, which enabled the French quickly to concentrate their forces at any threatened point. Kansas City, Missouri, in a similar way is preparing for an invasion, not of enemies, but of friends. H. H. Hanenkratt, a well known Kansas City contractor, has just made a ten-foot cut thru an old Confederate fortification in the south part of the city and is tearing up the earth generally thru battle fields in that vicinity.

The Paseo is the great main artery of the city. There are some 400,000 cubic yards involved in this one contract, which is the largest job of the kind in the history of the place. When completed under this contract, the Paseo will be nine miles long. Five miles at the north end already have been built; the Hanenkratt contract will take it to the south city limits.

The Paseo has been laid out with a double roadway scheme and will vary in width from 200 feet to 500 feet. Each roadway will be 40 feet wide, the variation being in the width of the intervening parks. This work is on a most elaborate scale. In each block the park will have different treatment, as suggested by the surface of the land, or the art of the designer. In one there will be a sunken garden, in another a concrete pergola, or perhaps a fountain, in some other a ravine will cut thru and its beauties will be preserved for the enjoyment of the people; in others there will be effective arrangements of the shrubbery, water effects, etc.

Feren Brothers, of Kansas City, are sub-contractors, and have a two-machine outfit at work. One is operated by an Emerson-Brantingham gasoline tractor and the other by a 25-h.p. Reeves.

At the south end the Paseo will cross above Seventy-seventh street by means of an ornamental double concrete viaduct. Each viaduct will be 70 feet wide and have a 60-foot span. The two viaducts will be 35 feet apart and steps from Seventy-seventh street will lead up between. The construction of these viaducts has been sublet to Dan Munro, of Chicago. W. A. Keene, of Kansas City, is superintendent.

The McMillan Contracting Company have a 325,000-yard contract on which they are busy, building the east end of Meyer boulevard, which connects with the Paseo at Sixty-sixth and Brooklyn and leads up to Swope Park. As it approaches the park entrance this boulevard will be 500 feet

AT THE DUMP. ONE OF THE MCMILLAN CONTRACTING COMPANY'S TRAINS OF FOUR-YARD WESTERN CARS MAKING A FILL IN THE CONSTRUCTION OF MEYER BOULEVARD, KANSAS CITY.

BUILDING THE PASEO. CONSTRUCTION TRAINS OF FOUR-YARD WESTERN CARS AT WORK ON THIS BIG STREET CONTRACT IN KANSAS CITY.

LOADING FOUR-YARD WESTERN CARS WITH BUCYRUS 70 C STEAM SHOVEL, BOULEVARD CONSTRUCTION, KANSAS CITY.

BUILDING THE PASEO, KANSAS CITY. ELEVATING GRADERS AT WORK.

wide. The work involves some 30-foot fills. J. P. Chenier is superintending the job, operating thirty 4-yard Western dump cars, with Vulcan dinkies. The loading is done with a 70C Bucyrus shovel and some splendid yardage records are reported.

The McMillan Company has sublet the team work to Amos & Deen, who have a camp on the ground.

W. C. Mullens has a 93,000-yard contract at the west end of Meyer boulevard; J. O. West, 18,500 yards on Rockhill road; Ed Meegan 70,000 yards on Ward Parkway, which connects with Meyer boulevard at its west end. Mr. West also has just completed 30,000 yards and Mike Haase, 21,000 yards on Benton boulevard; Archie Turner has just completed a 46,000-yard contract on Brookside boulevard.

While the contractors expect to complete the work of grading the Paseo by August or September of this year, it will take three years to complete the paving, Mr. Fred Gabelman, engineer for the Park Board, explained. This is on account of the numerous heavy fills. It will not do to pave them until they have had time to settle thoroly.

A bituminous macadam pavement will be laid, as in all boulevard work in Kansas City, made of native limestone with asphalt filler. The asphalt is poured from a kettle, a process which has proven very satisfactory, altho there is a tendency to get too much asphalt at the point where the pouring begins. Three gallons are put on to the square yard. This pavement is laid on a 9-inch base of hand-sledged rock, as large as 9-inch stones being used, covered with three inches of small stones, all heavily rolled, of course. Shortly after the paving is down it is oiled with a light residuum oil, which forms a binder and dust catcher. A light coat of oil is sprayed on frequently to lay the dust. This process has been found to be very effective. One such pavement, Mr. Gableman said, has been down five years without costing one cent for maintenance, except the cost of oiling to lay the dust. The first cost of such paving, averaging about $1.25 per square yard, is paid by the abutting property, also the curbing and sidewalks. The grading cost is paid by a special tax on the district benefiated, which is one-half block on each side in platted property and 150 feet in unplatted property. After the improvement has been completed, the assessor sets a value on each lot in the benefited district and the cost of the improvement is then apportioned. The plans for the Paseo are so elaborate and construction work so heavy, it was found desirable to set aside a special benefit district, varying in width from a quarter of a mile to one mile.

For maintenance the city makes an annual levy of two and one-half mills on the land value. There also is a special levy for maintenance of ten cents per front foot on boulevards and parkways. For maintenance the city is divided into districts and the money raised in one district must be spent in that particular district.

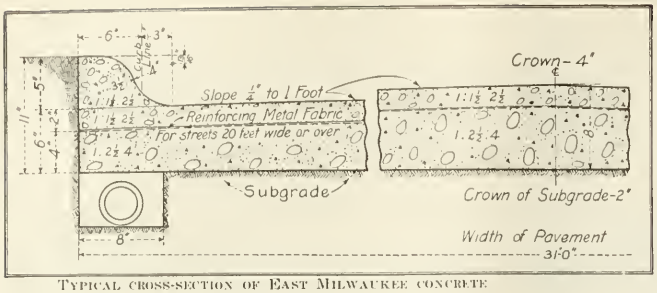
Two large paving contracts recently were let in Kansas City: Swope parkway, from Fifty-ninth to Sixty-seventh street, to the Halpin-Dwyer Construction Co., and Belmont avenue, from Gladstone to St. John, to James O'Conner & Son. The board is getting ready to let two large grading contracts, one of 130,000 yards, including a reinforced concrete bridge on the east end of Linwood boulevard, and the other, 150,000 yards on Van Brunt boulevard. It will take several months to get the preliminary court proceedings out of the way, which probably will delay the letting until next fall.

An amendment to the city charter, secured in 1895, gives the city the right to condemn property for street and boulevard purposes, and the wonderful development which is making Kansas City one of the most beautiful cities in America, may be said to date from that year.

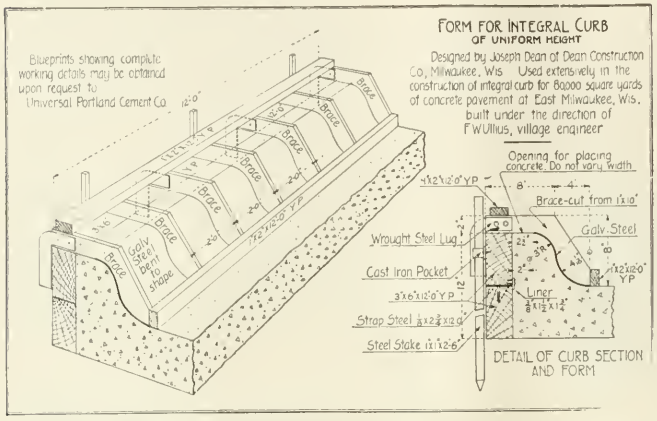
The Use of Integral Curb in East Milwaukee, Wis.

Use of integral curb in connection with concrete street paving saved $3,800 for the taxpayers of East Milwaukee, Wis., in 1915 and will save nearly as much in the 1916 work, according to the village engineer. These are substantial items per capita, for the total population of East Milwaukee is only 1,450. Concrete pavement built last year totals 89,000 square yards, an amount which in proportion to the population, probably exceeds that laid in any other municipality.

Prior to 1913 the only street improvements in East Milwaukee were those constructed under private contract by real estate men. The laws of Wisconsin did not permit villages



TYPICAL CROSS-SECTION OF EAST MILWAUKEE CONCRETE PAVEMENT WITH INTEGRAL CURB.



INTEGRAL CURB ON CONCRETE PAVEMENT WITH 7.3 PER CENT GRADE, MARYLAND AVENUE, EAST MILWAUKEE, WIS.

to improve streets by grading, paving and constructing curbs and gutters without a petition of the owners of a majority of the frontage, nor to do all necessary underground work except with the consent of all the abutting owners. The adjoining owners either absolutely refused to petition for improvements or could not agree upon the type of pavement to be used. It was found practically impossible to get the consent of all the abutting owners to the installation of all necessary underground work, which meant that even if streets were paved, the process of tearing them up for the installation of underground work would immediately follow the construction of the pavements. East Milwaukee was not satisfied with these conditions. Its representatives, headed by the village attorney, G. H. Gabel, generously gave their time in attempts to have the legislature revise the laws to permit villages to pave streets and do all underground work without the petition or consent of adjoining owners. Success was finally attained and villages thruout the state are indebted to East Milwaukee for the progress made.

As soon as the laws permitted, East Milwaukee started in earnest to make permanent improvements, including underground work, grading and sidewalk construction. The recent passage of these laws accounts for the large yardage of paving constructed last year and to be constructed this year.

The first concrete pavement constructed by the village was laid on Richland avenue in 1913. An illustration of this, photographed this year, accompanies. The excellence of this work resulted in the selection of concrete for the paving of Frederick street in 1914. In 1915 the village laid 80,000 square yards of concrete. This constituted all the paving work for the year, except 300 yards of another type which was laid to finish an uncompleted block.

One of the contractors, the Dean Construction Co., Milwaukee, used a curb form practically the same as that shown herewith. The principal difference is that East Milwaukees' curb is only 5 instead of 6 inches high. This form proved so successful that the engineer specified its use by all other contractors doing work in East Milwaukee.

As soon as the pavement is struck off, the form is set in place and any tendency for it to rise when concrete is placed behind it is overcome by placing at 12-foot intervals along the form, worthless cement sacks half-filled with sand.

Most of the East Milwaukee work is two-course construction with a base-course of a 1:2½:4 mixture and a top course of a 1:1½:2½ granite mixture. That portion of the integral curb extending above the pavement is made of the same mixture as the top-course of the pavement. All pavements over 20 feet wide are reinforced.

The following clause from the specifications shows that the village engineer appreciates the folly of using hank-run mixtures: "Mixed Aggregate Crusher run stone, bank run gravel or artificially (commercialy) prepared mixtures of fine and coarse aggregate shall not be used." In general, the specifications for the concrete pavement as well as for integral curbs follow those recommended by the American Concrete Institute in its standard "Specifications for Concrete Roads, Streets and Alleys."

The village constructed concrete sidewalks on practically all the streets where paving was done and will continue this practice in 1916.

Contracts have been awarded for this year's work as follows:

To Froemming & Retzlaff, Milwaukee, for 2,081 square yards

on Cramer street and 3,427 square yards on Kensington boulevard; to Dean Construction Co., Milwaukee, for 10,765 square yards on Farwell avenue; to Milwaukee General Construction Co., Milwaukee, for 6,895 square yards on Stowell place; to J. H. Donahue, Milwaukee, for 4,693 square yards on Menlo boulevard; to J. Donahue, Milwaukee, for 7,232 square yards on Marion street, and 1,620 square yards on Jarvis street.

Practically all the work constructed by the village has been in charge of F. W. Ullius, Jr., a graduate in civil engineering of the University of Wisconsin. Mr. Ullius spent several years as inspector of dredging for the United States Government at Oconto, Wis., as detailer for the Milwaukee Bridge Co., Milwaukee, and as instrument-man for the Chicago, Milwaukee & St. Paul Railway. He has been village engineer of East Milwaukee since 1913.

Economies of By-Product Coke

In years gone by the surplus gas available from by-product coke ovens was guaranteed by oven builders to be 5,000 cubic feet per ton of coal coked, with 500 B.t.u. Modern plants yield 6,250 to 6,600 cubic feet surplus gas. This, of course, is only possible where air is absolutely excluded, as leaks would prevent any such results.

The oven size has gone from a capacity of 4.5 tons of coal to 13.5 tons, which seems to be about the standard. While it varies with different coals, an oven is generally about 17 to 22 inches wide, with a taper to facilitate pushing the coke. The height of the oven is about 10 feet and the length from 35 to 40 feet.

The cost of ovens has increased from about $7,500 to nearly $20,000 per oven. This is easily explained by the increased weight of the materials entering into the construction, and the fact that the maintenance and conversion cost has been cut to well below 60c per ton of coal coked. Taking as an example coal around 28.5 per cent. volatile matter, with the ordinary yield a typical balance sheet for a 100 oven plant of 13.5 tons per oven capacity on an 18-hour coking time would be as follows, according to T. C. Clarke before the Society of Chemical Industry:

Daily Expenditure.

1,766 tons of coal, at $3 per ton	$5,298.00
Conversion cost, including depreciation, contingencies and all charges, except interest and administration; 60c per ton	1,059.60
Interest on investment of $2,000,000 at 5% $100,000= 22c per ton of coke. 1,236 × 22	271.92
	$6,629.52

Receipts.

Tar, 7 gal. per ton of coal, at 1½c per gal	$ 309.05
Sulphate, 1% at $60 a ton	1,059.60
Gas, 6,000 cu. ft. at 10c	1,059.60
Benzol, 2¼ gal. at 14c, or 20c less 6c conversion	556.29
Toluol, 0.3 of a gal. at 15c. per gallon	79.47
	$3,064.01

This makes the cost of coke $6,629.52—$3,064.01=$3,565.51 for 1,236 net tons, a yield of 70 per cent., or $2.88 per ton. So you have a ton of coke for less than the ton of coal cost you, and have 10,500,000 cubic feet of surplus gas of 550 B.t.u. at 10c per 1,000 cubic feet and a uniform coke both physically and chemically, with depreciation and interest taken care of.

At present war prices owners of by-product coke ovens selling their benzol at 50c per gallon and their toluol at $4.50 per gallon, find their coke costs them nothing.

Benzol as a Motor Fuel.

With the exception of the Semet-Solvay Company, the benzol industry is in its infancy. Plants are being built in practically every coke-oven installation since the war began, but the result after the war remains to be seen. Logically the first and greatest market for benzol will be as motor fuel.

Assuming the capacity of the old-type ovens at 5 tons of coal per day of 24 hours, and the larger ovens at 15 tons and getting a yield of 2½ gallons of 50 per cent. benzol per ton, we find the benzol production should be 84,900,000 gallons, or 2,694,000 barrels per year. Fear has been expressed that the sudden dumping on our markets after the war of 85,000,000 gallons of motor fuel would break the price badly and make a number of lean years for the coke-oven-benzol producer.

If 200,000 of the 300,000 Ford cars produced annually remain in this country, and have an average mileage of 5,000 per car and consume a gallon of gasoline for every 15 miles, their annual consumption will be 66,666,000 gallons. Since the benzol output, if all sold for motor spirits, only amounts to 84,990,000 gallons, and one make of car uses 66,666,000 gallons, with the increase in automobile production that the statistics show, it seems we are fortunate to have a new fuel coming on the market.

The production of tar in gallons in 1905 was 36,379,000; in 1910, 69,780,000 gallons, and when the various plants now built and building are in operation these figures will advance to 237,947,000 gallons of tar.

Sulphate of ammonia production in 1905 in the United States was 65,000 tons of 2,000 pounds; in 1910, 115,000 tons. When the present ovens now built and building are operating, the production will be about 340,000 tons. The price of these has been 2.5 cents per gallon for the tar, and for the sulphate of ammonia, around $60 a ton for the past ten years.

There are in operation or building 63 by-product coke-oven plants with 8,900 ovens, practically all of them fitted for benzol recovery.

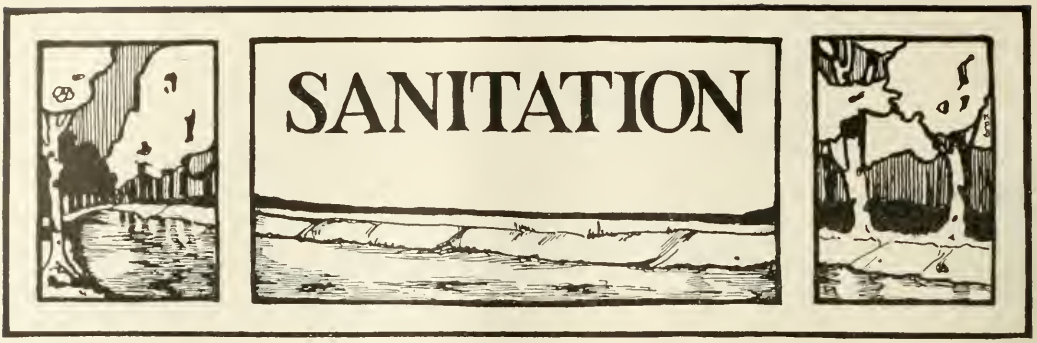
The Factograf Camera

The Factograf Camera is the direct result of the necessity for reliable meter readings. It not only reads the gas, the electric and the water meter with photographic fidelity, but it brings its indisputable record to the office files. In case of a disputed reading, the records are at hand. There is no need to go back and re-read the meter. It records, reliably, the reading of the "peak" on demand meters before they are reset for the next month. It eliminates argument—and does it economically. The meter reader can not only work more accurately with the Factograf than by the old method, but can work more rapidly. And when his record is turned in at the office there can be no doubt as to its being absolutely correct.

The reading is made by placing the front of the camera against the meter dial and pressing downward on the exposure lever. This action automatically turns on the light, opens and closes the shutter and turns off the light. The shutter, with each exposure has been wound into place, when, again automatically, it flies back to the "set" position. This prevents the possibility of a double exposure; that is, the superimposing of one exposure upon another. Likewise there can be no blanks, for the film can not be wound off until the exposure has been made. Winding reel and shutter are mutually inter-locking, thus eliminating the possibility of error from forgetting to turn the key or from turning the key before the exposure has been made.

The exposure is recorded upon a special sensitive emulsion on paper support, recording on a plane 1½x2⅛ inches. This special film is supplied in the familiar cartridge form and is, therefore, daylight loading. When the last exposure has been made on a spool of film, the shutter remains locked until a new spool has been inserted.

Cards may be provided with the reader's name, route number and date, which may be placed against the front of camera and photographed to identify the record.

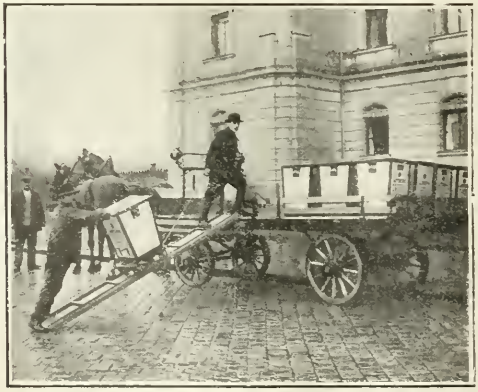


Sanitary Collection of Refuse and Street Sweepings

When the incinerator plan of disposing of the city's wastes is in use, the collection of these wastes should be made in a manner to suit the method of disposal.

Garbage and ashes can be collected together with advantage to both as regards the sanitary conditions of the collection. The ashes absorb the moisture of the garbage and delay, or for the time prevent, its decomposition and thus largely prevent the dissemination of odors common when garbage is collected separately. At the same time the moisture of the garbage allays the dust of the ashes so that there is little or none of the nuisance from the flying of dust which is an accompaniment of the separate removal of ashes.

The incinerator may be able to consume the ashes and garbage together, but in this country it seems to be necessary to collect all the combustible refuse in order to obtain fuel enough to consume the garbage in a sanitary manner. It may or may not be objectionable to mix the general combustible refuse with the ashes and garbage according to the method of collection adopted. Even if the combustible refuse



OCHSNER SYSTEM OF REMOVAL OF REFUSE AND STREET SWEEPINGS. NOTE STRICTLY SANITARY CONDITIONS AND FACILITIES FOR LOADING CANS BY SMALL TRUCK ON INCLINED RAILWAY.

is taken to the incinerator to be burned with the ashes and garbage it may be handled separately at the house and tied in bundles according to the fashion in some German cities.

At most, the separation of the refuse by the householder need be in no more than three divisions; the ashes and garbage in one can with a tightly fitting cover, the combustible refuse in the bundles mentioned and the incombustible refuse in another can or box.

The Ochsner system from Switzerland prefers to use removable cans for the smaller refuse, such as the garbage and ash mixture, street sweepings, and the like, and to remove them on wagons, horse or motor-drawn, like the one shown in one of the accompanying photographs, leaving clean cans in their places. This system is sanitary in all its details because neither dust nor odors escape at place of loading, or on the way to the incinerator, or even when unloading into the hoppers at the plant.

In contrast with this sanitary can system is the method of removing street sweepings shown in the photograph of an automobile truck used in the street cleaning service of Boston. The bed is high and three men are required to empty a can, two to lift it and one to place its contents in the bed, besides the chauffeur. The bed is open and, so far as its upper extension is concerned, is not dust tight, so that both in filling and

AMERICAN SYSTEM OF DUMPING CANS OF STREET SWEEPINGS INTO OPEN BODY ON MOTOR TRUCK WITH CONSEQUENT DISPERSION OF ODORS AND DUST WHEN EMPTYING AND IN TRANSIT.

in passing thru the streets there must be more or less dropping of material and flying of dust as well as some odor. The appearance of the street surfaces under the vehicles in the two pictures shows the difference between removing tight cans and emptying cans with consequent certainty of dropping more or less of their contents on the street in the operation.

We are indebted to Mrs. Flora Spiegelberg, a public-spirited citizen of New York, for the picture of the Swiss wagon and cans. She is spending considerable time and energy in trying to secure the adoption in New York of the desirable zone system of collection with an incinerator in each zone, located conveniently and of the sanitary and inconspicuous nature so common in foreign cities, and of which we have so few examples in this country.

MISCELLANEOUS

The March of Events

August 29-31, at Johnstown, Pa. League of Cities of Third Class in Pennsylvania. F. H. Gates, secretary, Wilkes-Barre, Pa.

September 4-8, at Lexington, Ky. Southern Appalachian Good Roads Association. Joseph Hyde Pratt, secretary, Chapel Hill, N. C.

September 13-15, at Tacoma, Wash. Washington State Association of County Commissioners. J. C. Hansen, secretary, Port Angeles, Wash.

September 18-20, at Philadelphia, Pa. Illuminating Engineering Society. C. A. Littlefield, general secretary.

October 2-6, at Grand Rapids, Mich. Playground and Recreation Association of America. H. S. Braucher, secretary, 1 Madison avenue, New York.

October 9-13, at Robert Treat Hotel, Newark, N. J. American Society of Municipal Improvements. Charles Carroll Brown, secretary, 702 Wulsin Building, Indianapolis, Ind.

October 17-20, at Chicago, Ill. American Gas Institute. Geo. G. Ramsdell, secretary, 29 West Twenty-ninth street, New York.

December 6, at New York. Society of Gas Lighting. Geo. G. Ramsdell, secretary, 29 West Thirty-ninth street, New York.

December 6-8, at Washington, D. C. National Rivers and Harbors Congress. S. A. Thompson, secretary, 824 Colorado Building, Washington, D. C.

December 5-8, at New York. American Society of Mechanical Engineers. Calvin W. Rice, 29 West Thirty-ninth street, New York.

December 26-31, at New York. American Association for the Advancement of Science. L. O. Howard, Smithsonian Institution, Washington, D. C.

January 20, 1917, at Kansas City, Mo. Western Paving Brick Manufacturers' Association. G. W. Thurston, secretary, 416 Dwight Building, Kansas City, Mo.

January 23-25, at New York. American Wood Preservers' Association. F. J. Angier, secretary, B. & O. Mt. Royal Sta., Baltimore, Md.

February 5-9, 1917, at Mechanics' Hall, Boston, Mass. American Road Builders' Association. E. L. Powers, secretary, 150 Nassau street, New York.

Technical Schools

The College of Engineering of the University of Illinois graduated 222 students in June, from 36 to 44 each in architectural, civil, electrical and mechanical engineering and smaller numbers in six other courses.

A committee of the Association of Urban Universities, the chairman of which is P. R. Kolbe, of the Municipal University of Akron, O., is sending to all instructors having supervision of field work of collegiate grade in any department of instruction, a series of questions regarding all the details of the organization and work done as a basis of a report and recommendation as to standards and methods of conducting work of this sort.

Bulletins of the N. Y. State College of Forestry, Syracuse, N. Y., outline A Street Tree System for New York City, Boro of Manhattan, and outline the work of the state forest camp in the Adirondacks, held every year in August.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

July 5: Chemists in Ordnance Department, Navy Yard, Washington, D. C., at $3.84 a day.

July 5, 6: Assistant inspector of weights and measures, Bureau of Standards, Department of Commerce, at $1,000 to $1,600 a year.

July 18: Natural gas engineer in Bureau of Mines, Department of the Interior, at $1,800 to $2,500 a year.

July 18: Assistant petroleum engineer in Bureau of Mines, Department of Interior, at $1,800 to $2,500 a year.

July 18: Ordnance draftsman in department of ordnance, Navy Yard, Washington, D. C., at $4 to $5.04 a day.

July 25: Instrument maker at Naval Observatory, Washington, D. C., at $3.84 at entrance.

Personal Notes

A prize of $100 offered by the Barber Asphalt Paving Company to students of highway engineering at Columbia University for an exhaustive study on the "Comparison and Selection of Roads and Pavements," has been awarded Mortimer L. Neinken, of Brooklyn.

O. A. Gierlich is the new city engineer of El Monte, Cal.

Louis Moyer is the new county superintendent of highways of Monroe county, at Seneca Falls, N. Y.

C. W. Cooper is city engineer of Anniston, Ala.

C. R. Crissey has been appointed city engineer of Johnstown, Pa.

Charles Pratt has accepted the position of city engineer of Erie, Kans.

G. N. Wood has been appointed to the vacancy in the city engineership at Chanute, Kans.

E. R. Wells is the new city engineer at San Angeles, Tex.

W. W. White has been appointed superintendent of the municipal light plant of Bolivar, Tenn.

George Brown is the new head of the Aberdeen, Wash., water department.

Karl C. Kastberg is the new city engineer at Des Moines, Iowa.

Robert McCormick is city engineer and water superintendent at Boone, Iowa.

Some charges by a former city employe, later an alderman, of Calgary, Alberta, against Geo. W. Craig, the competent and popular city engineer, have been investigated by the local members of the Canadian Society of Civil Engineers, by authority of the city council, and were found to be without foundation. Mr. Craig is an associate member of the American Society of Civil Engineers, having been in the city engineer's office in Omaha, Neb., in various capacities, including city engineer, for many years before accepting his Calgary position.

C. D. Martin is city engineer of Merced, Cal.

Robert L. Reading has been appointed city engineer of Redding, Cal.

Paul E. Kressly is now the city engineer of Beaumont, Cal., appointed for a second term.

F. J. Mueller occupies the double office of city engineer and superintendent of streets of Corona, Cal.

Sydney Jones has been appointed to fill the vacancy in the city engineer's office of Hayward, Cal.

W. C. Wattles succeeds Geo. N. Adams as city engineer of Hayward, Cal.

G. E. Hill has been promoted to city engineer of South Pasadena, Cal.

S. H. Finley is city engineer of the new town of Seal Beach, Cal.

M. T. Cantell has been appointed city engineer of St. Vital, Manitoba.

Richard Lamb, consulting and constructing engineer, has moved his office to 90 West street, New York.

H. L. Cory has been appointed city engineer of Baker, Mont.

C. C. Fletcher is commissioner of water works and sewerage at Aberdeen, S. D.

Free Articles on City Planning

Mr. Frank Koester, consulting engineer and city planning expert, 50 Church street, New York City, and author of "Modern City Planning and Maintenance," has prepared thirty short articles, newspaper style, covering the various phases of the city planning problems. Mr. Koester is prepared to furnish proofs of these articles free of charge to commercial and civic organizations "for the sole purpose that they be published in their local newspapers and other publications under the conditions that full credit is given to the author of same."

Municipal Lighting Matters in Massachusetts

The first instance of the gas commissioners being applied to for authority, under which a municipal lighting plant may build in another town, is in the case of the Middleboro (Mass.) lighting department, which asked approval of its plan to extend electric lines into the town of Lakeville. The law gives a town the right to make such extensions, merely leaving to the commission the expediency in individual cases. As both the voters and the lighting board were very desirous of making the extension, and since a considerable return is indicated on the necessary outlay, the board readily grants authority in the present case.

The voters of Concord, Mass., at a special town meeting, May 15, decided to retain the local electric generating plant rather than buy energy from an outside source. A special commiltee appointed in March recommended this course. The town will expend about $10,000 in improving the steam plant.

Co-Operative Collection of Municipal Data

The State Bureau of Municipal Information of the New York State Conference of Mayors and Other City Officials has made a report of its first year of work under a secretary with the work in his direct charge. The bureau has arranged for co-operation with similar bureaus and state offices in other states, secures copies of specially valuable city and state reports for distribution to the mayors of the cities of the state, has collected full information about prices of apparatus, products and service needed by cities, keeps watch of the newspapers and volunteers its services to any municipal officer who is thus found to need data, issues a semi-monthly multigraphed bulletin which is largely an index of its work. Reports have been compiled and printed of special value on garbage and refuse collection and disposal, street cleaning methods and cost, water rates in the state, cost and methods of street lighting in the state. It has made many smaller reports for special purposes on paving, police, salaries of officials, pensions, traffic regulations, water sterilization, and others too numerous to list here.

The state law now authorizes the cities to make the appropriations necessary to support the Bureau, the estimated cost requiring about $500 a year from first class cities, $300 from second class and $150 from third class, of which there are 3, 7 and 48 respectively. All of the first and second class cities and over three-fourths of the third class cities have made their appropriations.

Publications Received

Sixty-Third Annual report of the Board of Water Commissioners of Detroit, Mich., for year ending June 30, 1915. Theodore A. Leisen, general superintendent.

"Industrial Leadership," by H. L. Gantt, is a book of 128 pages containing addresses delivered in the Page Lecture series of 1915 before the senior class of the Sheffield Scientific School, Yale University, setting forth the principles on which the author believes an industrial democracy can be developed and outlining the extent to which the state can safely go in industrial and vocational training. It is published by the Yale University Press, New Haven, Conn., at $1.

Report of Water and Light Department of Duluth, Minn., for 1915. D. A. Reed, manager.

Report of the Board of Public Service Commissioners of Los Angeles, Cal., for year ending June 30, 1915. William Mulholland, chief engineer.

Report of Bureau of Water, Department of Parks and Public Property, Reading, Pa., for year ending April 6, 1914. Emil L. Nuebling, chief engineer.

Surface Oiling of Earth Roads, is the title of Bulletin No. 11, which has just been issued by the Illinois State Highway Department. This publication, which was prepared by B. H. Piepmeier, maintenance engineer of the Illinois State Highing the increased demand for information on this subject. The ing the increased demand for information of this subject. The purpose is not to cover in detail all that might be said in regard to ailing earth roads, but rather to give a general outline of the subject together with suggestions as to the best methods for oiling and maintaining earth roads. The purpose of oiling, the selection and preparation of the roads for oiling and directions for applying the oil are given and the questions of shipping and handling the oil are discussed in some detail. The bulletin gives as many cost data as are available at the present time. A short section deals with application of oil on gravel and macadam roads.

MACHINERY AND SUPPLIES

Removing Calking with Blowpipe

We reproduce a view showing operator removing lead calking of 40-inch main by means of an Oxweld welding blowpipe. With hammer and chisel it usually takes a man a day and a half to remove the lead, with danger of injuring the pipes. The lead was melted out with the blowpipe in an hour and a half. A small tip is used that gets right inside the crevice and the flame is confined to the lead only, without affecting the pipes in any way.

Heretofore it has been quite a serious and difficult problem to remove the lead calking in the joints of water mains when for any reason it was necessary to take out a section for repair or to insert an elbow, tee or other fitting in the line.

This same type of welding blowpipe was also very effectively used in repairing the Loomis street bridge, Chicago. The method of repair adopted was to trim out the damaged holes in the tire-plates until they were fairly regular, and to add on to the track teeth until they would fit the lengthened holes.

The entire eight teeth were built up in eight days at the rate of one tooth a day, at the end of which time the bridge was put back into commission.

One of the remarkable features of this piece of welding was the fact that it was done under abnormal weather conditions inthe open air, at zero weather.

The best evidence of the satisfactory character of the welding factoory work is the fact that the bridge is operating to-day, three years after the work was finished, on the teeth as built up at that time.

This welding blowpipe, as described, is made by the Oxweld Acetylene Company, Chicago.

Removing lead calking on 40-inch water pipe with Oxweld Welding Blowpipe.

The Mullen Gravel Heater and Dryer

For many years the problem of heating and drying gravel, grit and crushed stone, in relatively small quantities, on the job, has remained unsolved to most contractors and industrial managers. Sometimes the work has been done by sticking a pipe thru a pile of material on the ground and lighting a fire in it; sometimes a flat iron plate has been raised up from the ground on stones and a fire built under that. In either case much labor, fuel, time and patience have been consumed, with surprisingly poor results. The material to be heated and dried was not brought into a proper relation with the fire, and the fire expended most of its energy in an attempt to heat the surrounding atmosphere.

Several small equipments are on the market, but these are either of the drum type, requiring power to operate, or small pan arrangements that embody no efficient principle of heating and have no capacity worth mentioning.

Some years ago a New York City paving contractor engaged on a large granite block paving job, that required hot tar and hot, dry gravel for the joint filling, was having difficulty in following up the pavers with his joint filling. This man suffered so much inconvenience because of his lack of proper equipment for the purpose of heating and drying the gravel that he was forced to give the subject serious thought and study, the result of which is what to-day is used in New York City and known as the Mullen gravel heater.

This machine, of which an illustration accompanies this article, is remarkably strong and simple. The furnace consists of a multiple perforated sheet of heavy metal bent over roof-like to form the two heating sides. In cross-section it resembles an inverted letter V. At the ends of this multiple sheet are two solid end plates, in one of which is a fire door, and to which also fasten the multiple perforated flights, that are arranged down the sides of the furnace to form the heating chambers, and the hopper that is arranged above the point of the furnace.

The perforated flights are about 3 inches removed from the furnace sides at their bottoms and about 5 inches removed at their tops, causing the gravel that passes under them to do so in a layer averaging about 4 inches in thickness. The hopper discharges on both sides of the furnace under the topmost perforated flight on either side, having two 5-inch openings separated by the point at the top of the furnace.

A smokestack is arranged at the top of the furnace for starting the fire, and grates, wheels, ash pans, hot gravel pans, etc., are arranged at the bottom in quite the usual way.

But one man is required to operate the machine. He tends the fire, shovels cold, wet gravel into the hopper, and shovels hot, dry gravel away at the bottom into wheelbarrows, to be taken to the men at work, and he does not work overtime. As he removes the hot, dry gravel banked at the base of the machine, the gravel from the hopper gravitates freely down over the multiple perforated furnace side and under the multiple perforated flights until it is again banked at the base.

It is surprising what a small amount of fuel is required to heat and dry a large amount of gravel in this machine; but when one sees the actual construction of the machine and observes that practically all the heat from the fire passes out thru the multiple perforations in the furnace sides, thru the voids of the gravel or stone, and then escapes either thru the spaces between the flights or thru their multiple perforations, this efficiency of fuel is readily understood.

The machine shown in the illustration has a capacity of about four tons of gravel per hour, or forty tons per ten-hour day.

The temperature of the hot, dry gravel can be regulated by the length of time that it remains in the multiple perforated heating compartments on the sides of the furnace. It is not difficult to get a large yield of material perfectly dry and heated to about 200 degrees Fahrenheit.

There is also a Mullen combination tar pot and gravel heater, in which the gravel-heating and drying section is built on the same principle. This is used more for repair work along street railway tracks and for patching the tops of bituminous roads.

It is claimed for these machines that they are time, fuel, labor and money savers, and a great convenience besides. It is estimated that they pay for themselves in about three months' use.

The purposes to which these heaters have been put to date are for heating and drying gravel, slag, grit and crushed stone for paving joint filling, roofing, top dressing of bituminous roads, and winter concrete. When concrete must be mixed in cold weather, this heater will bring the stone to a sufficient temperature to heat the sand, cement, and water that must be mixed therewith, and maintain the batch in place sufficiently warm to keep it from freezing before setting. This was done in finishing up a bridge abutment.

The Mullen gravel heaters have been used by the contractors and street railway companies of New York City since 1910. The Third Avenue Railway system has purchased seven to date and the Brooklyn Rapid Transit system has five. Many have been shipped out to contractors who saw them in operation while visiting New York, but to date they have not been systematically marketed.

Littleford Brothers, of Cincinnati, Ohio, who are extensive manufacturers of melting kettles and other contractors' and industrial equipment, have secured from the inventor and patentee, Mr. Charles A. Mullen, of New York City, a license to manufacture and sell these heaters, and will henceforth handle them along with their general line.

Excavation Methods on Large Sewer Contracts

The plans for the construction of the new Union Station in Chicago have naturally made necessary a large amount of incidental work. The readjustment of the present sewer system has constituted a considerable part of this work. In brief, the sewers from the district west of the Chicago river flow into the river thru small sewers running down each street. Because of various conflicts, ten existing outlets are being replaced by three new intercepting and outlet sewers. The contracts for the construction of all three of these sewers were awarded to the W. J. Newman Company, of Chicago.

The largest of the three contracts is now under way. This contract has resulted in a rather complicated piece of work. The sewer itself, which will have a capacity of 500 cubic feet per second, is to carry the flow from the proposed Monroe street relief sewer to be built by the city. This begins at the corner of Monroe and Clinton streets and runs one block east on Monroe to Canal, two blocks north on Canal to Washington and east on Washington, by means of a tunnel, to the river. Between Monroe and Adams on Clinton there is a small brick sewer included in this contract.

The sewer is of reinforced concrete construction. The block along Washington street will be of double compartment section in order to increase the velocity due to the flat grade. On Monroe and Canal streets, however, it is all arched section 12 feet wide and 9 feet high, inside dimensions. The total length is about 1,200 feet, calling for an excavation of about 20,000 cubic yards, not including the incidental work made necessary, which will be described later, which adds 10,000 more to this total.

Before the construction of the sewer itself was started, it was necessary to do considerable preliminary work, as the grade of the street, especially that opposite the present Union Station, had to be considerably raised. This called for the construction of a retaining wall between Washington and Monroe streets on the east side of Canal. The large number of public utilities, such as pneumatic tubes, gas pipes, water

View showing shovel in excavation on Canal Street, approaching Washington Street.

mains and the like, required, in addition to this, the construction of a public utilities gallery along the west curb line of the street. This gallery was of concrete box construction. The contract for this was partially under the Union Station Company and partially under the city. The block between Madison and Washington was dug in part by a revolving shovel, but the obstructions, such as telegraph and trolley poles and the like, made it necessary to do the greater part of this work by hand. The block between Madison and Monroe was also done mostly by hand. In order to keep the roadway open for traffic, a temporary roadway of planks supported from below was built. It was necessary for this roadway not only to carry the traffic of Canal street, but the dump wagons which served the shovel used to dig the sewer. The total excavation for the public utilities gallery amounted to 1,083 cubic yards.

The excavation for the trench in which the retaining wall was placed was also a bothersome problem. This called for the excavation of 6,280 cubic yards. The wall is to be 19 feet high. Between Madison and Washington streets the trench

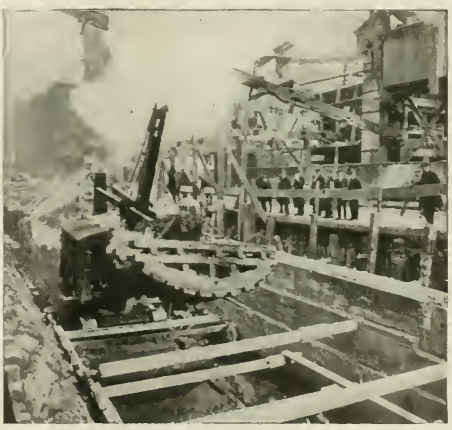
THIS VIEW GIVES AN EXCELLENT IDEA OF THE METHOD OF MIXING AND TRANSPORTING THE CONCRETE FROM A CENTRAL PLANT. THE MIXED MATERIAL IS CONVEYED FROM THE 175-FOOT TOWER OF LAKEWOOD DESIGN, THRU 400 FEET OF STEEL SPOUTING, TO A WOODEN HOPPER HERE SHOWN, FROM WHICH IT IS TAKEN IN CONCRETE BUGGIES TO THE SEWER, INTO WHICH IT IS DUMPED THRU THE SPOUTING SHOWN IN THE FOREGROUND.

was first dug about 11 feet deep and 14 feet wide, by a revolving shovel. The piles which form the foundation for the retaining walls were then driven to grade by means of followers. The remaining excavation was done by hand and the material thrown off to the side in the portion of the trench already excavated. Between Madison and Monroe streets the excavation was also done by hand. The material was loaded into a bucket which was handled by a Bucyrus revolving shovel acting as a crane with its dipper and dipper handle removed. Considerable care had to be taken on this portion of the work, inasmuch as the tubes and pipes mentioned before had not been moved into the new public utilities gallery which was then under construction.

The digging of the sewer itself is being done by the open cut method with the 18-B Bucyrus revolving shovel above mentioned. This machine is equipped with a ⅞-yard dipper and a dipper handle 30 feet in length. Some trouble was experienced along Monroe street, owing to the amount of water encountered, which made necessary the use of a Novo gasoline pumping outfit in order to keep the trench sufficiently dry for operation. The excavated trench was sheeted with 2 by 12-

NOTE THE HEAVILY CONSTRUCTED PLATFORMS OR FLOATS ON WHICH THE SHOVEL IS OPERATED. THESE PLATFORMS, AS MAY BE SEEN, ARE SHAPED TO THE BOTTOM CONTOUR OF THE TRENCH. SEE ALSO THE NEXT PHOTOGRAPH.

inch timbers with heavy wooden trench braces. The excavation of the Canal street section is practically completed. Our photographs give a very good idea of this portion of the work. During the winter, considerable heavy frost was encountered, which increased the difficulty of the digging. The depth of cut varied considerably between Madison and Monroe streets, running as deep as 20 feet with a bottom width of 18 feet. As the excavation approached Washington street, however, the depth ran up to about 17 feet 10 inches. In the block between Madison and Washington streets, as before stated, the shovel had already proceeded, taking out a portion of the material. The Bucyrus removed the remainder to grade. The material was at all times heavy to dig, consisting of a tough clay. Part of this was used for back-filling and part was hauled in wagons to various parts of the city. The problem was further complicated by the fact that it was necessary at all times to keep the street open as far as possible, especially that section between



MOVING UP. THE SHOVEL LIFTING ONE OF THE PLATFORMS INTO PLACE. NOTE HOW FEW MEN ARE NECESSARY IN ORDER TO ACCOMPLISH THIS.

Madison and Monroe streets, as stated before. This, of course, cut down the speed of advance.

As shown in our views, closely following the shovel forms were placed for the construction of the concrete sewer. The shovel thruout the work instead of digging the trench from a platform which straddled it, as is generally the custom, was operated in the bottom of the ditch. In order to be able to load the wagons easily, the machine was operated on a heavily constructed series of floats, the construction of which can be understood better by referring to the last two of our photographs. The bottom part of these floats was shaped to the contour of the bottom of the ditch. In order to move, these sections were chained, the chain being thrown over the teeth of the dipper and were lifted and placed in position by the shovel, as may be seen in the last of the accompanying photographs.

Portable Air Compressors

For many kinds of construction work, where the installation of permanent equipment, with its accompanying pipe lines and auxiliary appurtenances, would be both inconvenient and expensive, the employment of portable compressors has resulted in savings of considerable magnitude.

Thruout the work of laying gas and water mains, compressed air will be found useful for operating heavy chipping hammers of the pneumatic pick type. After the upper layer of asphalt or bitumen has been removed, it is often necessary to drill thru underlying concrete or rock for removal by blasting or wedging. For lowering pipe into ditches a small air hoist saves time and labor. After the laying of cast iron pipe, calking hammers are put to work calking the joints with lead wool, this type of joint having been demonstrated as quite durable and satisfactory. In the laying of large riveted steel water pipe, drills and riveters, rivet forges and holders-on can be used for reaming holes and riveting the steel pipe and calking hammers for calking seams and rivets.

When the work has advanced to the stake where the trench is ready for back filling, a rammer will be found expeditious and efficient for tamping down the dirt and putting on the finishing touches. This eliminates annoying settlements of pavement. On completion of the work, the whole pipe line can be tested by means of compressed air supplied by the portable outfit.

On road work the portable air compressor furnishes a complete power plant for rock drilling, which can be moved along as the work progresses.

Imperial Portable Compressor.

The added speed of construction with such equipment should effect savings which would go far toward paying for the compressor and drills.

Road cuts thru a rock hill, and the excavation of rock for crushing, require heavy drills, capable of putting in comparatively large, deep holes. This is the field of the tripod rock drill in road work.

For ditch work, breaking up boulders, drilling ledges and trimming rock cuts, drills have now almost entirely taken the place of other tools, one of their chief advantages being small air consumption, making the use of a small and comparatively light portable compressor possible.

The cost of drilling ledges and boulders in trench work in cities near Boston, using both air drills operated by portable compressors, steam drills, and hand methods, showing the following results:

Hand drilling cost per cu. yd excavated (standard rate for this district)	$4.00
Steam drilling cost per cu. yd	.96
Compressed air drilling cost per cu. yd	.80

The compressed air outfit can be operated by labor unfamiliar with it, while the ease and efficiency of operation of the compressed air drill make it ideal for this class of work.

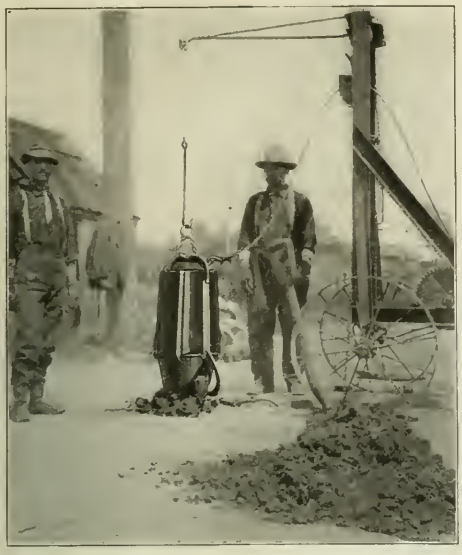
The illustration shows a view of the Imperial portable air compressor, as manufactured by the Ingersoll-Rand Company. This compressor is of the standard Imperial XII duplex type. The engine is a four-cylinder long stroke tractor type, capable of a considerable overload. It is connected to the compressor thru the Imperial short belt drive and a leather-faced coned clutch. The frame is of steel of very substantial construction and mounted on steel wheels. A gasoline tank of 25 gallons capacity and a large air receiver, fitted with safety valve, pressure gage, drain cocks and outlet valves, and a substantial cover with curtains are included as part of the complete outfit. The entire equipment is complete and the necessary gasoline and oil put it in shape for immediate use. It is light and easily moved from place to place and it runs so smoothly that no blocking is necessary.

Kuhlman Sewer Cleaning Machine

The accompanying illustration shows a view of the Kuhlman sewer cleaning machine, as operated by the city of Gary, Ind.

This machine, which was invented by Mr. John F. Kuhlman, commissioner on Board of Public Works, Hammond, Ind., consists of a series of patented expansion buckets for the cleaning of sewers 8 inches in diameter and upwards. "The bucket," states Mr. Kuhlman, "is not necessarily drawn from one manhole to the other, but is only drawn into the sewer far enough to be filled with the deposit and when full it is drawn back out of the same manhole in which it is inserted, for the bucket is so constructed that when the reverse pull is made, the jaws close up tight and hold anything that may have entered the bucket in its forward movement. Therefore, time is saved when the deposit is near the manhole by reversing the pull the shortest distance to the manhole. Then again, the manhole trolley jack is so arranged that the buckets will slide up out of the sewer without the cable cutting into the sewer or brick work. When the bucket strikes the arm, it releases a hook and guides the bucket to the center of the manhole and up to the surface."

The trolley jack attached at the bottom of the manhole is a special contrivance and has an arm pivoted at the upper end with a cable wheel attached at the lower end, holding the cable down and away from tiling or brick work while the cable is pulled. As soon as the bucket reaches this arm, it swings out to the center, allowing the bucket to come out of the sewer and up thru the center of the manhole without obstruction. This



arm is then automatically locked in an upright position, to be released when the bucket is returned to the sewer and again catch the cable in its lower position. This jack is held firmly in position by being forced against the sides of the manhole with expansion screws. In manholes that are of equal size, this device can be easily and quickly removed by a pull on the chain on the shoe side.

This system, which is manufactured by the Champion Potato Machinery Co., Hammond, Ind., consists of the following: Two steel trucks with hoist windlass and swinging loading boom; two patented trolley jacks for guiding the cable and buckets in manhole; two ⅜-inch wire cables 300 feet long; one each, 6-inch, 8-inch, 12-inch, 15-inch and 17-inch patented expansion buckets, and one 10-foot hand hook.

Portable Washer for Aggregate

We are illustrating a No. 4 Stocker concrete material washing plant of approximately 24 tons capacity per hour. This type of plant is run with a 13-h.p. engine. The feature of this plant is that all the material is perfectly clean and carries enough water to keep the ¼-inch screen from clogging. This would otherwise be impossible, as some gravel contains about 15 per cent. clay and about 50 per cent. torpedo sand.

First the gravel is hauled with wheel scrapers and dumped into a hopper under a dump bridge, from which it feeds upon a conveyor and is carried to a 3-inch grading screen over the washer. From the washer it is discharged into an upright elevator, which carries the gravel to a rotary screen which divides it into ¼-inch, ⅞-inch and 1½-inch perfectly screened material, which is deposited into four concrete bins.

The makers of this plant, the Stocker Concrete Material Washer Co., Highland, Ill., are also marketing a simple and portable washer especially intended for cleaning and grading material on small jobs where the washing must be done near the work. This washer consists of a steel drum about 30 inches in diameter and 8 feet long, having cast-iron heads, which rest on rollers. The drum is revolved by a sprocket chain that passes around one of the drum heads and over a pinion geared to a shaft which may be belted to a 2-h.p. engine or motor. The drum runs at about 6 r.p.m. To the shell of the drum are riveted horizontal angles to which steel plates, or shelves, are attached. Within it also is a series of inclined chutes of spiral form. These are adjustable and can be shifted to any desired angle, according to whether the material contains much or little foreign matter and must be passed thru slowly or rapidly.

The drum is partly filled wth water, which enters at one end. The gravel is delivered to a feed hopper (at the opposite end from the water feed) and falls to the bottom of the drum. The horizontal ribs in the drum carry the gravel up

Stocker Concrete Material Washing Plant.

until it drops into the first chute, by which it is delivered a little farther forward and dropped into the water, to be again carried up and dropped into the next chute. As the gravel moves forward, it meets cleaner water, and by the time it reaches the end of the drum the washing is completed. The washed product may be delivered to a screen attached to the drum, or to a conveyor or storage hopper.

White Tractors and Squad Wagons

The fire department of Chicago recently placed an award for three more four-wheel White tractors, as well as three White motor squad wagons.

The White tractor requires no changes in the frame of the ladder truck or turn table. The front wheels and tongue are kept in the quarters where the tractor is used and if the tractor meets with an accident, or has any trouble, by using two jacks and lifting the king bolt, the horse-drawn wheels and horses can be put back on. This is very beneficial where a village or town only has one truck and cannot afford to put it out of service for any kind of repairs.

Each of the three White squad wagons carry the following equipment: An outfit for cutting steel plates or iron bars with flame; one pulmotor; two helmets for use in places where gas or ammonia leaks are found; one 20-ton jack; one life net; one 20-foot extension ladder; eight axes; eight pike poles; two large hand pumps; hammers, mauls, saws, etc.

These machines will be equipped with Lee puncture-proof tires, single front and dual rear.

Cutting Pipe in the Trench

We are illustrating a No. 7 Strickler ratchet pipe cutter at work in the trench. The cut on this pipe, which measures 20 inches in diameter, was made in 35 minutes time. This machine, type No. 7, as illustrated, cuts any pipe 16 to 24 inches in diameter inclusive, and weighs approximately 250 pounds. "This style cutter," states the contractor, "cuts 24-inch pipe as fast as is possible to cut 12-inch pipe by other methods.

"The machine adjusts itself to the different sizes of pipe quickly and accurately and is possible of operation in tight places. It is automatic in operation. The machine opens wide on a strong hinge, permitting it to be placed around the pipe while in the trench, and is instantly put in place and fastened together by tightening the swing bolt.

"The guides which hold the machine in place on the pipe are equipped with hardened tool steel rollers which permit the body of machine to rotate about the pipe with remarkable ease. The yoke which holds the handle is equipped with dogs which engage the teeth on the body of the machine, and the body is rotated around the pipe by merely 'pumping' the handle. The operator can do this from any position he desires. The body rotating about the pipe causes the cutting tool to cut out its own path around the pipe, and the feeder sends the cutting tool in automatically; and this is done with so little labor that one man can quickly cut 8-inch pipe and three men cut 16 and 20-inch cast, wrought, or steel pipe.

"The following types are operated to cut the following diameters of pipe: No. 1 cuts ¾ to 2 inches; No. 2 cuts 1¼ to 4 inches; No. 3 cuts 2½ to 6 inches; No. 4 cuts 4 to 8 inches; No. 5 cuts 8 to 12 inches; No. 6 cuts 12 to 16 inches; No. 7 cuts 16 to 24 inches; No. 8 cuts 24 to 30 inches, inclusive.

This type of ratchet cutter, which is made by W. W. Strickler & Bros., Columbus, O., is used by water works and gas companies, railroads and mines, as well as by municipalities and public works contractors.

Speeding-Up Roller Transportation

The Kelly-Springfield Road Roller Company, Springfield, Ohio, make use of a 3½-ton Kelly truck in conveying rollers to the railroad yards for shipment, as this method results in a great saving of time as compared with driving the roller under its own power.

This method of road roller transportation has been adopted by a number of paving and road contractors specializing in county and state highway construction. Motor trucks, winches and inclined skids render the problem of loading and unloading a comparatively easy matter.

METHOD OF STEAM ROLLER TRANSPORTATION TO SHIPPING STATION AS ADOPTED BY THE KELLY-SPRINGFIELD ROAD ROLLER COMPANY.

The Mathews Gravity Carrier

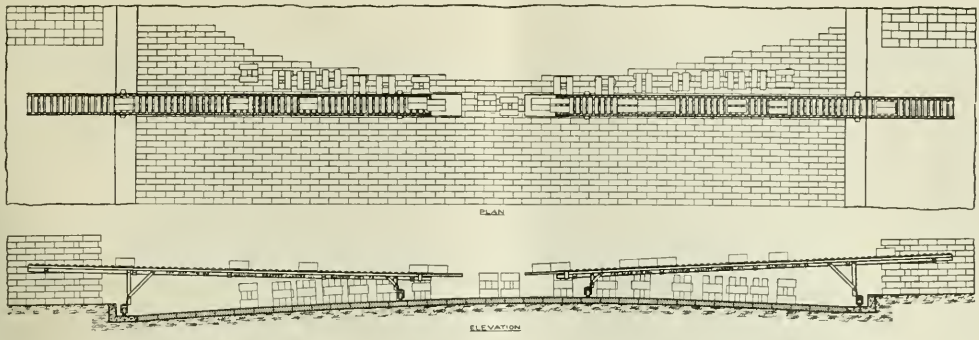
We are illustrating two sections of the Mathews gravity paving brick carrier, as operated by Roehl Bros., paving contractors, Cleveland, O.

Mr. Charles Roehl, of this concern, in explaining advantages of this method, states:

"When we use the 16-foot conveyors we use two men to set the bricks on the carrier and two men as setters, thus using four men to each carrier. While we have these men setting we have two men paving and we manage to lay 45,000 brick per day of 8 hours. By working the old way, it would take two extra men to do the same amount of work, using wheelbarrows.

"Further, we wish to state that another big advantage in operation of the conveyors over wheeling brick is that when wheeling the brick you gouge your pavement and bed full of holes and this costs money to level up. Thus, we find that the big advantages in using the conveyors are convenience, simplicity and style and the saving mentioned."

We are also showing elevation and plan views of two 16-foot sections, as shown in the photographic illustration. The elevation view shows the two sections in place on both sides of a street being paved. These sections are made entirely of steel, the rollers being formed of cold-drawn seamless steel tubing with improved, patented ball-bearings. Caster supports are provided which permit the sections to be rolled along on the new-laid pavement in the rear of the droppers. The support at the upper, or loading end, is set in a distance of 4 feet, which permits the conveyor to extend out over the curb, bringing it within convenient reach of the brick piles. On the lower, or discharge end, a detachable receiving apron is provided which prevents the brick falling off and keeps the line of brick in check in case the conveyor is full. Sixteen-foot sections are generally used on all streets from 24 to 32 feet



TWO 16-FOOT SECTIONS, MATHEWS GRAVITY CARRIER, AS OPERATED BY ROEHL BROS., CLEVELAND, O.

wide. They are made in any desired lengths. These conveyor sections, which are made by the Mathews Gravity Carrier Co., Ellwood City, Pa., are built on a grade of 4 per cent—a fall of ¼ inch to the foot. On this grade the brick travel by their own weight gently, without injury or danger of falling off.

All sections are made 8 inches wide, and each roller is provided with flanges at ends, rising ¼ inch above surface of roller. These flanges act as a guard rail, but do not produce friction, because they are a part of the roller and revolve with it. Axles are full length, extending clear thru the rollers, the ends terminating in the side rails and securely fastened by means of a full-length lock bar. This method of handling brick is endorsed and recommended by the National Association of Paving Brick Manufacturers.

A majority of the prominent contractors in states where brick paving is carried on extensively are using this method in preference to wheeling the brick. It can also be used for unloading cars into wagons or trucks, at a substantial saving in labor and time. The Mathews Gravity Carrier Co. will be pleased to send their Bulletins Nos. 3 and 4 to any contractor who may be interested.

Artificial Leather for Book Binding

With the increased shortage of hides, users of leather are looking to other quarters for material that will take its place. Artificial leather is proving especially satisfactory for automobile, furniture and railway car upholstery. During the last few months it has been used extensively for book-binding. It is answering the purpose, and standing the strongest tests.

Book-finish Fabrikoid is entirely different from any material heretofore offered. It is the result of a practical binder's experience, who made a careful study of the subject, as well as the manufacturing process. The book-binding process of manufacture is different from that used for other grades of any other artificial leather.

Some of its advantages and features are, that it has the leather effect in any grain or color, and costs less, comes in rolls and thus eliminates waste in cutting, no unused corners or edges. It has just the needed degree of pliability, not too soft to work well in a case-making machine, nor too hard to

TWO 16-FOOT SECTIONS, MATHEWS GRAVITY CARRIER, AS OPERATED BY ROEHL BROS., PAVING CONTRACTORS, CLEVELAND, O.

stand the bending of the joints. It is waterproof and washable. This is a strong point, for books naturally get dirty, but if bound in Fabrikoid the covers can be washed. Besides it is vermin-proof, and cannot be destroyed in that manner.

It is made in several grades so that any kind or size book can be bound in it. Some of the largest bookmakers, blank book and loose leaf manufacturers have adopted it. They find that it can be used for work for which artificial leather would have been thought impossible but a short time ago. The Du Pont Company, Wilmington, Del., have issued a neat little booklet that covers the subject fully, which is sent upon application .

Hex Blocks on Chicago Bridge

The accompanying view shows laying of Kreolite Hex blocks on the State street bridge, Chicago.

This material was furnished by the Jennison-Wright Co., Toledo, O., to the Chicago Surface Lines for use inside their tracks, and was approved by the Chicago bridge engineer, who wanted a block that could be nailed to the sub-base, and also one that would automatically take care of any expansion that might occur.

According to the chief engineer, Chicago City Railways Co., "hexagonal paving blocks were used for two reasons: First, to avoid most of the expansion troubles, since each block is the entire log of wood and hence is subjected to radical expansion only, which is about one-third as much as the tangeutial expansion of the rectangular block; second, each block is 100 per cent. heartwood and so can be face-nailed to the sub-planking without the block cracking. This is necessary on a bascule bridge in order to hold the pavement when the span is raised. This nailing was tried experimentally on several well dried blocks, and it was found that not only could a 60d wire nail be driven to the head of the nail into the block, but that a follower could be placed on the nail and the head driven clear thru without splitting the block. This is impossible with a rectangular block and was the deciding factor in the selection of the hexagonal type.

These blocks are 3½ inches in depth. One advantage of the Hex block is that, because of their shape, they have more body than a rectangular block, and for that reason a 3½-inch Hex block will withstand as much hard wear as will a 4-inch rectangular block, thus making a saving of a half inch in timber.

The Koehring Hot Mixer

The Koehring hot mixer affords a wide range of mixer utility, as it is designed for asphaltic concrete, rock asphalt, mastic floor work and bituminous and cement concrete.

While it may be primarily purchased for hot work, it is readily transformed into a standard Koehring mixer for cement concrete. This flexibility equips the owner to do a variety of work at the smallest possible investment in special equipment.

Special Heating Device.

The heating device of this machine consists of a two-burner oil furnace and a blower mounted on the mixer frame. Combustion takes place in a brick-lined chamber and the conduit which carries the heated gases into the drum thru the drum opening on the charging side. Heated gases, and air from blower and furnace are injected directly into drum by large hot air flue, the design of which insures perfect combustion of gases before the drum is reached. The flue is lined with the greatest fire-resisting material known, which is easily and inexpensively renewed if it burns out. The gate automatically opens as charging skip rises. In closed position this gate prevents escape of dust.

When aggregates are dried in the drum, the full blast is allowed to enter until the aggregates are dry and mixture is brought to desired temperature, at which stage the hot blast is modified. This feature of heat control secures the utmost efficiency in drying aggregates and bringing material to desired temperature in shortest possible time, and at the same time it is easy to avoid any danger of burning the material.

Drying capacity, of course, is dependent on amount of moisture in the mixture and kind of aggregate. On the average, sand, stone and gravel without excess moisture can be thoroly dried in three to five minutes, heating the aggregate to 300 degrees F. in that time, or to a higher temperature in a longer time.

The bituminous material should be heated in melting kettles, then poured or pumped into the Koehring measuring tank, from which it flows into the drum thru a large pipe.

When lime dust or cement are part of the mixture it is advisable to dry the larger aggregates before adding the finer ingredients. Ordinary mixtures are charged into the drum at one operation of the loading skip. The entire mixture is brought to specified temperature by allowing the full blast from both burners to enter. One burner is then shut off by

KREOLITE HEX BLOCKS ON STATE STREET BRIDGE, CHICAGO.

West Michigan Pike, Petoskey, Mich.
Treated with "Tarvia-B" August, 1915.

A Tarvia County—

WE sent our Mr. Clark to see the Emmett County Highway Commission, to tell them about Tarvia.

There were many miles of macadam roads in Emmett County which were being churned up into dust by automobiles as fast as they were built. Repair work was incessant and expensive.

Our Mr. Clark said, "Paint your roads with 'Tarvia-B', applied rapidly and cheaply from a modified sprinkling cart, and covered with a little sand or stone screening. The Tarvia will act as a tough binder cementing the surface together.

"That tough and slightly-plastic surface thus formed, will be automobile-proof. There will be no dust, no mud and very little wear. The coating can be renewed at small expense and the saving on maintenance will more than pay for the Tarvia. The use of Tarvia won't increase your road expenses—it will reduce them and give you better roads besides."

So Emmett County bought a tank car of "Tarvia-B", and tried it on the above road.

October 1, 1915, we received this letter:

> I wish to say that the tank car of "Tarvia-B", purchased through your man Clark, is doing everything and more for our roads than he claimed. The Board of County Road Commissioners are trying to arrange to use it on all of our improved county roads in Emmett County next year. Charles W. Lempke,
> Emmett County Highway Comr.

On March 23, 1916, the Emmett County Commissioners signed an order for 50,000 gallons of "Tarvia-B" to be used on their macadam roads this year.

There is a grade of Tarvia and a Tarvia process for every macadam road problem.

Booklets free on request. Address our nearest office.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems.

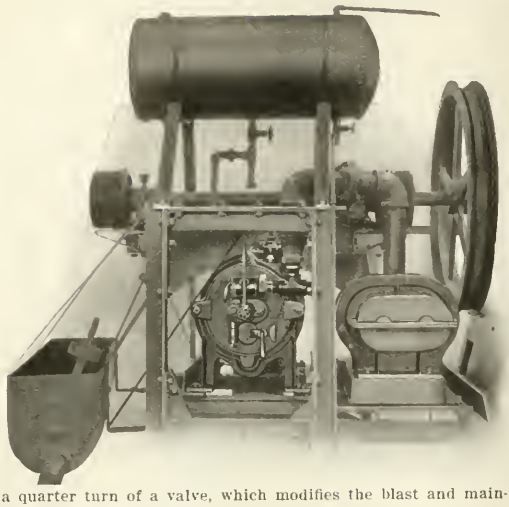
The advice of these men may be had for the asking by anyone interested.

If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will haveprompt attention.

The Barrett Company

New York Chicago Philadelphia Boston St. Louis Cleveland Cincinnati Pittsburgh
Detroit Birmingham Kansas City Minneapolis Nashville Salt Lake City Seattle Peoria
The Paterson Manufacturing Co., Limited: Montreal Toronto Winnipeg
Vancouver St. John, N. B. Halifax N. S. Sydney, N. S.

TRADE B MARK



a quarter turn of a valve, which modifies the blast and maintains the desired temperature during the mixing process which, with bitumens added, requires only two minutes.

When auxiliary drying plants or ovens are employed partially to take the moisture out of the material, the capacity is greatly increased.

Remelting and Mixing Old Asphalt.

In re-laying and patching asphalt pavement, this type of machine is beyond question an economical and efficient apparatus.

In the first place it eliminates a great amount of double haulage inseparable from the stationary plant. With the Koehring mixer the old asphalt is remelted and remixed as it is ripped from the street. A very small amount of new asphalt is usually added.

The pavement is laid hot from the mixer. The haulage is restricted to a very small amount of new material. From a big item, haulage is reduced to the smallest item. A liberal crew for operation of this unit mixer for this work is composed as follows: One foreman, one man breaking asphalt, four wheelers who also clean concrete sub-base, one man painting base, patching edges and joints with hot asphalt, one mixer operator, three men raking, smoothing and tamping, and operating hand roller.

The No. 22 paver type, as made by the Koehring Machine Co., Milwaukee, is usually used for this asphalt repair work. This mixer is provided with its own traction for moving ahead on the street or for moving from job to job. Remelting and mixing capacity of this mixer, while varying with character of materials, is adequate to keep a full crew as enumerated above constantly busy.

A Storm Water Sewer in Greenfield Township, Wayne County, Michigan

A very interesting construction was adopted in building the storm water sewers in Greenfield township, northwest of Detroit. Probably a mile of these sewers have already been constructed principally in the subdivisions known as West Lawn and Schoolcraft located out Grand River avenue.

The principal feature of the construction was the use of arched Hy-Rib to form the circular tops of the sewers. Before this Hy-Rib was set concrete had been poured forming the invert of the sewer. At either side extending down the length, a small wall 12 inches high was built between forms. This wall was 12 inches wide at the base and 8 inches at the top. The arched Hy-Rib formed a complete semi-circle and was set directly on top of the concrete wall. The Hy-Rib was furnished bent to this exact curve by the Trussed Concrete Steel Company. The concrete was poured directly on top of the arched Hy-Rib to a thickness varying from 6 inches at the center to 8 inches at the sides. No forms of any nature whatever were used in the construction. The work proceeded very rapidly and the Hy-Rib served the double purpose of forms and reinforcement for the concrete.

The diameter of the storm sewers is 3 feet so that the arch has a radius of 18 inches. Photographs give a good idea of the construction of this work.

The contractors for the construction were the Otis Cement Construction Company, Detroit, Mich. Hy-Rib reinforcement was furnished by the Trussed Concrete Steel Company, of Youngstown, Ohio.

HY-RIB ARCHED CONDUIT, SNYDER ROAD, GREENFIELD TOWNSHIP, NEAR DETROIT, MICH.

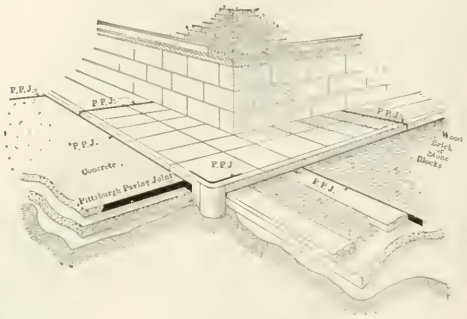
HY-RIB IN PLACE WITH INSIDE AND OUTSIDE FORMS FOR WALLS.

HY-RIB IN PLACE WITH OUTSIDE FORMS FOR STARTING CONCRETE LAYING ON ARCH.

COMLETED CONCRETE ARCH OF SEWER.

The Pittsburg Paving Joint

We are showing a view illustrating the different uses of the Pittsburgh paving joint and road construction. This joint, which is pre-molded, is all asphalt in construction and is to be had with or without reinforcing. The reinforcing is accomplished by means of a linen mesh embedded in the asphalt.



SHOWING VARIOUS USES OF PITTSBURG PAVING JOINT IN STREET AND ROAD CONSTRUCTION.

This reinforcing is said to give added strength and prevents the possibility of cracking or shattering under unusually severe cold conditions.

This type of joint, which is handled by Ray D. Lillibridge, Inc., 111 Broadway, N. Y., is made in standard lengths of varying widths and thicknesses to suit the needs of the individual job.

Air Compressor with Motor Drive

The National Brake and Electric Co., Milwaukee, Wis., are marketing a type of portable air compressor with gas motor drive, as illustrated.

This outfit possesses all the advantages of stationary installations and, in addition, eliminates the necessity for extensive piping, as the outfits can be easily moved from place to place and the air applied just where needed. For outdoor service of every nature, including construction and contracting work, these outfits fully meet the demand for self-contained units of power, adapted to a wide range of service.

These outfits, as regards the construction and the method of control, are identical, in every respect, with National stationary installations of the same type. To adapt them for portable service, however, the complete unit, including air compressor and engine, is mounted on an all-steel truck, built especially strong and durable. The frames of the truck are underhung from the axle, as this method of construction permits ready access to the outfit when manipulating same. To facilitate starting of gas engine a clutch of the multiple disc type is mounted on the engine shaft and is operated by a hand lever. By this means the gas motor is disconnected from the compressor while the motor is being started. The gas-driven 3VS compressor is, therefore, as complete a compact self-contained unit of power as the 3VS motor-driven-type compressor.

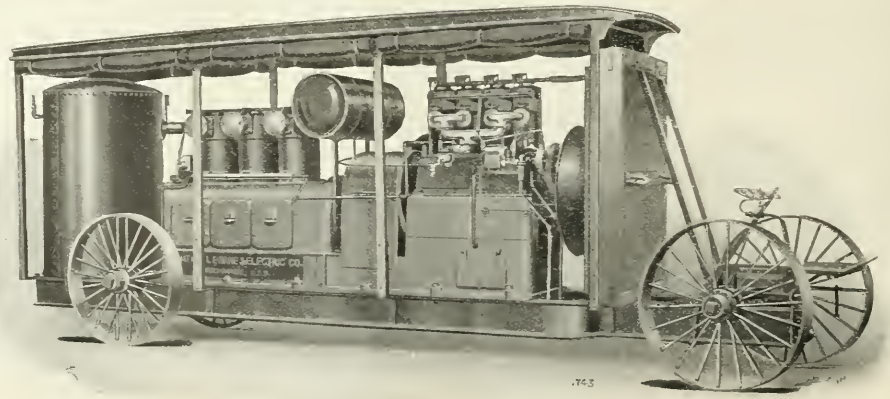
In order to automatically maintain the air supply within predetermined limits of minimum and maximum pressures, National type 3VS gas-driven compressors are equipped with a National type G pneumatically operated unloading device.

Type G unloader consists essentially of two valves, an admission valve and an exhaust valve, cylinder and piston. The valves are so arranged that each valve performs its function and returns to normal position before the other valve commences operation. A lever, actuated by the piston of the unloader, is also provided.

When the air supply has reached the fixed maximum limit the lever just mentioned causes pins to force the suction valves of the compressor from their seats, which results in the compressor being unloaded. When the air supply has reached the fixed low limit of pressure, the valves are permitted to return to their seats and the compression of air is resumed.

Unloading the compressor reduces the load on the engine. This operation causes the fly-ball governor to restrict the supply of gasoline fed to the engine, so that the increase of speed will not be more than 5 per cent above full-load speed.

225-CUBIC FOOT NATIONAL TYPE "3VS" PORTABLE GAS DRIVEN AIR COMPRESSOR WITH CANOPY TOP AND SIDE CURTAINS, AND THERMO-SYPHON SYSTEM OF WATER COOLING.



New Book on Steel Joists and Studs

The new book on Kahn pressed steel construction is a comprehensive publication on the use of steel joists and studs with Hy-Rib in building construction. It describes an improved type of fireproof floors presenting the advantage of light weight, economy and simplicity of erection. The construction is particularly adapted for stores, apartment houses, schools, hotels and residences. It entirely eliminates the use of wood joists and wood lath, giving permanent construction at a comparatively nominal cost. The catalog shows various types of these floors, including their use with reinforced con-

crete beams, with structural steel and with masonry walls, giving tables for carrying capacity, tests, etc.

Another portion of the book deals with the use of the construction in partitions and bearing walls. The simple standard connection is brought out clearly, showing how all the members are securely united without the use of any rivets or bolts; only the simple wedge connection. Tables giving carrying capacity of partitions are included; also complete specifications covering floors, partitions, roofs, ceilings, etc.

The back part of the book shows the various standard sections with their properties, weights, etc. The catalog is profusely illustrated with examples of the use of pressed steel construction in important work.

The book is sent free to anyone interested in improved building construction by the Trussed Concrete Steel Co., Youngstown, O.

Blasting a Canal

Recently, Blaster Patterson, of Illinois, was called upon to blast a ditch 1,600 feet long, 4 feet deep, 4 feet wide at the bottom and from 8 to 10 feet wide at the top, to save the members of the club from taking their boats on a long detour of a mile and a half. Mr. Patterson did the work successfully with 1,200 pounds of 60 per cent straight Du Pont dynamite. The canal is straight and clear.

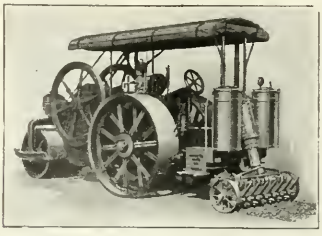
Bitoslag in Allegheny County, Pa.

The board of county commissioners of Allegheny county, Pa., have awarded contract to the Thomas Cronin Company, of Pittsburgh, for 1½ miles of Bitoslag pavement.

It was in McKeesport, Pa., which is in Allegheny county, that Bitoslag was laid originally in 1910. The success of the McKeesport pavement, also the success of Bitoslag pavement laid in Philadelphia last year, under heavy traffic, is causing many communities, especially where slag abounds, to look with favor upon this form of pavement.

The Austin Pneumatic Road Scarifier

Earth, gravel and macadam roads require frequent and extensive repair. To make these repairs economically and efficiently it is necessary to scarify the old surface, and to roll the new material into close union with the old road bed. A combined roller and scarifier suggests itself as a valuable combination, and the Austin Mfg. Co., Chicago, Ill., have made the combination, attaching the scarifying bars to a piston working in a compressed air cylinder supplied with air from



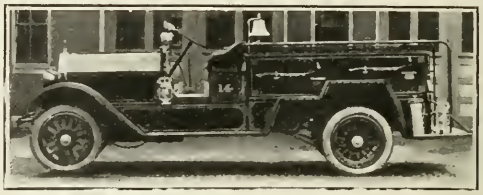
storage tanks mounted on either side of it. The frame carrying the entire apparatus is attached to the rear end of the frame of the road roller. The air pressure in the storage tanks is maintained by an air compressor on top of the engine cylinder, operated from the crankshaft. The accompanying cut gives a view of the machine and will be more satisfactory than a long wordy explanation. A booklet describing and illustrating the combination will be sent on request.

New Cleveland Hose Wagon

The fire department, city of Cleveland, Ohio, has in operation its new South Bend "Double Duty" hose wagon which is unique in many respects.

Even when running at full speed, in response to an alarm, it is convenient and easy for firemen to pass over the running boards from the rear step to the driver's seat with perfect safety, due to the fact that mudguards on the rear wheels have been turned into step-like platforms on the running boards.

The body is finished in Lincoln Highway red and finely striped in gold leaf. The wheels, which are in natural wood



South Bend double-duty hose wagon, as operated by fire department of Cleveland, O.

finish, are striped in gold and colors. The platforms, running boards, etc., and battery boxes are covered with one-quarter-inch battleship cork linoleum, bound with heavy strap steel.

This outfit carries, in its equipment, two 6-pound standard fire axes, two standard break-bottle fire extinguishers, 8-foot pike pole, 16-foot extension jack ladder, crowbar, door openers, etc.

The pneumatic tires are 37x5 single in front, 37x5 dual in rear.

The following details of this outfit, as manufactured by the South Bend Motor Car Works, are of interest: H.p., 95; 54.1, S. A. E. rating; motor, Wisconsin; cylinders, six; starter, Lece-Neville; frame, chrome Vanadium pressed steel, heat-treated; body, 100 inches long, 22 inches deep and 47 inches wide; capacity, 1,500 feet triple-jacket fire hose.

Bitulithic Decision in Pennsylvania

In the case of Warren Brothers Company v. W. C. Evans in the U. S. District Court for Eastern Pennsylvania, arising out of the award of two contracts for Filbertine roadway by the State Highway Department to Mr. Evans, Judge Dickinson has decided that the proposed construction would be an infringement of the Warren patent No. 727,505 and has enjoined the construction of the roads.

Trade Notes

The Asbestos Protected Metal Company, of Pittsburgh, announces that hereafter it will be represented in Cincinnati, O., and surrounding territory, by Mr. E. G. Irwin, located in the Union Trust building.

The city of Houston, Tex., E. E. Sands, city engineer, has adopted the Cleveland Dock Engineering Company's design for a marginal dock in Buffalo Bayou. This is a turning basin, and the dock about to be built is Unit No. 4 of ten units.

The J. G. White Engineering Co., New York, have a contract for the construction of a new paper pulp plant of 120 tons daily capacity at Bagotville, Quebec, on HaHa Bay, Saguenay river, for the HaHa Baie Sulphite Co., of Chicoutimi, Que.

The Portland Cement Association is the new name of the re-organized Association of American Portland Cement Manufacturers, with main offices in Chicago and a New York office at 101 Park avenue, in charge of Lewis R. Ferguson.

Vol. LI. — No. 2.

Municipal Engineering

The World's Leading Municipal Publication

August, 1916.

HOW SHALL A CITY BE INVESTIGATED

The Nashville muddle shows what can be done in interfering with municipal business and increasing cost of doing it when investigations are started to serve personal ends or vent personal spite. It is undoubtedly true that the city government of Nashville is inefficient and possibly to some extent dishonest, but so are the governments of all cities and of all great corporations of any sort, whether public or private, it is only a question of degree. But that is no reason for tying up the functions of government and causing expense and delay wholly unnecessary and yet inevitable under such circumstances.

It is a good thing to investigate a city government once in a while, whether it seems to be efficient or not, but let us do it in the right way and not block the wheels of progress while the job is being done.

After all, publicity is the best corrective of wrong conditions and a turning of the light upon the doings of the city officers will accomplish far more, in less time, with less interference with real business, and at less expense than the knock-down-and-drag-out methods under which Nashville has been suffering for the last year or more. And to what end? Some new men are in office but the routine of regular business is being resumed and one outside the city can see but little real result of a permanent nature.

MOTOR TRUCK HIGHWAYS

The passage of the bill providing for the expenditure of $85,000,000 by the United States Government in the construction of highways in the various states means the expenditure of several times that amount upon the same roads, as well as of still greater amounts upon their extension and the building of branch and connecting roads. At least twice the amount must be spent, as the government will not pay more than half the cost of the road and will not pay more than a fixed maximum per mile. Moreover, the cost of roads on which the government money is to be expended is fixed so high that a really good road is insured.

Such roads as will thus be made possible are no better than are necessary to carry the traffic of the future. The war has demonstrated the ability of the motor truck, under very trying conditions, and it is now necessary only to demonstrate its economy to insure its universal use.

One very important source of economy in motor truck haulage is the good road. Without it we know the truck can be made to go, but we also know that accidents are numerous, that the trucks must be helped out of bad places, that temporary reconstructions of roads or bridges are expensive; and so only the more adventurous are willing to try the experiment of running trucks regularly over the average roads of the present days, and they stop running when the roads become too soft to go over safely.

No one has yet been able to compute what the saving in truck transportation may be because no one can foresee what its development will be when we really have the good roads. We have been able to compute the saving to the farmer in getting his produce to market by horse transportation over 365-day roads, but that is only one step in the process. Farming will be revolutionized. The nature of the products to be brought to market will be changed, especially in the vicinity of the larger cities. Crops can be raised and successfully distributed which are impossible with present methods of transportation.

Study the developments of farming and of transportation in the vicinity of such cities as New York, Philadelphia, Boston, as the roads have been improved, and you will get some faint idea of what will happen around every city when the roads are sufficiently improved. The developments about many other cities are less only because the proportion of roads improved to the highest efficiency is less.

Interstate traffic with motor trucks may never be as great as with lighter automobile vehicles, but there will be plenty of it to justify the expenditure of the common funds in aiding the construction of state roads on lines approved by the National Government.

CIVIC SANITATION

Civic sanitation, including in that term the physical, mental and moral sanitation of the citizens, whether of city, town or country, is strongly emphasized on all sides just now; from the theoretical side in many such books as Prof. Herman G. James's "Handbook of Civic Improvement"; from the practical side by the many campaigns against various forms of disease, censorship of amusements, white slavery, and the like; from the commercial side in the exploitation of preparations for destroying or preventing disease germs, in societies to improve the mental and moral education of children, with the sale of books as the primary object, and others too numerous to mention.

The movement is one of the utmost importance and great good will undoubtedly result from the sum of all the efforts put forth, tho occasionally one is misguided and results in disaster.

Professor James's book is an excellent little guide to municipal studies along the lines of public health, safety, education and morals and the lists of questions on each subject, which he gives with each chapter, if answered for each city, will necessitate a thoro welfare survey of such city and the information thus obtained will form an excellent basis for plans for civic betterment.

The Municipal Supply Department IV.

AUDIT AND INSPECTION

By Hugh M. Foster, New York City.

The inspection of municipal supplies must be in honest hands or must be so checked that any departures from exact honestly can be discovered. How to do this without excessive expense is a problem. Auditing of the accounts of supplies purchased and issued is another check upon inspectors. Systems of handling these problems are worked out in this article.

(a) *Personal or Visual.*

THE function of audit in the case of supplies and the certification of claims for supplies is in its last analysis based on inspection. This power should be in an official independent of the purchasing agent and of the storekeeper. Within the department it should be exercised by the auditor of the department, and for the general function thruout all departments of the city should be exercised by the general auditor or comptroller or chief financial officer of the city. By expeditious auditing cash discounts are availed of, and a further advantage is gained for the city by promptness in payment of bills, as this attracts a larger and better class of dealers. The mistake has been made in the Cedar Rapids purchasing system of making the purchasing agent the auditor, and thereby he audits and checks himself, which is obviously unsound practice. As a wholesome check on the purchasing agent and storekeeper the inspection should remain in the hands of the auditor and the comptroller. The mere certificates of the subsidiary departments and the storekeeper and the purchasing agent are insufficient for the purpose of inspection and audit.

The comptroller in certifying claims should base such certification on the actual knowledge of his own subordinates, both auditors and inspectors. A subordinate auditor of accounts certifies to the propriety of all previous certifications, general signatures and appropriations. His certification as to quantity and quality is based on the actual physical inspection. Inspectors should be required to attach cards, tags or stamps to the goods which they inspect and pass, giving their name and date, and stating clearly that the goods have been so inspected and passed. To be effective inspection should be complete—that is, it should include all deliveries and a reasonable proportion of every delivery. The approval of the departments is not sufficient, as they are necessarily prejudiced by their likes and dislikes in actual use. Any complaints from them, however, should be given due consideration. Brands of goods are not sufficiently reliable or uniform to warrant the elimination of inspection.

Any competent and experienced inspector knows that regular monthly or weekly deliveries of a given article vary from week to week or month to month, and that one inspection of one delivery is no guide whatever as to the next delivery. The contention that the departments using supplies know their own needs and the qualities required is directly contradicted by good inspectional practice. The departments using supplies may know what they want, but their desires may be, and often are, unreasonable. The contention that after one inspection subsequent deliveries should be judged merely by brands of goods, would lead to all sorts of fraud. A good delivery of canned goods marked with a certain brand is no guarantee whatever that the next delivery of the same goods, under the same brand, will be of uniform quality. Variations are too well known to admit of much discussion on this point. A few actual inspections of such goods would demonstrate this error. The practice of having departmental inspections as well as inspections by the comptroller is not only a mere duplication of work, but frequently creates unnecessary friction. There should be one centralized and expert corps of inspectors.

In the city of New York 50,000 vouchers per annum are passed for supplies, at an average cost for clerical work in auditing and inspecting of $1.35 each. This does not represent all the work for each voucher, because each voucher may have attached to it many orders and bills. The obvious saving in clerical work alone would be enormous if a competent centralized supply department were established, by greatly reducing the number of individual purchase transactions. A further and almost equal saving could be achieved in inspection by the central concentration of deliveries at one general storehouse.

Specialization is an absolute desideratum in inspection. At present the Greater City of New York is divided into 18 districts, covering over 2,100 receiving points. These delivery points include schools, fire houses, police stations, street cleaning stables, section houses, almshouses, hospitals, and other large receiving points. To each of these districts an inspector is assigned and is required to inspect all the supplies delivered in that district, except such supplies as meat and lumber. To these items two inspectors devote their energies as specialists. It would seem that in the present development of commercial activity and even professional activity, the advantages of specialization hardly needed an advocate. No one man can readily know all the supplies delivered in a given district of the city. A man who possesses such knowledge would be worth far more in commercial life than in the small paid position as a city inspector. The value of an inspector of supplies depends, aside from the qualification of honesty, which is taken for granted, upon the inspector's knowledge of supplies. It stands to reason that any man must know one line, with its allied branches, better than he can know two.

The argument against specialization is the opportunity for bribery, aside from mere morality or from the question of business expediency in the loss by a wage-earner of his greatest asset, namely, his reputation. The opportunity for bribery is no more pronounced in specialization than in the district system. A man who is looking for a bribe will get it, no matter what restrictions are put on him, and the sooner he is discovered and eliminated the better for the system. The re-inspection of supplies by the chief or supervising inspector, from time to time, should keep track of such possibility.

The inspection of repairs should be separated from that of supplies, and men trained in repair work assigned to one branch, and men trained in supplies to the other. Repairs should be subdivided into painting, papering, decorating, carpentry and masonry, plumbing, roofing, steam and gas-fitting, and electrical work, and supplies therefor. Supplies should be subdivided into foods, forage, furniture, lumber and textiles. In large contracts of bulky supplies, such as iron, steel or materials of construction, it is frequently an advantage to make the inspection at the sources of supplies. It is better policy to prevent an error than to correct it after it has happened, and this practice is a saving of time and labor to the contractor

and to the city. I have in mind an instance of the kind in the case of a new hospital being equipped with hospital furniture. The specifications of the contract described elaborately the process of coating the iron frames with paint and enamel, and the number of coats to be applied, and described the character and dimensions of the metal. The inspection of this furniture was made after delivery at the hospital and there was no way for the inspector to know that the specifications had been complied with. The only way to arrive at such knowledge would be for the inspector to be on hand at the place of manufacture and watch the processes as the goods were made.

Proper supervision is an essential to good inspection. The chief of the inspection corps should not only review all reports, but should make frequent, irregular and unannounced visits in the field to watch inspectors at their work, to correct errors and to promote uniformity of inspection. It is a distinct loss to the city if goods are rejected at one point and accepted at another because of the variation in the competency of the inspectors. Contractors soon learn such a condition and take advantage of it to defraud the city. Proper inspection includes certification of quantities. For this purpose, at delivery points so large that actual physical count cannot be made by inspectors, the inspectors should have a clerk to count the supplies. At all points of receiving supplies a sufficient stock should be kept on hand to allow time for inspection, so that the plea of immediate emergency requirement may not be advanced to avoid inspection. In 1904 the city of New York passed for supplies 158,400 claims. This gives some indication, considered with the fact that the city buys annually some 23,000 different items, of the enormous field and variety to be covered. In such a bewildering field lack of specialization is a farce, and altho the basis for proper inspection is specification, the training for inspection develops powers of observation, and upon that ability largely depends the value of the inspector.

The total annual supply bill for the city of New York is $15,000,000, summarized as follows:

Fuel	$2,500,000
Food products	1,800,000
Printed books and forms	1,200,000
Forage	1,000,000
Materials of construction	1,000,000
Office equipment	400,000
Pipes, valves and fittings	400,000
Furniture and furnishings	350,000
Vehicles	350,000
Dry goods	250,000
Total	$9,250,000

So that nearly $10,000,000 worth of supplies is purchased under ten classifications.

The departments purchasing the greater amount of supplies are as follows:

Education	$1,500,000
Charities	1,500,000
Water supply	1,000,000
Street cleaning	1,000,000
Docks and ferries	1,000,000
Fire department	700,000
Bellevue	700,000
Health	600,000
Parks	500,000
City Record (which supplies all departments with books, stationery and forms)	750,000
Total	$9,250,000

So that nearly $10,000,000 worth of supplies is purchased by ten departments.

The important qualifications of an inspector are honesty, knowledge, tact, loyalty and industry. The quality of tact is important because of the relations between the purchasing departments and the department having jurisdiction of finances. Honesty is the first desideratum in an inspector, in that the greater his knowledge and ability the greater harm he may do if he is dishonest. Without loyalty to his chief he is almost worthless.

To illustrate extraneous work which may be achieved by an inspector, one or two instances may serve.

A short time ago the corporation counsel wished to purchase sixty-seven new typewriters and exchange seventy old ones, and requested the advice of the comptroller in the transaction. The matter was referred to the division of inspection. The price quoted for the new typewriters was $5,291.66, and the allowance to be made for the seventy old ones was $1,690, leaving a net cost for the transaction of $3,601.66. The division of inspection, after an investigation, put thru the transaction at a net cost of $2,091.46, thus effecting a saving on this one transaction of $1,510.20.

Prior to 1910 the fire department spent $70,000 each year by contract for horseshoeing. A certain inspector recommended the establishment of a traveling blacksmith shop, to be manned by the laborers employed by the fire department, with the result that the fire department has spent on this work since then $36,000 annually, showing an annual saving of $34,000.

The police department since 1912 has undertaken to do its horseshoeing in the same way.

Prior to 1911 the contracts for horseshoeing in the department of street cleaning were made according to the number of horses in the stable, irrespective of how many horses were actually shod. Since then the expense has been incurred only on the basis of the horses actually shod.

Before 1910 the department of street cleaning bought by contract refills for street broom blocks at an annual expense of $30,000. According to the recommendation of the division of inspection this work has been done since then by the penitentiary on Blackwell's Island at an annual cost of $22,000, effecting an annual saving of $8,000.

(b) Laboratory, Physical and Chemical, and Research.

A large proportion of specifications now require tests in a physical or chemical laboratory for supplies for which visual inspection is not adequate. From the list of supplies susceptible to visual inspection, the larger single classification of all, that of fuel, including coal and fuel oil, and amounting to at least two and a half millions a year, must be stricken out. Other supplies must be entirely stricken from the list of those susceptible to visual inspection for the same reason. They are cordage, rope and oakum; drugs and chemicals; paints, oils, varnishes, etc.; rubber goods; seeds, plants, etc.; wire rope and wire. Many other supplies are partly susceptible to visual inspection and partly susceptible to physical or chemical tests. These are: Apparatus (laboratory, etc.); arms and ammunition, etc.; cleaning materials and compounds; dry goods; food products; hospital supplies and surgical supplies; iron, steel and other metals; leather, saddlery, belting, hose; materials for construction; materials for the manufacture of prison goods, and lubricating and illuminating oils. By saying that goods are partly susceptible to visual inspection and partly susceptible to physical and chemical tests, it is meant that the finer distinctions of qualities must be shown by such tests, while the grosser distinctions may be determined by visual inspection.

For example, in the case of dry goods, an inspector well trained in that kind of supply will readily see gross differences in finish, nap, weave or thread count, whereas the test for tensile strength must be left to the physical laboratory. In inspecting dry goods an inspector may justly reject supplies delivered on the basis of the delivery and the requirements of

the standard specifications being so gross as to be apparent to the senses. It is only the finer distinctions of thread count and tensile strength that need be left to the laboratory, but an inpector can make a count test himself.

Thruout the kinds of supplies enumerated as susceptible to both methods of inspection, instances similar to the illustration of dry goods frequently happen. In all instances where the inferiority is so great as to be apparent the inspector can protect the interest of the city and save money without reference to the laboratory. Such supplies as drugs and chemicals, medical and surgical instruments, scientific specimens and equipment for physical and chemical laboratories are unsuitable for visual inspection. These goods are delivered to the various hospitals, almshouses, the City College, Normal College, high schools and the Museum of Natural History.

I remember an occasion when I was sent to the College of the City of New York to inspect repairs made on an instrument for measuring the rate of travel of the sun's rays. I had never seen such an instrument before. I knew nothing of its operation, and still less about the repairs, and whether the instrument, after being repaired, performed its functions properly or not. I offer this as an illustration of the farce of amateur inspection of highly specialized supplies. As the city spends about half a million a year for such supplies, a specialist for such inspection should be able to save the city more than his cost, because such supplies have never before been properly inspected.

(c) *Fruit and Vegetable Inspection Device.*

The old-fashioned method of inspecting fresh frults and vegetables is still in force in the city.

Suppose a truckload of 100 bags of potatoes is delivered. The truck driver throws off one bag from the tail end of the truck, stands it up on its bottom end and cuts the string sewed in the top end; then he topples the bag over flat on the floor and a few potatoes from the top spill out; then he has to take hold of the bottom of the bag and pull it up until the bag is entirely emptied of its contents. A bag of potatoes weighs from 170 to 200 pounds, so that this is heavy work. The same operation is repeated two or three times for two or three more bags to be emptied. If the inspector is in doubt another and another bag must be emptied until he has reached his decision. Please observe that all these bags are taken from the tail end of the truck. When 75 or 100 bags of potatoes are loaded on a truck they are packed so tight that it is practically impossible to pull out the bag in the center, or even bags in random places thruout the load. The knowledge that for inspection bags must be taken from the tail end of the truck offers to unscrupulous dealers the opportunity to place there supplies of good quality and to conceal those of inferior quality elsewhere. Because of this condition it frequently happens that fruits and vegetables are officially accepted by an inspector as of satisfactory quality on the basis of such inspection, and later, upon being used, a larger portion of the remainder, which, on account of the condition described, have not been seen by the inspector, is found to be of decidedly inferior quality.

An invention has recently been made by one inspector engaged in such work to obviate these difficulties. It is an open tray built on a frame on wheels and so designed that its height can be adjusted to that of a truck. This machine is wheeled to the end of the truck and a bag of potatoes placed on a dumpling device and turned over into the open tray, spilling its contents into the hopper. All of the potatoes are seen at a glance, and by releasing a lever catch the inspector allows the hopper to dip and the potatoes to run thru a spout into a bag hung below. The operation does not take more than half a minute and there is no physical labor. Not only can all the potatoes in the bag be seen at a glance, but by the elimination of labor and the reduction of time, all or a large proportion of any delivery of such goods can be seen in a short time.

New Metered Water Rates for Salt Lake City

In the interests of economy and efficiency, the water department of Salt Lake City, Utah, has worked out a new plan for assessing water rates on meters. It was inaugurated about April 1.

Heretofore the meter rates have been: Seven cents per 1,000 gallons for the first 100,000 gallons; 6½ cents for the next 100,000, and 6 cents a thousand for more than 200,000 gallons. This system involved complications, inasmuch as the meters measure the water by cubic feet. Much time and labor was required in the water office to reduce all the bills and notices from cubic feet to gallons and figure the bill to each customer.

Under the new system the rate will be figured in direct ratio to the number of cubic feet of water used thru each meter. The rate will be 5½ cents per 100 cubic feet for the first 13,000 cubic feet; 5 cents per 100 for the second 13,000 cubic feet, and 4½ cents per 100 for all over 26,000 cubic feet. This scale approximates the old as nearly as is practicable.

A saving of $250 a year in the cost of making out bills will be effected under the new system, according to C. F. Barrett, superintendent of water works.

The water department also contemplates the adoption of postal card bills to all consumers, a measure that will save the city $600 in postage during the year.

Asphalt Industry in 1915

The asphalt industry as a whole was prosperous in the year 1915, according to a statement just issued by the United States Geological Survey. The natural asphalt, including grahamite, gilsonite, elaterite and bituminous rock, produced and sold at mines and quarries in the United States in 1915, amounted to 75,751 short tons, valued at $526,490. Though this quantity was 5 per cent less than the output in 1914, the reports of the sales of manufactured asphalt derived from petroleum of domestic origin disclose a gain of 84 per cent over the quantity sold in 1914. The total sales of manufactured asphalt amounted to 664,503 short tons, valued at $4,715,583. In addition to this output, refiners in the United States made and sold 388,318 short tons of asphalt, valued at $3,730,436, that was derived from petroleum imported from Mexico.

The decrease in the output of natural asphalt is confined to bituminous rock and is due largely to the keen competition that this type of asphalt is forced to meet in its chief market—the paving industry—with manufactured substitutes.

Statistics just completed under the supervision of J. D. Northrop, of the Geological Survey, show that of the quantity of manufactured asphalt derived from domestic petroleum in 1915 a total of 417,859 short tons, valued at $2,392,576, was marketed as road asphalt and flux, and 246,644 short tons, valued at $2,323,007, as residual pitch, used chiefly for paving.

The output of the Mexican product in 1915 may therefore be subdivided into road asphalt and flux—174,854 short tons, valued at $1,325,201—and residual pitch—213,464 short tons, valued at $2,405,235.

SETTING WATER METERS

AT TERRE HAUTE, IND.

By Jay A. Cravens, Asst. Supt. of the Terre Haute Water Works Company.

This article shows what can be done when plans are laid in advance and are worked out in proper detail. The Terre Haute Water Works Company petitioned the public service commission of Indiana for a change of rates which would have the effect of greatly increasing the number of meters. In anticipation of the commission's decision the plans were made and the meter boxes were made as described, so that when the decision was rendered establishing the new rates in February the company was ready to begin work at once. The very efficient advertising for which this company is noted increased the applications for meters even more rapidly than had been expected, but the plans were so well laid that every application was taken care of promptly and properly. The engineer in charge of the work supplied the data for the article.

LAST year the Terre Haute Water Works Company decided to set a considerable number of additional water meters in frost-proof outside meter boxes.

The preliminary office work entailed a complete list of all meters to be set, and when compiled showed a total of about 2,250. This was made up by going over the ledgers, selecting all services which did not have purely domestic use, i. e., without sprinkling, or, in other words, those places which did not comply with the new rules in effect February 1, 1916, for flat-rate services. Four sets of lists were prepared, one of which was filed with the Board of Public Works, the board issuing a blanket permit covering all on the list. A remarkable thing about the making up of this list was the popularity of the use of meters, necessitating a daily increase in the number upon our list. Some days as high as thirty to forty signed up meter applications. Each day four lists were made up of the additional ones, one going to the city for the blanket permit, the others being added to our files of lists. At this time letters were sent to all consumers who had sprinkling service only during other years. Other notices were sent to consumers who had not been using water for some time and to other residents who had never used water, but where mains were available. Thru these means and thru the voluntary signing up of people who demanded meters the number on the lists was increased to about 3,000. While the water company, under the new rules, has a right to install meters on all services upon notice, the consumer also has the right to demand a meter. The great increase in the number to be set had a marked effect upon the original plans, due to the using up of all tile and the exhaustion of the number of meters on hand.

During the summer and fall of 1915 the necessary concrete tiles were made at the pumping station. For this purpose eleven forms were used, ten of them for making a tile 15 in. in diameter by 3½ ft. in length and one for tile 18 in. in diameter and 4 ft. in length. The latter form was purchased from H. W. Clark in July, 1911, at a cost of $17.50; the other ten were purchased in three lots from the Ford Meter Box Company, one in May, 1912, at $12.40, four in January, 1914, at $14.88 each, and five in October, 1914, at $12.40 each.

Day labor was used and was paid 20 cents per hour. Portland cement was obtained at $1.98 a barrel delivered, gravel at $1 a yard, and the mixture used was 1 of cement to 3 of fine gravel and sand. While the average number made each day was ten, it was possible in dry weather to remove the forms from the first set and in this way make twenty tiles a day. The average cost of the tiles was about 45 cents each.

The accompanying cut shows the general set-up when installed, the surface of the ground coming flush with the top of the cover. The tile shown in cut is the small size mentioned, 15 in. inside diameter and 3½ ft. long. The metal cover shown is 9 in. high, and at the top 9½ in. outside and 8 in. inside in diameter. Two covers are provided, shown at bottom of cut, one for frost protection (shown flat) and the other the locked top cover (standing). The yoke shown at the top of the risers in the setting makes a rigid connection, no coupling being necessary. For removing it is only necessary to withdraw the wedge shown in cut, the meter then being ready to lift from the well. Washers are used at the inlet and outlet ends on the meter.

The average cost of the yoke or rigid setting for meter and the cover was about $3.75. It must be borne in mind, however, that these materials were contracted for before the advance in prices. The risers shown average about 6 ft. of w. i. galvanized pipe to a setting. The cost of pipe at 7 cents a foot, with four threads at 5 cents each, made the total cost of the pipe about 62 cents; two ells at 5 cents each were used in each setting.

Ten canvas fitters' bags were equipped, each containing one 10 and one 14-in. pipe wrench, one ratchet die, one rasp, one turnpin, one hammer, one oil can, one rule and one pipe cutter.

At first the foreman on the job, with his list of places to be metered, endeavored to look after all the work, and in addition locate the service boxes. This, however, proved too much for him, and before the work had progressed very long it was found best to have all boxes staked off in advance of the diggers. This helped very much in speeding up.

Altho all customers could not be satisfied in setting the meters, everything possible was done toward this end. Where the service box was near a tree or shrubbery the householder was consulted and his wishes were complied with whenever possible. Extra expense was incurred in many places where the meter had to be set a distance away from the service to avoid cutting roots of the trees, the men having strict instructions to avoid injuring them, unless absolutely necessary.

No special arrangement had been made for selecting the men before the work started other than advertising that help would be needed. With the exception of three or four of the regular job men, all were inexperienced on meter setting.

The first two weeks of the work all materials were delivered by the company's truck, the driver, with one helper, looking after this. When the men gained a little more experience, teams had to be obtained to help in delivering to keep up with the work.

The tiles and tops were distributed two or three weeks in advance to advertise and get new customers to come in and sign up contracts for the water.

Three distinct divisions of the work were made: First came the diggers, who uncovered the service pipes; then the meter-setters, who made all the necessary connections, and

then the gang which set the tile and covers and filled in. Slight changes were made in this as the work advanced. It was found that one or two of the laborers could handle the setting of the tile and cover, and the best ones were selected to do this. They were followed up by the men who filled in and cleaned up.

As considerable extra excavated material was left at each site, it was necessary to have one to three teams all the time to haul this away.

The foreman made many changes in the men, as he believed in weeding out the undesirables, which he did right along as fast as he could replace them. In time he had a fairly well balanced gang for the work.

The work was begun on February 24, 1916. The first day 33 meters were set, with a total of 140 hours of labor, the latter not including the foreman's time. The total cost of labor on meter setting was $1.44. This included foreman's time and the truck at $10 a day and one team. It will be noted that the cost per meter the first day was less than the average. On this day, however, the gang was smaller, easier to look after, and included some of the regular shop men accustomed to the work.

Detailed cost of the labor on the setting of meters has been made up for the first two weeks only. On the first full week ending Friday night there were two bad days, on which no work was done. For this week there were 898 working hours and 179 meters were set at an average cost for labor only of $1.68. This does not include overhead charge. On the second week there were five working days and 278 meters were set at an average cost of $1.53. The total number of hours of labor was 1,488. The largest number of meters set in one day was on March 24, and was 135. On 27 days in which the weather and other conditions did not interfere with the work too much between 50 and 100 meters were set each of these days, and on 10 of these days over 100 were set.

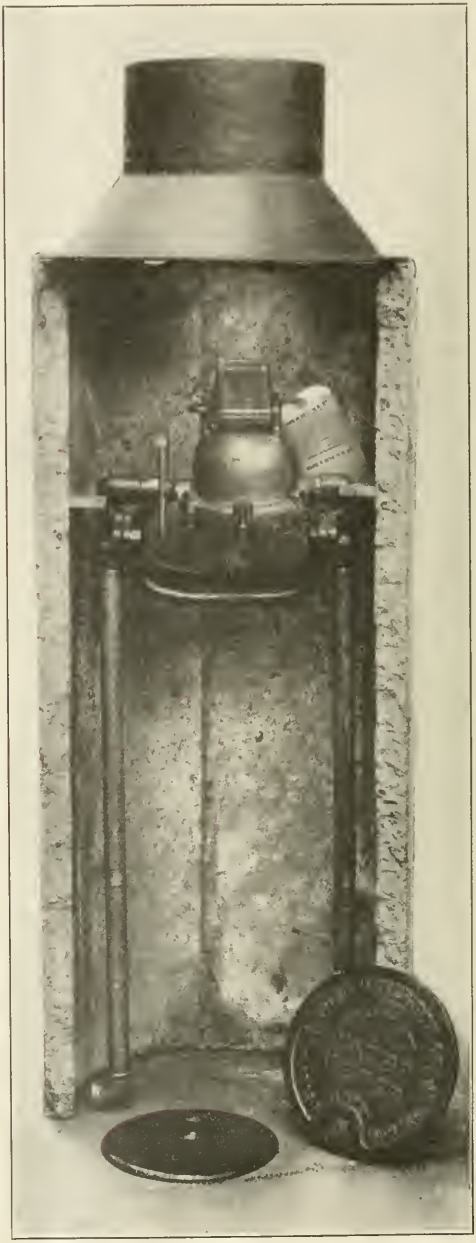
Due to the increased number to be set, we ran short of tiles, and various ways were tried to keep up on them. First, the forms were taken to one of the large concrete manufacturers here and his force turned out as many as possible each day. As it was cold at the time, the work did not progress very fast. As one of the large tile manufacturers is situated near by, we were able to obtain some stock tile which were 15 in. in diameter and 2 ft. in length. At the same time a contract was made with one of the companies to supply us with a special tile 15 in. in diameter by 3 ft. in length. Running short on this material held us up for some time. Delays were also occasioned by difficulty encountered in getting the extra needed number of meters and yokes and covers, due to the manufacturing situation at the time.

The record for the number of meters set in a day was made by one of the men engaged at that time who had no previous experience and was not a pipefitter, his record being 22.

The average cost for meter setting when the large force was working was approximately $7.50, which included all labor and hauling and the material used, with the exception only of the meter. This does not include any overhead.

In considering the cost of setting it must be remembered that the work was begun in the spring of the year and there were many days of rain and snow, which seriously interfered with but did not stop the work. In digging, too, it was necessary to pick thru the frosted ground, which otherwise would have been easy shoveling. On some of the cold nights, where it was necessary to leave holes open, risers and meters were frozen and extra time was required to thaw them out, adding to the cost.

As it was felt that some were missed that should be metered, but could not be detected by the book records, a hurried survey was made one morning after a snowstorm, attention being paid to those using outside fixtures the year round. The results of this inspection increased our list considerably, as at many places tracks in the snow were found leading to several houses in the neighborhood, and the flat rate was being paid only for the residence at which the hydrant was located.



METER BOX AS INSTALLED IN 15-IN. TILE. THE SURFACE OF THE GROUND COMES FLUSH WITH THE TOP OF THE COVER. THE TOP, SHOWN LYING FLAT ON THE GROUND, IS FOR FROST PROTECTION, AND THE ONE STANDING IS THE LOCKED TOP COVER.

METHODS OF CONCRETE SEWER CONSTRUCTION

By J. F. Springer, New York City.

Several varieties of design and construction of concrete sewers are described which, with the photographs, show the adaptability of concrete to such construction, making many economies possible in materials and labor as well as in special forms of construction and of transmission of materials which are not possible with other materials. The descriptions of actual work done make the article specially practical and valuable.

SOME of the characteristics of concrete lend themselves splendidly to sewer construction, but no material is so perfect as to be ideal in all cases. Concrete, in other words, has its faults as well as its advantages. Prominent among its faults are its permeability to water under pressure and its lack of tensile strength. These defects are both of them more or less capable of elimination. Steel reinforcement supplies to some extent a means of combatting tensile weakness and is rather peculiarly fitted for this duty because of the fairly close correspondence of its co-efficient of linear expansion with that of concrete. Permeability may be fought by giving the concrete a maximum density. Unfortunately, density means an increase in the percentage of the most expensive ingredient, portland cement.

Concrete sewers may be built of concrete pipe or as concrete-lined excavation. In both cases the sewer must be strong enough to resist the crushing pressure on its arch of the weight of earth or other load on top of it and pressure in any other direction on account of water in the ground or compressible or movable soil, as well as pressure of water from within in case such pressure is possible for any reason.

In illustration of a portion of the foregoing remarks, may be cited the Stieren street storm sewer at San Antonio, Tex. The main line is made of concrete, some of it being 3½ and some 4 feet in diameter. Part of this line was given a reinforcement of wire mesh, part was not reinforced. Where the reinforcement was used, it weighed about 1 ton to, say, 185 linear feet of conduit. It was bent to shape by workmen using hammers, the resulting section being not a circle, but octagon. Steel forms were employed and the tube was cast in position. The typical section shows a cylindrical shell with a flat horizontal surface where the sewer rests on the soil. The trench in which this pipe was poured varied in depth from 6 to 12 feet. The concrete was similar to that made by the formula 1:2:4, the river gravel containing an excess of sand. Crushed limestone was used to offset this. This ability to use local materials in large part in making the concrete has done much to popularize it for sewer construction.

At Los Angeles, Cal., we have an example of a concrete pipe sewer over 5½ miles long. The pipe in this case was cast in sections above ground and then allowed a period for maturity before being put in final position. The minimum period for maturing was 15 days. Steel forms were employed, and the sections cast were 3 feet in length, whatever the diameter might be. A fairly dense concrete was employed, following the formula 1:2:4. One-half mile or more of the sewer consists of 66-inch pipe, and 5 miles of pipe, varying from 34 to 60 inches in diameter.

The joints were made by means of a cement mortar, 1:2 mixture. Heavy roofing paper or sheet iron was employed on the exterior of the sewer to provide a form for the grout. When all was ready, the grout would be poured from one side until it appeared on the other, when pouring would be completed from the other side. If, for any reason, the grout failed to appear as expected, the joint was dug out and the difficulty was removed. A 3-foot length of 60-inch pipe, having a wall thickness of 6 inches, weighed 3,600 pounds.

At other points along this De la Brea sewer at Los Angeles, the size of conduit required was much greater, 1,240 linear feet having dimensions of 12¾x9 feet, and 1,621 linear feet being somewhat smaller, 10x8 1/3 feet. All of this larger size was constructed of reinforced monolithic concrete. On other sections, monolithic concrete, not reinforced was used for cross-sections of large but varying sizes. Part of the large construction consisted of invert and arch, the latter provided with numerous reinforcing rods.

An interesting instance concerned in the laying of pre-molded concrete shells occurred not long ago in Philadelphia. Two varieties of shell were used, a 36-inch circular shell and an egg-shaped shell, 36x42 inches in dimensions. The pipes

A CONCRETE SEWER HERE DISCHARGES ITS ORDINARY FLOW OF SEWAGE INTO THE CHANNEL TO THE INTERCEPTING SEWER RUNNING OFF TO THE LEFT TOWARD THE SPECTATOR. WHEN SUFFICIENT STORM WATER COMES TO OVERFLOW THE DAM SEEN IN THE FOREGROUND, THE EXCESS RUNS OFF IN THE OVERFLOW SEWER UNDER CONSTRUCTION AT THE RIGHT. NOTE THE REINFORCEMENT IN THE WALLS WHICH WILL BE EXTENDED UP TO RECEIVE A FLAT TOP OR AN ARCH OF CONSIDERABLE RADIUS OVER THE WIDE SPACE AT THIS SEPARATION OF THE WATERS. NOTE THE METHOD OF SUPPORTING THE EXISTING VITRIFIED PIPE LINE DURING THE CONSTRUCTION OF THE NEW SEWER.

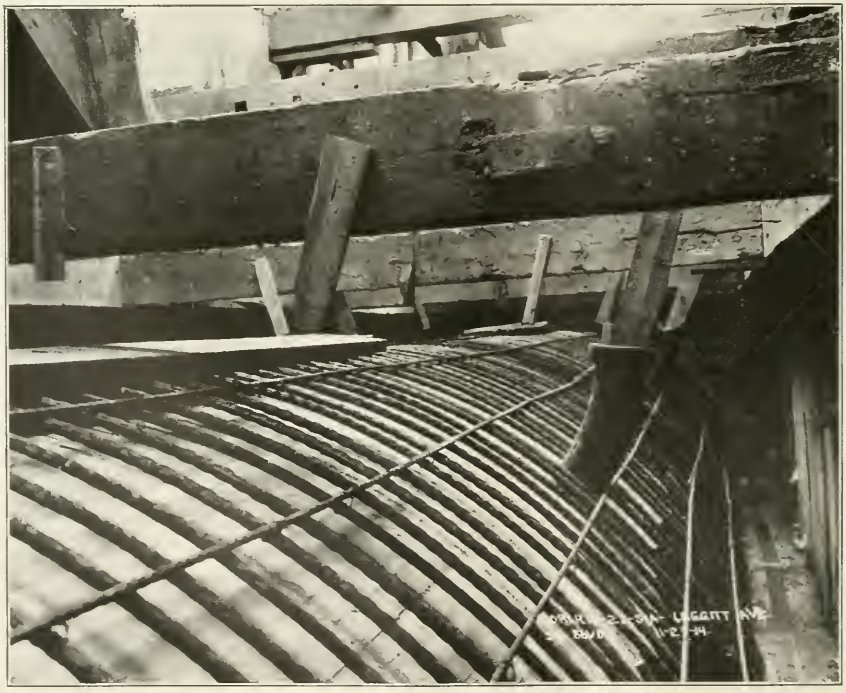
were in general made in short lengths of 4 feet each. The circular shell had a wall thickness of 4 inches. Triangular steel mesh was used for reinforcement. It was set concentric with the shell and $1\frac{3}{4}$ inches back of the interior surface. Similar mesh similarly placed was used in connection with the egg-shaped sections.

The forms were of metal and consisted of two cast-iron rings for top and bottom of the pipe length and of two sheet-steel shells for the body. Clamps and bolts held all together. The inner shell was provided with a horizontal shoulder formed of angle bar, upon which was placed a thin steel disc. This disc closed the interior of the mold and served as a table from which concrete might be worked into the form. The mode of providing for the projecting steel mesh at the socket end was as follows: The cast-iron ring for the socket end was laid on the working surface and the inner shell of the form put in place. A slot was provided in the cast-iron ring of such dimensions as to make it a convenient receptacle for the projecting reinforcement. The piece of mesh was now set in place in the slot and the latter was filled up with sand. The purpose of the sand was to prevent the entrance of concrete when the pipe was cast. The cylindrical shell of mesh was in one piece, being made from fabric wide enough for one length of pipe. One roll of the material weighed about 450 pounds.

The socket and spigot ends had such forms as would be produced by counter-boring in the one case and exterior recessing in the other, and when put together the continuity of the inner cylindrical surface was not interrupted. When the joint was prepared, the two parts fitted together with the projecting reinforcement between them. A hole was provided at the top thru which grout might be poured. In this way the upper part of the joint was sealed and reinforcement included in it.

The aggregate used in the concrete was made in proportions 1:2:4 from gravel or sand and trap rock crushed to a size varying from $\frac{1}{4}$ to $\frac{3}{4}$ in. The concrete was mixed rather wet so that it flowed readily into the form. It was put in place by an experienced man armed with a spade made from a steel plate which had been curved a trifle. The effective handle was about 7 ft. long. In spite of every effort in placing, air holes would sometimes form on the surface of the pipe. Paraffin oil was used on the forms to prevent adhesion of the concrete.

CIRCULAR ARCH AND INVERT WITH DIFFERENT RADII AND A LOW VERTICAL WALL BETWEEN, AS USED IN NEW YORK. FORMS WITH WOODEN RIBS, BRACES AND LAGGING WERE USED IN THIS CONSTRUCTION.



OUTSIDE OF FORMS USED IN CONSTRUCTING THE SEWER SHOWN IN THE PRECEDING PHOTOGRAPHS, SHOWING THE WOODEN LAGGING, THE DEFORMED BAR REINFORCEMENT, CIRCUMFERENTIAL AND LONGITUDINAL, THE METHOD OF HOLDING HOUSE-CONNECTION PIPES IN PLACE UNTIL CONCRETE IS POURED AND SET, AND THE TRENCH BRACING.

CIRCULAR ARCH AND CIRCULAR INVERT OF LARGE RADIUS. DESIGN USED IN THE NEW SEWER CONSTRUCTED IN CONNECTION WITH THE FOUNDING OF THE UNION DEPOT BUILDINGS IN CHICAGO. PRESSED STEEL RIBS ARE USED IN THE FORMS AND WOODEN PANELS COVERED WITH SHEET STEEL FOR LAGGING.

Some trouble was nevertheless experienced. A 12-hour vapor bath was tried, but some doubt had been expressed as to the desirability of using this remedy, because of the considerable difference in temperature between top and bottom.

The trenches were excavated about 1 ft. wider than the pipes. The depth was carried to a level about 3 in. lower than the point determined for the bottom of the sewer. Instead of resting the concrete shells directly on the soil a concrete cradle of 1:3:4 mixture was provided. The cradle was broad enough to provide a curved rest 12 in. deep. How to seat the pipe on the cradle seems to have required experimentation. After some trial, the method adopted required the concrete cradle to be brought up to within about $\frac{1}{2}$ in. of the proper level

A DESIGN USED IN NEW YORK INVOLVING A CIRCULAR INVERT WITH LARGE RADIUS, VERTICAL SIDE-WALLS AND FLAT SLAB TOP. THE CLEAR MARKS OF BOARDS AND NAILS SHOW THAT WOODEN FORMS WERE USED HERE ALSO.

ot the bottom of pipe. Three days or more were allowed for hardening. When all was ready for actually setting the pipe, a mortar was spread to the depth of $\frac{5}{8}$ in. and the pipe was settled upon it. The making of the joint then followed, whereupon the cradle was brought up to its required height.

The making of the joint was effected "by first overlapping the reinforcement projecting into the socket and pressing it into position, then applying a stiff mortar to the lower half of the socket from the inside of the pipe, and grouting the upper half from the outside thru the pouring hole at the top. The mortar was pressed thru the reinforcing until the lower half of the socket was completely filled, when it was troweled to a smooth finish; a steel band 6 in. in width was then sprung around the entire interior of the pipe and keyed tight to prevent the escape of the grout, the exterior being sealed with a coat of stiff mortar covering the joint on the entire upper half of the pipe and extending about 12 inches below its center. While the grout was being poured a heavy steel wire was worked in the joint to prevent choking and to expel the air. This was continued until the joint was completely filled and the grout was brought to the top of the pouring hole. The steel band was removed in 24 hours and the joint smoothed to a finish on a plane with the interior surface of the pipe." Both the mortar and the grout followed the formula 1:2.

As to relative cost of such sewers as compared with brick, it is interesting to note that several years prior to actual construction, but at a time when labor and material costs were about the same, bids were received for brick construction. The lowest bid for the circular 36-in. sewer was $7.95 per lin. ft. The lowest bid for concrete, the concrete bids being re-

A SECTION OF MILL CREEK SEWER, ST. LOUIS, MO., WHERE THE SEWER HAS A SEMI-CIRCULAR ARCH, VERTICAL SIDE-WALLS AND AN INVERT WHICH IS ALMOST FLAT. STEEL FORMS SEEM TO HAVE BEEN USED IN THIS CASE. THE WATER STANDING ON THE BOTTOM MAKES IT DIFFICULT TO SEE THE DESIGN AS IT REALLY IS. THIS SECTION OF THE SEWER IS A ROCK TUNNEL LINED WITH CONCRETE WHICH WAS PLACED BY COMPRESSED AIR.

ceived presumably about the time of construction, was $5.10 per lin. ft. of sewer. Here is a very substantial difference. However, for the egg-shaped construction, the lowest bids were about the same, the brick having a slight advantage. The prices included excavation, backfilling and repairing.

It is considered to be a bad condition when a reinforced concrete sewer develops any kind of cracks, even those as thin as hairs. There is then danger that the reinforcement will suffer corrosion. It should be remembered that the relation between concrete and steel is a two-fold one. The steel is there to furnish tensile strength; the concrete has the duty of protecting the steel. It is valuable then to know that experiments carried out for the benefit of the city of Philadelphia showed that a concrete cradle provided a much better support for reinforced concrete pipe than a bed of sand. The experiments coverd both circular and egg-shaped shells, the latter having a flat base. The superiority was observed for both types, but was more pronounced in the case of the circular pipe. The loading against which protection was sought was similar to that of a backfill.

As to permeability—that is, liability to leakage—if concrete is properly made and in accordance with the formula, 1:2:3½, no trouble should ensue for pressures amounting to 5 pounds per sq. in. That is, a constant head of ground water of 11 ft. is permissible. It was brought out in the permeability tests at Philadelphia that pressure on freshly poured concrete promotes water-tightness. The parts of the shells which constituted the upper halves when in the forms were found more permeable than the other parts. My suggestion, growing out of this, is to the effect that the forms should be so made as to make it possible to put the whole shell under pressure during the early period.

The Philadelphia experiments are thought to warrant placing the reinforcement (wire mesh) close to the inner face of the sewer. This remark is to be understood as applicable to circular sewer pipes 3 ft. or less in diameter and to egg-shaped pipe whose greatest diameter is no larger than 3 ft. The typical thickness of concrete over the mesh on the interior was 1¼ in. With reference particularly to the question whether this amount of concrete is sufficient to protect the

AN EGG-SHAPED SEWER LAID ALONGSIDE THE SUBWAY CONSTRUCTION IN SEVENTH AVENUE, MANHATTAN BORO, NEW YORK CITY, OF REINFORCED MONOLITHIC CONCRETE. THE MASSIVE CHARACTER OF THE STRUCTURE AND THE ELABORATE PROVISIONS FOR A WATER-TIGHT JOINT WHEN THE SEWER IS EXTENDED ARE CLEARLY SHOWN IN THE PHOTOGRAPH, ALSO THE NATURE OF THE FOUNDATION CONSTRUCTED FOR IT. WOODEN LAGGING WAS EVIDENTLY USED IN THE FORMS.

steel itself, may be cited ¼-in. square bars in the City Hall pavement at Philadelphia. Such bars were placed 1 or 1¼ in. from the surface. A piece of such rod buried 1¼ in. was examined, after 19 years of service, by Mr. E. G. Perrott, who states that there was "no evidence of corrosion or rust of any kind." However, too much reliance must not be placed upon one or two instances.

The Philadelphia experimentation developed that it required an internal hydraulic pressure of 25 pounds per sq. in. to crack the pipe (36-in. circular). This is equivalent to a head of 57 or 58 ft.

Some of the pipe tested at Philadelphia was given a hot vapor bath for about 12 hours, the temperature ranging around 100 degrees. This procedure is advantageous to the contractor because it permits the forms to be removed the day after pouring. Furthermore, concrete set under these conditions could be placed readily in very cold weather. However, the advantage to the purchaser was scarcely proved. It seems that pipe cured by this process gave rather erratic results under test. A steady increase of strength with age, as is the case with concrete ordinarily cured, was not to be depended upon. Some doubt must therefore follow this procedure.

Seattle has put in some 21 miles of sewers in recent years. On one section something over 2 miles long, brick and concrete have been used in conjunction. The cross-section is a circular one, 12 ft. in diameter. This big conduit is largely an example of tunnel construction. The arch is brick and the invert concrete.

Chicago is building a big intercepting sewer in the southern part of the city. It will be 10 miles long and cost some $3,800,000. A horseshoe section has been adopted. A mile and a half of the sewer runs mostly thru a section where the ground is low and swampy. A stiff blue clay lies beneath the upper layer. The section of the sewer in this district is 13x10.4 ft. Monolithic concrete is the material.

The general mode of procedure was as follows: A concrete mixer with a steam engine and boiler shifts upon a track along one side of the trench. Dump cars bring up the material, each car having on board just about the right amount for one charge into the ¾-yd. mixer. A charging hopper is swung down to receive the materials from a car. When the concrete has been mixed, it is chuted to the point of use. The chute has two hinged sections which may be successively thrown up to shorten it. Naturally, the long chute is used when delivery has to be made low down in the trench, and the shorter lengths as the placing rises to the top of the arch. The contractor used wooden forms for the arch at the beginning, but later on used a type of form which consists of steel ribs and wooden panels, the latter being faced with steel sheeting. With the steel forms, the short length of sewer is poured in two operations. First, the invert is cast, wooden forms being employed. Then, the side and arch forms are put in place and the pouring is carried to completion. A 24-hour interval is allowed the invert for setting before the second operation is begun.

At St. Louis, the Mill Creek sewer is a notable piece of concrete construction. The section is in general a horseshoe standing on a rather flat invert. Exteriorly, the side walls are vertical. On the interior, however, the typical open-cut section has inclined sides, the widest part of the interior being about half-way between top and bottom. The exterior sides also incline in the same direction when the rock extends above the springing line. The material is, in general, reinforced monolithic concrete. This sewer is a big one, a typical section being 16½x16½ ft.

A part of the sewer is in tunnel, nearly the whole of this section having vertical side walls and circular arch. The concrete here is specified to be such that the fine aggregate has one-half the volume of the coarse aggregate. To every 4½ cu. ft. of coarse aggregate, 94 pounds of cement are required.

JUNCTION OF HORSESHOE SHAPED SEWER, ON THE LEFT, WITH A CIRCULAR SEWER, ON THE RIGHT. CONCRETE IS SPECIALLY ADAPTABLE TO SUCH CONSTRUCTIONS AS THIS, AS THE POSSIBILITY OF MAKING VERTICAL WALKS AND FLAT ROOFS RENDERS UNNECESSARY THE BELL-MOUTH ARCH INTERSECTIONS SO NECESSARY AND SO DIFFICULT TO DESIGN AND CONSTRUCT IN MANY PLACES WHEN BRICK OR STONE IS THE STRUCTURAL MATERIAL USED.

A good deal of concrete placed at St. Louis, especially in the tunnel portion, was put in position by compressed air. The materials were dropped down thru vertical holes connecting the excavation with the surface. They were received in a hopper which stood over the mixer. The mixing apparatus consisted of a single chamber tapering underneath to about the size of the transmission pipe. At the top, this mixer had a door opening downward—that is, inward. All the materials, including water, were put in thru this door, whereupon it was closed. The interior of the mixing chamber was not provided with paddles or other mechanical devices for mixing. In fact, the mixing of the materials was accomplished by manipulating two jets of compressed air which discharged when desired into the chamber. One jet was located at the top, the other at the bottom. The lower jet was directed horizontally and was located at the elbow of the discharge tube. Part, perhaps a considerable part, of the mixing was probably accomplished in the transmission pipe immediately after discharge from the mixing chamber. After the charge was jostled by the jets, it was shot off thru the transmission piping.

The pipe line for this system may be added to at will until it is 900 or 1,000 ft. long. In the present case, it seemed convenient or desirable to use about this length, the concrete being carried along the tunnel in one direction up to the maximum length of the pipe line and then in the other direction up to the maximum length. In this way about 1,900 ft. of tunnel could be dealt with from one position of the mixer. Turns could be made readily, provided only that they were not too sharp and that the interior surface was normally smooth. The turns might lie in any plane—horizontal, vertical or oblique. The size of the transmission line used at St. Louis was, if I am not mistaken, 8 in. in diameter. A somewhat smaller size may be used, but the maximum size of coarse aggregate then permitted is reduced. In transmitting it is important not to let the pipe get full of concrete anywhere. An experienced man, it is understood, has no real trouble. The air pressure during mixing may be used in one or the other jet up to 80 pounds or even more. In actual transmission, the pressure may be cut in two after the initial dislodgement is effected. The concrete often or generally travels at the rate of 50 ft. per second in this system, so that tamping is unnecessary. It is especially suitable for placing concrete overhead, as gravitation is overcome by the drive of the air. It is not necessary that the concrete be especially wet. Naturally, one will select pipe having a smooth interior and which may readily be connected up. Lap-welded, merchant steel pipe with flanges welded on would appear to be nearly ideal. A pipe-line system such as this has a strong appeal in connection with sewer work, especially where the sewer is a small bore tunnel. The pipe affords a very compact means of transporting the concrete. It is easily lengthened and may be used again and again.

There is another system of placing concrete which is coming into notice and which has its strong points in sewer construction. This is a system which uses a special mixer and atomizer and transmits, like the compressed-air system, thru a pipe line, but uses superheated steam as the driving power. It has been used on tunnel work in connection with two old stone-lined water conduits for whose maintenance the Delaware, Lackawanna & Western R. R. is responsible.

The Public Service Commission of the First District, New York State, exercises in New York City, amongst other duties, a supervision of certain sewer construction. Four of the accompanying photographs show examples of concrete construction carried out under their care.

STREET CLEANING IN NEW YORK

John T. Fetherston, commissioner of street cleaning of New York, under the mayor of the city, is the first such commissioner the city has ever had who was experienced in the actual cleaning of streets. He has the highest executive ability of any commissioner in the history of Manhattan boro except Col. George E. Waring, which has been demonstrated in the thoro manner in which the problem of snow removal has been solved and the comparatively low cost at which this work has been done for heavy snowfalls, as compared with former records of completeness, speed and cost of removal. His work in this line has been described in recent numbers of MUNICIPAL ENGINEERING.

There are several obstacles in the way of the highest efficiency and economy in carrying out the work of the department, and Mr. Fetherston has obtained from Richard T. Fox a full report after a thoro investigation of his work and the conditions under which it is done, with recommendations of a plan for installing a model street cleaning district in Manhattan boro to serve as an object lesson on street cleaning methods and results on which to base extensions of the system thruout the city, as well as to serve as a ground for experiments in new machinery and methods.

Mr. Fox was for seven years prior to 1902 connected with the department in various capacities, and has for some years been in executive charge of the Citizens' Street Cleaning Bureau of Chicago.

Mr. Fox gives a brief history of the New York street cleaning department, showing its close connection, with but one or two exceptions, with the political machinery in the city and the consequent comparative inefficiency of many of its 7,000 employes, contrasting this with the independent administration of Colonel Waring, who was able to produce far better results with very little increase in cost, because he could employ competent men, discharge incompetents and develop a system and an esprit de corps which produced co-operation and a desire of each man to do his full duty. The removal of this handicap from Mr. Fetherston's department is strongly recommended. Another difficulty is the necessity under the present financial plans of the city for estimating months in advance the various items of expenditure that detailed appropriations may be made. It is evidently impossible to do this accurately in a business which depends so much upon the weather and the varying conditions of traffic, building operations and street repairs.

Detailed recommendations as to the establishment of the model district are made and studies of methods developed by Mr. Fox in his Chicago organization are given in great detail.

In brief, Mr. Fox favors the hand cleaning of streets with brush and pan, each man patrolling the area of his district rapidly enough so that each dropping of dirt can be picked up within fifteen minutes, thus preventing drying and plastering over the surface as much as possible. He includes sidewalks in the street area for cleaning. This hand work is supplemented by flushing with pneumatic or pumping motor flushers at night to remove the fine dust not touched by the brooms.

The standard of cleanliness is one very difficult to define, but Mr. Fox has defined it as above for Chicago, and shows that it is higher than the standard in New York and removes 50 per cent. more dirt.

The large cities will doubtless long have much horse traffic, tho the percentage of automobile traffic has vastly increased. As the use of the horse on city streets is reduced the street cleaning problem will become less complicated and will more nearly approach a condition of police regulation of littering the streets

SOME COMPARATIVE TESTS

OF THE WEARING QUALITIES OF PAVING BRICKS, CONCRETE, MORTAR AND NEAT CEMENT

By F. L. Roman, Testing Engineer, Illinois State Highway Department.

THERE are at present very few data on which to base reliable estimates as to the relative length of life of concrete and brick pavements, when the wearing qualities of the materials alone are considered. The following experiments, while in no way conclusive as to the comparative value of brick and concrete pavements, have brought out a number of interesting facts in regard to the comparative wear of brick and concrete blocks, and also as to the comparative wearing qualities of neat cement, mortar and concrete.

It should be kept in mind, however, thruout the following discussion, that concrete in a pavement is, with the exception of the joints, in a continuous slab, and will therefore show much better wearing qualities, as compared to a brick pavement, than comparative tests of concrete blocks and paving bricks would indicate.

Description of Tests.

The experiment consisted of preparing blocks of concrete, mortar and cement of a standard paving brick size (3½ by 4 by 8½ in.) and submitting them, when 90 days old, to the rattler test for paving brick.

The same cement was used in the preparation of all of the blocks, and the same sand was used in the mortar and concrete blocks. The analysis of the materials is given in the last portion of this paper.

The quantity of water used was such as to give a cement paste of normal consistency for the cement blocks, and such as to give mortar and concrete which could be floated without tamping, but which were not so wet that they would flow readily.

The mortar blocks were made of 1 part cement and 2 parts sand, and the concrete blocks of 1 part cement, 2 parts sand and 3½ parts gravel or crushed stone. All measurements were by weight.

The blocks were kept under wet sacks for one week and after this period they were sprinkled with water once a week. The blocks were all tested in the rattler at the age of approximately 90 days, after they had been air dried for one week.

The rattler used was a standard paving brick rattler as recommended by the National Paving Brick Manufacturers' Association, rotated at the rate of 30 revolutions per minute.

Ten blocks were taken for each test and a standard charge of 300 pounds of cast iron shot used. In order to follow closely the effect of this abrasion test, all the blocks were submitted to repeated rattler tests of 900 revolutions each. Ten paving bricks, representing five brands of blocks used on State Aid roads in Illinois, were submitted to a similar test. Each block was marked in such a way that it could be identified during the entire experiment.

Results of Tests.

The neat cement blocks chipped so badly in the rattler that they could not be identified at the end of 900 revolutions. The average loss of these blocks was 42.9 per cent. It should be noted, however, that this loss was due mainly to chipping and not to actual wear of the surfaces, as some of the blocks when taken out of the rattler were showing practically no wear on some of the faces.

The results of the rattler tests on the mortar blocks, concrete blocks and paving bricks are shown in Tables 1 and 2 respectively. Crushed stone was used as the coarse aggregate in the concrete blocks marked 1 to 5, inclusive, while gravel was used as the coarse aggregate in the concrete blocks marked 6 to 10, inclusive.

TABLE No. 1.

Showing losses of blocks in per cent by weight in last 900 revolutions:

Revolutions of Rattler	900	1800	2700	3600
Mortar Block No. 1	22.0	22.8	22.0	24.8
Mortar Block No. 2	22.6	21.8	21.0	24.4
Mortar Block No. 3	23.0	23.8	22.1	26.7
Mortar Block No. 4	23.1	23.2	22.2	26.3
Mortar Block, No. 5	24.2	24.4	23.1	28.0
Mortar Block No. 6	21.2	21.1	20.0	22.9
Mortar Block No. 7	20.6	21.1	19.9	23.4
Mortar Block No. 8	22.8	24.3	23.0	26.6
Mortar Block No. 9	25.5	26.8	25.6	31.6
Mortar Block No. 10	27.0	28.6	28.4	34.5
Average per cent loss of mortar blocks	23.2	23.8	22.7	26.9
Concrete Block No. 1	34.4	30.2	55.4	
Concrete Block No. 2	34.3	31.7	40.8	
Concrete Block No. 3	39.5	37.2	39.2	
Concrete Block No. 4	38.1	36.7	45.2	
Concrete Block No. 5	41.3	37.8	15.9	
Concrete Block No. 6	34.5	24.2	23.6	
Concrete Block No. 7	42.9	35.6	broken	
Concrete Block No. 8	32.0	26.0	30.8	
Concrete Block No. 9	36.2	28.3	34.4	
Concrete Block No. 10	32.2	27.3	29.2	
Average per cent loss of concrete blocks	36.6	31.5	34.9	
Average per cent loss of crushed stone concrete blocks, 1 to 5 inclusive	37.5	34.7	39.3	
Average per cent loss of gravel concrete blocks, 6 to 10 inclusive	35.7	28.3	29.5	
Paving Brick D No. 1	12.4	6.1	6.5	7.1
Paving Brick D No. 2	11.8	5.2	4.8	4.3
Paving Brick P No. 3	16.4	9.3	6.8	6.8
Paving Brick P No. 4	15.2	7.8	7.5	4.2
Paving Brick A No. 5	12.1	6.2	6.1	5.1
Paving Brick A No. 6	12.1	11.6	9.3	9.3
Paving Brick S No. 7	11.3	broken		
Paving Brick S No. 8	16.5	5.9	6.7	4.8
Paving Brick B No. 9	16.5	9.0	9.4	10.7
Paving Brick B No. 10	12.3	9.0	5.2	5.2
Average per cent loss of paving bricks	13.7	7.8	6.9	6.4

Note—D No. 1, and D No. 2, Danville Blocks; P No. 3 and P. No. 4, Poston Pavers; A No. 5, and A No. 6, Albion Shale Blocks; S No. 7, and S No. 8, Springfield Blocks; B. No. 9, and B No. 10, Barr Blocks.

FIG. 1. CONDITION OF VARIOUS BLOCKS BEFORE AND AFTER RATTLER TEST, 1,800 REVOLUTIONS.

1, NEAT CEMENT BLOCK; 2, MORTAR BLOCK; 3, GRAVEL CONCRETE BLOCK; 4, CRUSHED STONE CONCRETE BLOCK; 5, PAVING BRICK.

TABLE NO. 2.

Showing total losses in per cent by weight of blocks:

Revolutions of Rattler	900	1800	2700	3600
Mortar Block No. 1	22.0	39.7	53.0	64.7
Mortar Block No. 2	22.6	39.6	52.3	63.9
Mortar Block No. 3	23.0	41.2	54.2	66.5
Mortar Block No. 4	23.1	40.8	54.1	66.2
Mortar Block No. 5	24.2	42.5	55.8	68.3
Mortar Block No. 6	21.2	37.8	50.3	61.7
Mortar Block No. 7	20.2	37.5	49.8	61.7
Mortar Block No. 8	22.8	41.5	55.0	66.9
Mortar Block No. 9	25.5	45.6	59.4	72.3
Mortar Block No. 10	27.0	47.8	62.7	75.5
Average per cent loss of mortar blocks	23.2	41.4	54.7	66.8
Concrete Block No. 1	34.4	54.2	79.5	
Concrete Block No. 2	34.3	55.2	73.5	
Concrete Block No. 3	39.5	61.9	76.9	
Concrete Block No. 4	38.1	60.8	78.5	
Concrete Block No. 5	41.3	63.4	69.2	
Concrete Block No. 6	34.5	50.4	62.0	
Concrete Block No. 7	42.9	63.3	broken	
Concrete Block No. 8	32.0	49.7	65.2	
Concrete Block No. 8	32.0	49.7	65.2	
Concrete Block No. 9	36.2	54.2	70.0	
Concrete Block No. 10	32.2	50.7	65.1	
Average per cent loss of concrete blocks	36.5	56.4	71.1	
Average per cent loss of crushed stone concrete blocks 1 to 5 inclusive	37.5	59.1	75.5	
Average per cent loss of gravel concrete blocks 6 to 10 inclusive	35.7	53.7	65.6	
Paving Brick D No. 1	12.4	17.8	23.1	28.5
Paving Brick D No. 2	11.8	16.4	20.5	24.0
Paving Brick P No. 3	16.4	24.2	29.4	34.2
Paving Brick P No. 4	15.2	21.8	27.6	30.7
Paving Brick A No. 5	12.1	17.6	22.6	26.6
Paving Brick A No. 6	12.1	22.2	29.7	36.1
Paving Brick S No. 7	11.3	broken		
Paving Brick S No. 8	16.5	21.4	26.7	30.3
Paving Brick B No. 9	16.5	24.1	31.2	38.6
Paving Brick B No. 10	12.3	20.2	24.7	28.3
Average per cent loss of paving bricks	13.7	20.6	26.2	30.8

Note—D No. 1, and D No. 2 ,Danville Blocks; P No. 3, and P No. 4, Poston Pavers; A No. 5, and A No. 6, Albion Shale Blocks; S No. 7, and S No. 8, Springfield Blocks; B No. 9 and B No. 10, Barr Blocks.

When a block broke in the rattler, the weighing of the pieces was not undertaken, but they were retained in the charge. The condition of the various blocks, after 1,800 revolutions in the rattler, is illustrated in Fig. 1 and Fig. 2. The samples of these blocks are numbered in the following order on all the photographs:

1, Neat cement block; 2, Mortar block; 3, Gravel concrete block; 4, Crushed stone concrete block; 5, Paving brick.

The mortar blocks wore very uniformly, as shown in Tables 1 and 2. This is illustrated somewhat better by Fig. 3, which shows the mortar blocks after they had been submitted to 3,600 revolutions of the rattler.

The gravel concrete blocks show a somewhat more irregular surface than the crushed stone concrete blocks. The mortar

FIG. 2. ABOVE: CEMENT MORTAR AND CONCRETE BLOCKS. BELOW: BRICK BLOCKS, NUMBERS SAME AS FOR FIG. 1.

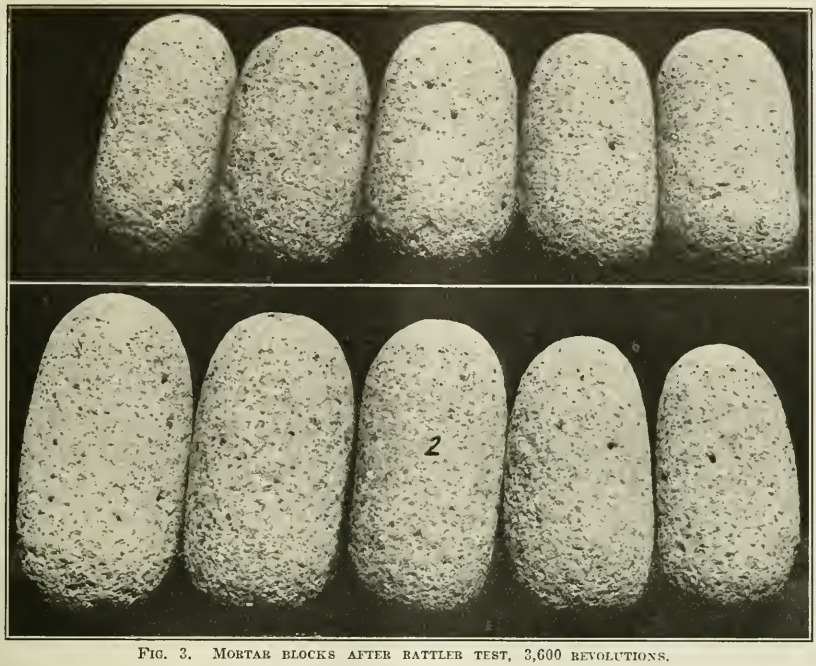


FIG. 3. MORTAR BLOCKS AFTER RATTLER TEST, 3,600 REVOLUTIONS.

blocks were, however, by far the best blocks tested, outside of the bricks. While their loss in the rattler was larger than that of the paving bricks, they remained more uniworm in size and appearance and did not tend to break and chip like the paving bricks. These qualities of the mortar blocks were checked by rattling a second charge of ten blocks, a sample of which is shown in Fig. 1. None of these blocks broke in the rattler or showed any signs of chipping. The comparative wearing qualities of the paving bricks and various kinds of blocks are well illustrated by the curves of Fig. 5 and Fig. 6.

Conclusions.

While no definite conclusions can be drawn from these tests as to the relative wearing qualities of brick and concrete, yet the results obtained appear to bring out the following facts which have a bearing on concrete road construction:

1. The advisability of using rather small aggregates in one-course concrete road construction. This will tend to insure more uniform wear and a smoother surface.

2. The apparent advantage as far as wearing qualities are concerned, of the two-course method in concrete road construction. A rich mortar or fine aggregate concrete could thus be used for the surface course, insuring much better wearing qualities. At the same time, a lean concrete, or aggregates of rather poor quality, could be used for the lower course and the resulting cost of the road would probably be less than the cost of the one-course concrete pavement, as built at the present time.

3. The disadvantage of using a very wet concrete or of excessive floating of the concrete, both of which have the effect of bringing to the surface of the road a layer of neat cement. The above tests show that neat cement will not stand impact and will rapidly be worn off under traffic. It seems probable that some of the depressions which form on concrete pavements are due to the wearing of neat cement as well as to the formation of stone pockets.

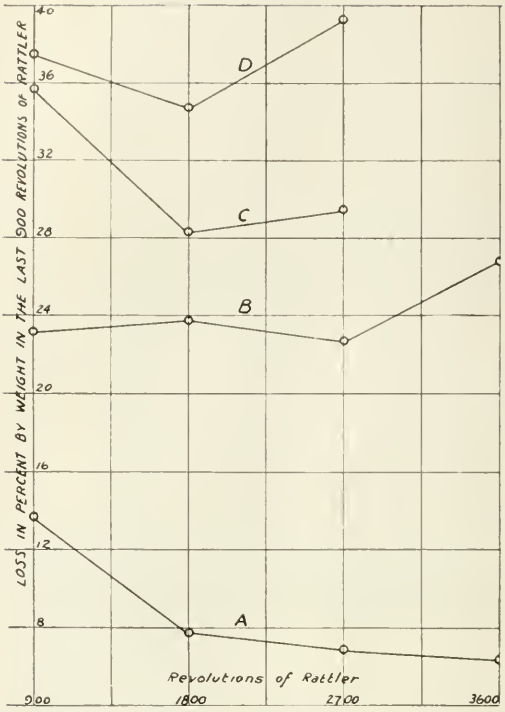
Materials.

The following materials were used in the tests described:

Cement—The same cement was used in all the blocks. It consisted of a portland cement of good quality, meeting the requirements of the specifications of the American Society for Testing Materials and showing the following analysis:

Specific Gravity	3.16
Fineness:	
Retained on No. 100 sieve	4.5%
Retained on No. 200 sieve	23.3%
Time of Setting (Vicat Needle):	
Initial Set	4 hrs. 30 min.
Final set	7 hrs.
Water required for paste of normal consistency	23%
Soundness Tests:	
Accelerated Test	good
Normal Test	good
Tensile Strength:	
24 hr. neat briquettes	305 lbs.
7 day neat briquettes	703 lbs.
28 day neat briquettes	834 lbs.
7 day sand briquettes	317 lbs.
28 day sand briquettes	367 lbs.
Chemical Tests:	
Sulphuric anhydride	1.48%
Loss on ignition	2.00%
Insoluble residue	0.20%

Sand—The same sand was used for the mortar blocks and the concrete blocks. It consisted of a material representing approximately the average sand used for concrete roads in Illinois. The fine sand passing the 1/20-inch sieve consisted largely of quartz, while the coarse grains from ¼ to 1/20 were mainly limestone and trap rock with a small per cent of soft materials, such as ochre, slate, etc. The results of tests of this sand were the following:



CURVES SHOWING TOTAL LOSS IN PER CENT BY WEIGHT OF PAVING BRICKS, MORTAR BLOCKS AND CONCRETE BLOCKS SUBMITTED TO REPEATED RATTLER TESTS OF 900 REVOLUTIONS.

A—Average loss of five brands of paving bricks.
B—Average loss of 1-2 mortar blocks.
C—Average loss of 1-2-3½ gravel concrete blocks.
D—Average loss of 1-2-3½ crushed stone concrete blocks.

Sieve Analysis:

Passing 1/4 -in. sieve	97%
Passing 1/8 -in. sieve	83%
Passing 1/10 -in. sieve	77%
Passing 1/16 -in. sieve	62%
Passing 1/20 -in. sieve	54%
Passing 1/30 -in. sieve	27%
Passing 1/40 -in. sieve	14%
Passing 1/50 -in. sieve	4%
Passing 1/100-in. sieve	2%
Clay in Sand	1.2%
Wearing Test: Per cent of wear	3.4

Tensile Strength:

7 day, 1-3 mortar.....116% of Standard Ottawa Sand
28 day, 1-3 mortar.....119% of Standard Ottawa Sand
90 day, 1-3 mortar.....129% of Standard Ottawa Sand

Crushed Stone—The crushed stone used in the concrete blocks No. 1 to No. 5, inclusive, represents approximately the average stone available for concrete roads in Illinois. It was graded as follows:

Passing 1½-in. sieve	100%
Passing 1¼-in. sieve	97%
Passing 1 -in. sieve	74%
Passing ¾-in. sieve	56%
Passing ½-in. sieve	27%
Passing ¼-in. sieve	2%

The physical tests of the average rock in the quarry from which the above crushed stone was obtained, are given below:

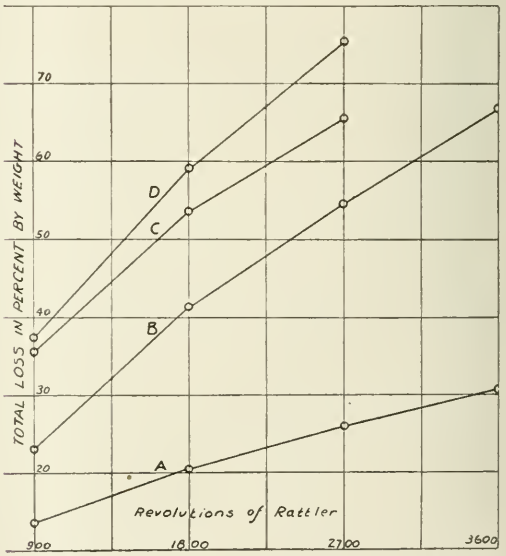
Specific gravity	2.65
Weight per cu. ft.	165 lbs.
Water absorbed per cu. ft.	2.33 lbs.
Per cent of wear	4.7
French coefficient of wear	8.5
Toughness	7

Gravel—The gravel used in the concrete blocks No. 6 to No. 10, inclusive, was a mixed product consisting mainly of limestone, trap and chert, with a very small per cent of ochre, slate and other soft pebbles. Its granulometric analysis and per cent of wear were as follows:

Sieve Analysis:

Passing 1½-in. sieve	100%
Passing 1¼-in. sieve	86%
Passing 1 -in. sieve	82%
Passing ¾-in. sieve	64%
Passing ½-in. sieve	32%
Passing ¼-in. sieve	0%
Wearing Test: Per cent of wear	3.60

Paving Bricks—The paving bricks used in these tests represent five different brands of standard size pavers of the same quality as used on State Aid roads in Illinois during the past two years.



CURVES SHOWING LOSSES IN PER CENT BY WEIGHT IN THE LAST 900 REVOLUTIONS OF RATTLER TEST OF PAVING BRICKS, MORTAR BLOCKS AND CONCRETE BLOCKS.

A—Average of five brands of paving bricks.
B—Average of 1-2 mortar blocks.
C—Average of 1-2-3½ gravel concrete blocks.
D—Average of 1-2-3½ crushed stone concrete blocks.

LEGAL DECISIONS

The Nashville Receivership Case Will Not Longer Delay Paving

For many months the municipal affairs of Nashville, Tenn., have been in very unsettled condition, due primarily to a suit brought against the city and its board of commissioners by R. M. Burns, who had been suspended by the commission from his position in the financial department of the city.

He obtained a temporary injunction against his discharge.

This suit was followed by another brought by a number of taxpayers against the city, the commissioners, contractors, corporations and individuals, finally aggregating about fifty parties. This case is still in progress, the complainants not having completed their testimony, tho the record already exceeds 8,000 pages.

As a result of this suit, some of the commissioners have been ousted and four of the five present commissioners are new members of the board, one having been reinstated, two having been appointed to fill the unexpired terms of persons ousted or resigned and two having been elected at the beginning of regular terms of office.

The lower court ordered the city placed in the hands of a receiver, but this order was reversed by the higher court before it could be put into effect.

Injunctions were issued prohibiting the payment of any money on any existing contracts, especially on paving contracts, so that work in the city has been suspended for about a year. These injunctions were dissolved several months after they were issued or were so modified as to permit the contractors to proceed with their work, but immediately notice was served on the board by those interested in the taxpayers' suit that they would hold the members individually liable for any payments on contracts which were later decided by the courts to be invalid or illegal.

The board has been slow to take action under this state of affairs, but has finally decided to follow its advisers and permit work to proceed and on July 8 signed the necessary agreements with two of the largest paving contractors whereby they will proceed with the completion of the contracts which were awarded to them in 1914 and 1915.

The advisers of the commission have been the city attorney, who declared the paving contracts valid when they were let, and special counsel of the new commission, Charles C. Trabue and Thomas H. Malone, Jr., employed at the suggestion of the city attorney to give an independent opinion upon the contracts in the light of their original making and of the subsequent court proceedings. He had the advantage also of the results of the investigations made by an expert engineer, Walter Douglass, of the staff of James Cameron, who had gone over all the details of the contracts, and of the evidence given on both sides in the taxpayers' suit.

The following extracts from special counsel's opinion give the principal points on which their conclusions are based:

So far as we are advised, three grounds of objection to the validity of these contracts on account of fraud have been suggested, namely:

(a) Because of the exclusion of the bid of the West Construction Company; and

(b) Because the Southern Bitulithic Company, the successful bidder, was a subsidiary of the patentee, Warren Bros. Company; and

(c) Because of a combination to stifle competition.

(a) Mr. Douglas(expert engineer employed by the city of Nashville) says: "The bids of the West Construction Company were not regular, in that they did not accept the so-called license agreement clause, which required the successful bidder to pay to Warren Brothers Company $1.25 per square yard for a sufficient quantity of bitulithic mixture (that is, stone, sand and bitumen) to pave one square yard of bitulithic pavement 2 inches thick, the said mixture to be furnished within three miles of the work."

This West bid was not considered by the commissioners. The city has the right to specify Warren Brothers patented bitulithic mixture; then undoubtedly it was its right and duty to disregard any bid that did not conform to that specification, and it is certain that the West Construction Company's bid did not so conform.

And even if the specification of Warren Brothers' bitulithic was void, this would not let in the West bid, but would invalidate the whole letting. The terms of the bid stated that it would be "necessary to determine what royalty Nashville will be charged," and there is evidence from various sources tending to show that the usual royalty was 25 cents a square yard, so that, on the theory on which the West Construction Company acted in making its bids—and assuming that the Warren Brothers Company would have acceded to this plan—it would seem that there should be added to the West Construction Company's bid the royalty of 25 cents a square yard, which, according to the details in Mr. Douglas' appendix 11, would make the West bid exceed that of the Southern Bitulithic Company. City Engineer Southgate confirmed that in his testimony in the city suit.

The city's specifications incorporated Warren Brothers' patented specifications for the bitulithic wearing surface, the city acquiring the rights to do so under the license agreement. The West Construction Company in its bids ignored this license agreement and proceeded on the assumption that Warren Bros.' patent was invalid. It appears, however, that this Warren Brothers' patent was some years ago sustained by the United States Circuit Court of Appeals for this circuit (opinion by Judge Lurton), in Warren Brothers Company vs. City of Owosso, 166 Fed. 399, 92 C. C. A. 227, a decision which the Supreme Court declined to review on writ of certiorari (214 U. S. 525, 53 L. Ed. 1067), and that decision had been followed in three other Federal cases, namely, Warren Bros. Co. vs. City of Montgomery, 172 Fed. 414; Warren Bros. Co. vs. City of New York, 187 Fed. 831, 109 C. C. A. 591, and Warren Bros. Co. vs. City of Grand Rapids, 216 Fed. 364. We conclude, therefore, that the city commissioners exercised a reasonable prudence in treating the Warren Brothers' patent as established, and in excluding from consideration the West bid, which ignored that patent.

(b) As has been seen, these contracts were awarded to the Southern Bitulithic Company.

This company was, we think, a subsidiary of Warren Brothers Company; certainly the relationships between the two companies were very intimate. If we are right, then the Southern Bitulithic Company, in bidding, had an advantage over other

companies. It may not have had to pay Warren Brothers Company $1.25 a square yard, or it may not have paid anything, the separate identity of the two companies being purely formal and involving a mere matter of bookkeeping.

While the city commissioners had, themselves, by specifying Warren Brothers' bitulithic at $1.25 a square yard, excluded from competition 70 per cent. of the total cost, nevertheless the other 30 per cent. was supposedly open to competition. Practically considered, however, it does not appear that, as respects the bitulithic contracts, the city was damaged by the circumstance that we are now considering. The unfairness consisted in the opportunity of Warren Brothers Company or its subsidiary to underbid other competitors, not to overbid them.

The only real interest that the city would have in awarding the 30 per cent. would be to see that the cost was not excessive, and Mr. Douglas expresses the opinion that it was not.

The vital question is whether the city had the power to award 70 per cent. of the cost of the contracts in advance of the bidding.

The rule is that fraud, to be relieved against, must be operative and injurious to the party (Wayerbury vs. Netherland, 6 Heisk. 526), and that fraud without damage, or damage without fraud, gives no cause of action. (Flippen vs. Knaffle, 2 Tenn., ch. 240; Rogers vs. Dibrell, 6 Lea. 77, and see also Chamberlain vs. Coal Company, 92 Tenn. 13.) It has been seen that the 30 per cent. was awarded at a reasonable figure, so that if there was any fraud here, the city was not damaged thereby.

It has been seen that the specifications for these bitulithic contracts for 1914 and 1915 prescribed a patented material, namely, Warren Brothers bitulithic wearing surface, and provided that the successful bidder must pay Warren Brothers' Company therefor the sum of $1.25 per square yard; and it has likewise been seen that this sum of $1.25 a square yard to be paid to Warren Brothers' Company in any event constituted 70 per cent. of the total cost, leaving only 30 per cent. open to competition.

The question as to whether a municipality can specify a patented material under a charter which expressly or impliedly provides for competitive bidding is one which has often been before the courts, and one about which there is a decided conflict of authorities. The argument in favor of allowing municipalities to specify patented articles proceeds on the theory that it is to the interest of the city and of all its inhabitants that the best materials and methods of construction, whether patented or unpatented, should be followed. The discussion of this question might be extended to great length by a review of the cases, but this seems to be unnecessary, inasmuch as they are collected and reviewed in elaborate notes in 18 L. R. A. 44, 5 L. R. A. (n. s.) 780, and 46 L. R. A. (n. s.) 990. The author of the latest of these notes sums up his conclusions as follows (46 L. R. A. (n. s.) 992): "The majority of the late cases considering the question with reference to paving contracts, however, sustain the right to stipulate for a particular kind of paving material which is controlled by a patent, where the owner of the patent files with the municipality an agreement to furnish the material to a successful bidder at a stipulated price, altho by a statute such contracts are required to be let upon competitive bidding."

Upon a careful consideration of this whole matter we are of opinion that, while the question is not all free from doubt, the weight of authority and of reason supports the view that city officials, in the exercise of an honest judgment, may specify a patented article or material, notwithstanding the provision in its charter that contracts shall be awarded to the lowest responsible bidder, and that, therefore, these bitulithic contracts were not illegal for this reason.

It has been seen that probably there was no excessiveness in the cost of the 30 per cent. which was left open to bidding, so that, if the cost was excessive, the excessiveness was in the price of $1.25 a square yard fixed in the license agreement. There is nothing to indicate that the city officials were induced by fraud to adopt bitulithic as a paving material or to consent to the price of $1.25 a square yard, so that the question here resolves itself into this: Does the fact that city officials, in entering into a contract that is unaffected by fraud, exercise a bad judgment and agree to pay the contractor an unreasonable and excessive price afford a legal ground for avoiding the contract?

We conclude on this point that these bitulithic contracts cannot be avoided for the sole reason that the price contracted to be paid was excessive, unless the excessiveness was so gross and unconscionable as to impute fraud.

The city contracted to pay $1.45 a square yard for the bitulithic wearing surface. Was that price excessive, and, if so, was it grossly excessive? We have heretofore seen that the excessiveness, if any, was in the license agreement of $1.25 a yard, so that the question really is whether that license price was excessive.

In the first place, what does excessiveness mean in this connection? Does it mean in excess of the market price, as determined by what other cities paid? Or does it mean in excess of the cost plus a reasonable profit? If the particular price was substantially greater than the market price it would be excessive, otherwise not.

The freedom of individuals and corporations to contract is highly regarded by the courts. In the absence of some such circumstances as fraud or a fiduciary relationship the courts will not interfere. A person may legally sell his wares or services for whatever another will pay for them; and a patentee may do this with the added and legitimate advantage that he enjoys a monopoly.

We have no reason to doubt the validity of the Warren Brothers' patent on this bitulithic paving. Also, the information we have is that this bitulithic paving is good paving for municipal purposes. Mr. Douglas, in his report, says: "We must admit that the Warren Brothers' patents are probably valid, that the pavements they have laid in Nashville are excellent, that they are masters of art of such construction, and that it is difficult to get contractors who have knowledge of the art approximately equal to theirs."

There is exhibited with Mr. Douglas' report a statement (Appendix 11) purporting to show the license agreement prices in some 370 contracts entered into with 200 or more cities or towns. Most of these contracts are shown to have been made in 1912, 1913 and 1914, but a good many were made before 1912. Of the prices fixed in these 370 license agreements none was lower than $1.25, the price fixed in the Nashville agreements. Only 21, 5.7 per cent., of the 370 were as low as $1.25, and of these 7 were made with Nashville. All of the 349 license agreements in the list that were at a higher price than $1.25 were made with other cities. They averaged from $1.30 to $1.45, but a good many were in excess of the latter figure.

It even seems doubtful whether the Nashville price could be shown to be unreasonable from an absolute standpoint, for, while it may be an easy matter to ascertain the cost of the labor and materials, and to add to that a reasonable profit, something more must be added to represent the worth of the patent, and this last item is one about which opinions may differ widely. Yet this difficulty must be overcome before any one can say that the price is unreasonable. The worth of a patent in the sense spoken of is largely a matter of opinion; and it may be suggested with some force that the price that the public is willing to pay is the best evidence of its worth.

In the same report above referred to Mr. Douglas says: "I want you to realize that the Warren Brothers' Company will be able to get a great many men of good reputation who will agree with them as to the fact that the bitulithic is worth the price paid by Nashville for it."

We conclude that these bitulithic contracts cannot successfully be impeached on the ground of excessiveness of price.

The contractors have their grievances due to the delay in completing their work, which has caused them much extra expense, due not only to the ordinary expenses of delays, but also to the sharp increases in cost of materials and in wages since these contracts were signed. They had brought suits against the city for damages on account of these delays. The agreements with the two contractors referred to, the Southern Bitulithic Co., and the Foy-Proctor Co., cover the points on both sides.

The companies withdrew their suits against the city; the city agreed to pay the costs in the same up to dismissal; the city pays the companies the amounts due for work already done on contracts, and the companies waive claims to interest on such payments for the time they have been delayed; the companies agree to complete their contracts as promptly as possible and the city to pay for the work according to contract. The companies do not relinquish any rights to bring suits for damages against persons or corporations responsible for the delays producing the damages.

Four of the commissioners signed the agreements, Mayor Ewing and Commissioners Elliott, Stainback and Tompkins, but Commissioner Treanor refused to sign, claiming that his legal adviser considered the contracts invalid. He will do nothing to prevent the execution of the agreements, however.

The amount to be paid the Southern Bitulithic Company when the work is completed is $84,820.88 and the Foy-Proctor Co., $153,633.45.

The city has one peculiar problem on its hands in that it is paying interest on the bonds issued to pay for this paving at the rate of 5 per cent and is receiving 3 per cent on the money on deposit in the banks, so that it has been losing 2 per cent a year on its capital. The bonds are serial bonds and some of them come due before the pavements are completed and paid for, so that the board is obliged in some way to provide the fund to retire the bonds immediately coming due, and pay the difference in interest, as it must now use the money raised by the bond issue to pay the amounts coming due on the contracts, and the assessments for paying the bonds cannot yet be made.

Decisions of the Higher Courts of Interest to Municipalities

Ashland Need Not Purchase Water Works.—By original contract, Ashland, Ky., could elect to purchase water works from company at expiration of franchise for an arbitrated price. Under provision of state Constitution, adopted later, people voted $175,000 bonds for the purchase, but the arbitration board, appointed under mutual agreement to make the transfer, fixed value at $276,000. *Held*, that the constitutional provision did not impair the obligation of the contract between the city and defendant's predecessors, in violation of the federal Constitution, since the contract imposed on the city no obligation to defendant and its predecessors to exercise the option of privilege of purchase thereby conferred, and the Constitution in no way affected the obligation resting on the city of permitting defendant and its predecessors to exercise the rights granted, and hence such option to purchase could only be exercised in accordance with such section. A favorable vote by the voters of a city on the question of incurring an indebtedness in a sum not exceeding $175,000 for the purpose of purchasing and acquiring the rights, property and franchise of a water works system did not authorize the city to incur an indebtedness of over $276,000 for such purpose. Ashland Water Works Co. v. City of Ashland (Ky.) et al., 230 Fed., 254.

Damages for Delay in Completing Contract.—A contract for the construction for a city of a bridge, which provides that the bridge shall be completed within 150 working days, and which stipulates that the contractor, for delay beyond the time specified, shall forfeit to the city, as liquidated damages, $25 a day, and which authorizes the harbor engineer to determine the amount, quality and acceptability of the work, and all questions in relation thereto, and the performance thereof, and decide every question which may arise as to the fulfillment of the contract, and which declares that his decision shall be final, permits the city to rely on the benefit of the stipulation for liquidated damages for delay, tho the work has been unnecessarily or unreasonably delayed by the city or its agents or by others, as provided for in the contract, but the contractor is entitled to credit for such delays in arriving at the number of working days the work extended beyond the 150-day period. Mayor and City Council of Baltimore (Md.) v. Ault et al., 94 Atl., 1044.

Binghamton Water Commissioners Legislated out of Office.—The city of Binghamton was incorporated by Laws 1867, c. 291. The Water Act (Laws 1867, c. 780), enacted to enable the city to supply itself with water, while not enumerating the water department in the list of departments created by the charter, by its provisions as to the duties and powers of the water commissioners closely related it to the city government, so as to make it in effect a city department. The Second Class Cities Law (Consol. Laws, c. 53) applicable to Binghamton on January 1, 1916, without specifically repealing the Water Act or its amendments, by section 252 repealed all ordinances of the city, so far as inconsistent with the chapter and provided by section 94 that, if the city owned and operated water works, the commissioner of public works should appoint a superintendent to hold office during his pleasure and to manage the city's water works under the direction of the commission. *Held*, in an action against the treasurer of the water commissioners and the commissioner of public works to restrain their interference with plaintiffs as water commissioners, that the water works was in fact a city department, and that the Water Act, as amended by Laws 1906, c. 588, was inconsistent with the Second Class Cities Law, and hence was impliedly repealed thereby. Water Com'rs of Binghamton (N. Y.) v. City of Binghamton et al., 158 N. Y. Supp. 888.

Official Index to State Legislation

The "Official Index to State Legislation," for 1915, published in co-operation with the state legislative reference departments and libraries represented in the National Association of State Libraries and the American Association of Law Libraries, and under the direction of the joint committee on national legislative information service of those associations, has been issued. It furnishes a ready reference to all state legislation, and is corrected and cumulated weekly to include all changes in position and new bills introduced during the week. The arrangement of the subject index is (a) by subjects, (b) by states, (c) under each state, the Senate first and then the Assembly or House, and (d) the bills first, and then the resolutions, by introduction numbers. Each entry for each bill and resolution gives (1) the bill number, (2) the date of introduction, (3) the name of the member introducing the bill, (4) the subject, (5) the effect of the proposed legislation or the "short title" of the bill, and (6) the position or status of the bill, on the date shown at the head of the column. In 1916, until June 1, the index will be cumulated and published weekly, with insertion of changes in position of bills and new bills introduced subsequent to the previous issue. The subscription to all the weekly numbers, and the annual number and supplements, for 1916, will be $100, and subscribers for 1916 will be furnished the final 1915 number for $10 additional. Law Reporting Co., 74 Broadway, New York.

City Planning for Somerville

Somerville, Mass., has a planning board of seven members, established by ordinance under an act of the legislature of 1913. It seems to have very little money, $100 serving for expenses for three months or more, and to have no powers except of recommendation to the city council. Five of the seven members serving in 1915 were new to the work. The board recommends a thoro social and economic survey of the city, with complete maps of physical facts prepared by the city engineer. They propose to consider, in developing their work, an increase in industrial establishments and their location in the east and northeast parts of the city; better development of the congested portions of the city, the population per square mile in the city being more dense than in Boston or most large cities in the country; developing retail store districts, to which shopping facilities will be restricted and in which social and civic centers will be established; transportation to Boston and across town, to utilize the new rapid transit lines; recreation grounds and connections between them and the Metropolitan Park system. The board recommends that it be reduced to five members, one appointed each year, so that it will have a more permanent character than is possible under the present ordinance.

FIRE DEPARTMENT

New Developments in Fire Apparatus

The Locomobile Company recently delivered an auto patrol to the Bridgeport, Conn., police department.

The body is mounted on a 48 chassis and is finished in Locomobile green, with the words "Police Department," in gold, standing out in strong contrast with the dark background.

The motor is a Locomobile standard 6-cylinder model M, capable of developing a speed of at least fifty miles per hour.

Entrance is effected at the rear of the car by means of a wide step and two brass rails. There are no doors at this entrance.

The interior of the car is 5½x10x6 feet high, enabling an average man to stand upright in it. Large cushions, upholstered in genuine black leather, run lengthwise of the car, affording seating accommodations for twelve persons. A dome light, such as is used in the most up-to-date limousines, is located in the center of the roof.

The car is equipped with an electric starting and lighting system, extra large wind shield, special dirigible searchlight, and is considered one of the most handsome jobs of its kind ever turned out by the Locomobile Company.

Low Upkeep at Winthrop, Mass.

It cost the town of Winthrop, Mass., just $26.93 to operate a Kelly fire truck for one year. Following is an itemized table showing just how this money was spent:

Gasoline, 79 gallons at 25c	$19.75
Oil, 4 gallons, 2½ quarts, at 45c	2.08
Grease, 1 pound	.20
Dry batteries, 10 at 19c	1.90
Presto tank	3.00
	$26.93

Middletown's New Tractor.

On April 27, 1916, Middletown's new Federal tractor went into service. Under the able leadership of Fire Chief Pitt this department has progressed very rapidly, and to-day the taxpayers are probably assured of a greater measure of protection for each dollar of taxes paid toward investment and maintenance than any other city of equal size in the world.

Middletown is fortunate in having Chief Pitt serve them in his present capacity, for he brings to bear an experience that has been gained over a longer period than that of any other chief in the state. The purchase of the tractor was made in view of the splendid work done by Federal combination No. 3113, which cost for gasoline only $5.07 for the first four months of 1916. During this time the equipment was closely watched and its speed and dependability, especially when running the steepest hills, instilled such a measure of confidence in the people that they eagerly took up Chief Pitt's recommendation for another Federal fire fighter.

Considering that this department lays claim to the distinction of being the first in the state to motorize, we are glad to learn that their continued use of Federal equipment proves conclusively the economy of Federal substitution for the good old faithful horse. Taxpayers are certainly enthusiastic over the chief who can give additional protection at less cost, and this is what Chief Pitt has done for Middletown and what others are doing in all parts of the country. For he has proved that motor equipment will pay for itself in two or three years, one-half of which comes back immediately on the sale of the horses. Curiously enough, it also makes another fireman available for service in time of need, for the Federal tractor at a fire stands without an attendant.

Motor Trucks and Pumps in Fire Departments

The Lent Motor Pumping Engine.

The motor pumping engine described herewith, and built by the Alberger Pump and Condenser Company of New York City, from designs patented by one of their engineers, Mr. L. B. Lent, uses a unique type of centrifugal pump which is direct connected to the gasoline motor. The car is also directly driven through the pump by the use of a conventional transmission, drive shaft and worm-drive axle.

THE PUMP CONNECTION.

A six-cylinder gasoline motor carries the main clutch bolted to its flywheel. Directly behind the clutch shaft, and in line therewith, is the pump, whose shaft is connected to the clutch shaft through a flexible steel coupling. The rear end of the pump shaft is connected to the transmission thru a similar flexible steel coupling, and a pair of universal joints and drive shaft conveys the drive to the worm of the rear axle. It is thus evident that the car is driven in the conventional manner, the drive passing right thru the pump. If the pump casing were removed, the remainder would constitute a standard truck chassis.

The design of the pump discloses a very simple and clever method of meeting the service demands of fire apparatus, which call for a considerable range of pressures and capacities. Specifications usually call for the pump capacity to be delivered against 120 pounds pressure and approximately half of the capacity against 200 to 250 pounds pressure.

The pump shown is built as a pair of two-stage pumps in a common casing. A division wall thru the center divides the two sides. A suction connection is provided on each side

of the car. These connections divide outside the pump and pass water to each side of the pump at the bottom.

Each side of the pump is capable of delivering its rated capacity (400 gallons) against a discharge pressure of 125 pounds per square inch. Thus when the two sides are running together, or in parallel, the total delivery will be the sum of the deliveries from the two sides, or 800 gallons at 125 pounds pressure. A water passage, cored in the casing, connects the discharge from one side to the suction side of the other side. This passage may be opened or closed by a quarter turn of the plug valve located therein. It is thus possible to easily and quickly deliver the discharge from one side of the pump to the intake of the other. In this case 400 gallons per minute at 125 pounds pressure is delivered to the other side, in which the pressure is increased another 125 pounds, making the actual delivery 400 gallons at 250 pounds pressure. The delivery of water under pressure to the suction side of the pump casing, as described, closes a check valve in the suction line leading to this side, and so prevents water under pressure flowing back into the suction pipe. The whole process of conversion from a pair of two-stage pumps to a single four-stage pump, or vice versa, is accomplished by a quarter turn of the plug valve. In both the conditions described the results are obtained at the same rotative speed, which is obviously the same as the motor speed. By varying the motor speed, a wide range of pressures and capacities is obtained.

The suction connections on both sides of the car are close to the ground and in a handy position for coupling up. Four discharge connections and gates are placed on each side of the car, so that the maximum pump capacity may be taken off from either or both sides. The usual fire equipment is carried and body space is provided for 1,200 feet of 2½-inch hose.

The total weight, with full equipment, but without men or hose, is said to be less than 10,000 pounds.

THIS FEDERAL TRACTOR IN COMBINATION WITH MIDDLETOWN'S HOOK AND LADDER GIVES "GREATER PROTECTION AT LESS COST" AND IS THE ENTHUSIASTIC RECOMMENDATION OF THE OLDEST FIRE CHIEF IN CONNECTICUT.

Gas Emergency Truck

Many lives have been saved and heavy property losses averted in the city of Chicago, since the installation of a new emergency truck by the Peoples' Gas Light and Coke Company. It responds to every big fire alarm, gas leaks, sewer and street cave-ins, accidents to buildings, asphyxiation cases, suicides,

drownings, leaking gas mains and meters and similar emergencies, rendering first aid to the injured and using the most modern type of pulmotor to revive unconscious victims. The attendants in charge of the truck are experts in the use of the pulmotor and have rendered invaluable service.

The truck covers the entire city of Chicago, an area of over eighty square miles of territory. It can be summoned out at any hour of the day or night without expense to the city, corporation, contractor, physician or private individual. Physicians have highly praised the work of this truck and the speed which it is able to make frequently enables it to reach the injured person before a physician can arrive.

The truck was built by the White Company, of Cleveland. It has a capacity of ¾ ton and a 45-h.p. motor. In answering

fire calls it is the duty of the attendants to rush into the burning building, turn off the gas or render such other assistance to the injured or entrapped persons as it is possible for them to perform. Before the truck was purchased by the Peoples' Company, firemen were greatly handicapped in discovering gas leaks or locating the shut-off valves. Delays of this kind were very dangerous and frequently gas explosions followed small fires that otherwise could have been averted had the fire-fighters been able to quickly shut off the gas. The emergency men know the exact location of all gas lines, electric light connections, etc., and are able to render quick assistance.

Big Saving at Worcester, Mass.

Name of chief—Wesley N. Avery.
City—Worcester, Mass.

AUTO APPARATUS.

Period of time—From December 1, 1914, to December 1, 1915.
Type of motor fire apparatus—Combination hose and chemical.
Name of make—American-LaFrance.

Cost of repairs, including labor and material	$ 2.81
Cost of gallons of gasoline	22.73
Cost of gallons of oil	4.77
Cost of gallons of grease	.10
Miscellaneous expense	16.41
Total cost	$ 46.82
Distance traveled (miles)	330
Cost per mile	$ .14
Number of alarms answered	151

HORSE-DRAWN APPARATUS.

Period of time—From December 1, 1914, to December 1, 1915.
Type of horse-drawn fire apparatus (same equipment)—Hose wagon.
Name of make—Local builder.

Cost of repairs, including labor and material	$ .50
Cost of feed	330.07
Cost of shoes	72.00
Harness repairs	17.40
Miscellaneous expense	
Total cost	$419.97
Distance traveled (miles)	310
Cost per mile	$ 1.35
Number of alarms answered	158

MAXWELL CHIEF'S CAR AS OPERATED BY CITY OF ROSWELL, N. M.

UPKEEP ON TWO MOTOR PIECES.

Chief B. H. Barnes, fire department, Olympia, Wash., submits the following costs covering upkeep of one Seagrave combination hose and chemical and White truck for a period of twelve months:

Cost of repairs, including labor and material	$ 10.75
Cost of gallons of gasoline(at 19c)	43.60
Cast of gallons of oil	5.50
Cost of gallons of grease	2.40
Miscellaneous expense	200.00
Total cost	$262.25
Distance traveled (miles)	260
Number of alarms answered	98

KISSEL COMBINATION TRUCKS IN FIRE DEPARTMENTS.

KISSEL 6 CYL., 60 H. P., COMBINATION AND HOSE TRUCK (WITH LADDERS,) CITY OF NORTH PLATTE, NEB.

KISSEL 6 CYL., 60 H. P., COMBINATION PUMPER AND SQUAD WAGON, CITY OF OAKLAND, CAL.

KISSEL 6 CYL., 60 H. P., COMBINATION CHEMICAL AND HOSE TRUCK, CITY OF FALL RIVER, MASS.

KISSEL 4 CYL., 50 H. P., COMBINATION CHEMICAL AND HOSE TRUCK (WITH LADDERS) CITY OF KANKAKEE ILL.

KISSEL 6 CYL., 60 H. P., COMBINATION CHEMICAL AND HOSE TRUCK (WITH LADDERS), ARKANSAS CITY, KANS.

KISSEL 6 CYL., 60 H. P., CHIEF'S CAR, CITY OF DULUTH, MINN.

Average Annual Team Cost.

Chief H. B. Jones, fire department, Amarillo, Tex., states that the average annual cost of a team of fire horses is $888. Chief Jones submits the following cost record covering operation of a motor combination, for the same period:

Cost of repairs, including labor and material	$ 1.18
Cost of gallons of gasoline	55.00
Cost of gallons of oil	25.20
Cost of gallons of grease	1.60
Miscellaneous expense, storage battery	8.17
Total cost	$ 91.51
Distance traveled (miles) (Combination, 265; combination, 231; pump, 151)	647
Cost per mile	$ .14
Number of alarms answered	52

The year's cost of tires and inner tubes for three pieces of motor apparatus, is listed as follows:

Tires, 1-1-15 to 1-1-16	$390.00
Inner tubes, 1-1-15 to 1-1-16	27.00

Annual Cost of Four Teams.

Mr. James P. Welsh, fire chief, Eau Claire, Wis., lists horse maintenance (four teams), for past twelve months, as follows:

778.28 bushels of oats, average cost $0.454	$353.55
30.45 tons of hay, average cost $7.465	227.41
Rolled and ground feed	47.18
6560 pounds straw	13.18
Total cost for forage	$641.32
Cost per horse per year for forage	$80.165
Cost per horse per day for forage	.21 96/100
Veterinary service	$ 12.30
Shoeing (per horse, $13.65)	109.20
Barn supplies	10.85
Total cost	$773.67
Total cost per horse per year	$96.70
Total cost per horse per month	8.058
Total cost per horse per day	.26 49/100

"Our hose and chemical motor car," states Chief Welsh, "during the year covered a distance of 246 miles, at the following cost:

Gasoline consumed amounted to 134 gallons, at a cost of	$14.50
Lubricating oil, 5 gallons	2.00
Oil forage for car (1.37½ per month)	$16.50
Repair costs	34.11
Total for year	$50.61

Maintenance cost per month, $4.22.

"During the year we changed our rear wheels to standard and from block to demountable four-inch dual solids; cost, $188.08.

"In view of the fact that tire deterioration takes place regardless of mileage, I would place a depreciation charge on tires of approximately $3.00 per month. I do not believe it will exceed that figure, and may drop somewhat below that estimate.

"With the prospects favorable for an additional piece of motor apparatus in 1916, and the retiring of two more horses, places us about 40 per cent. motorized."

Oakland, Cal., Comparisons.

Mr. Elliott Whitehead, fire chief, Oakland, Cal., submits the following statement of motor costs as compared with horse-drawn maintenance:

AUTO APPARATUS.

Period of time—From September, 1915, to March, 1916.
Type of motor fire apparatus—Hose and chemical.
Name of make—Seagrave.

Cost of repairs, including labor and material	none
Cost of gallons of gasoline (55 gallons)	$ 5.23
Cost of gallons of oil (4 gallons)	1.20
Cost of gallons of grease	1.10
Miscellaneous expense	3.10
Total cost	$ 10.63
Distance traveled (miles)	90
Number of alarms answered	43

AUTO APPARATUS.

Period of time—From September, 1915, to March, 1916.
Type of motor fire apparatus—Double 80-gallon chemical.
Name of make—American-LaFrance.

Cost of repairs, including labor and material	none
Cost of gallons of gasoline (50 gallons, at 9½c)	$ 4.75
Cost of gallons of oil (4½ gallons, at 30c)	1.45
Cost of gallons of grease	1.85
Miscellaneous expense	3.00
Total cost	$ 11.05
Distance traveled (miles)	37
Number of alarms answered	27

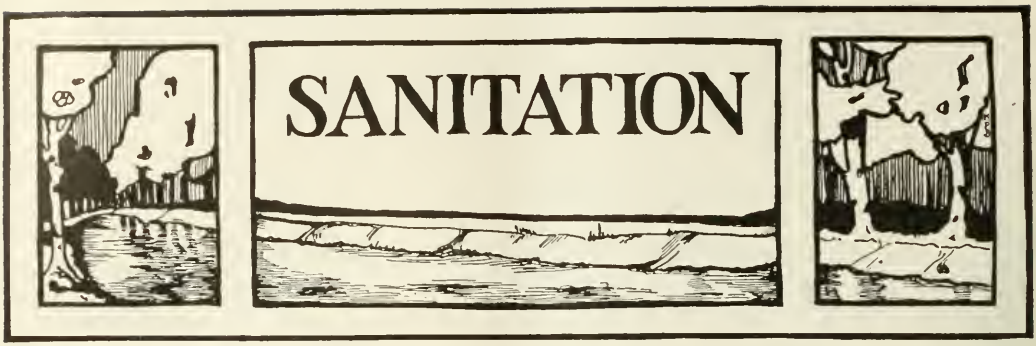
HORSE-DRAWN APPARATUS.

Period of time—From September, 1915, to March, 1916.
Type of horse-drawn fire apparatus (same equipment)—Hose and chemical.
Name of make—Robinson.

Cost of repairs, including labor and material	none
Cost of feed (two horses)	$120.00
Cost of shoes	30.00
Harness repairs	2.60
Miscellaneous expense	3.85
Total cost	$156.45
Distance traveled (miles)	73
Number of alarms answered	45

John Snoharger has been the efficient chief of the fire department of Goshen, Ind., continuously since 1884. The department was reorganized in 1905 on a paid basis, with twenty-one call men and six regular firemen.

Chief Albert Herring, of Murphysboro, Ill., joined the volunteer fire company at sixteen years of age. Fifteen years ago, when the paid company was formed, he was chosen to head it and thus became the youngest fire chief of any paid fire department in Illinois. He is a member of the Illinois Firemen's Association and the International Association of Fire Chiefs.



Concrete Septic Tanks for Farm and Town Dwellings

Recent statistics show that many cities are healthier places in which to live than is the average rural community. The reason for this is that city health authorities enforce regulations compelling the disposal of house wastes in a sanitary manner. Most cities are equipped with sewerage systems and disposal plants where sewage is rendered practically harmless. Small towns and rural communities are not usually so favored. Farmhouse wastes are often thrown out upon the ground in a thoughtless manner, without regard for the possible sickness and death that may result from such practice, not only to persons in the immediate locality, but to others far away. Most epidemics of disease in the city, such as typhoid, scarlet fever and diphtheria, can often be traced to insanitary conditions on the farm, such as contaminated water supplied to dairy stock.

House wastes scattered upon the ground or even discharged into a cesspool, seep thru loose soil and eventually contaminate water supply, which, in turn, passes germs on to dairy stock, then into milk. Cesspools, if located in firm soils, must be pumped out periodically. In such cases the contents are distributed over the surface of the ground, giving forth vile odors, and the filthy wastes are sooner or later washed into some stream, thus polluting it and spreading infection. If the cesspool is located in sandy or gravelly soil, thru which the contents made continually seep out, then sooner or later the source of domestic water supply on the farm, the well, will become contaminated.

Modern conveniences of the city dwelling have been extensively adopted for the farmhouse. The kitchen sink, the bath and indoor toilet are too convenient to do without, yet have a penalty attached unless the wastes that are handled by such a system of house plumbing are disposed of in a satisfactory manner. The cesspool should no longer be tolerated. Instead, a sewage disposal system that will be sanitary, convenient for use, easy to maintain and of simple construction, should be substituted. Such a system is represented in the modern septic tank.

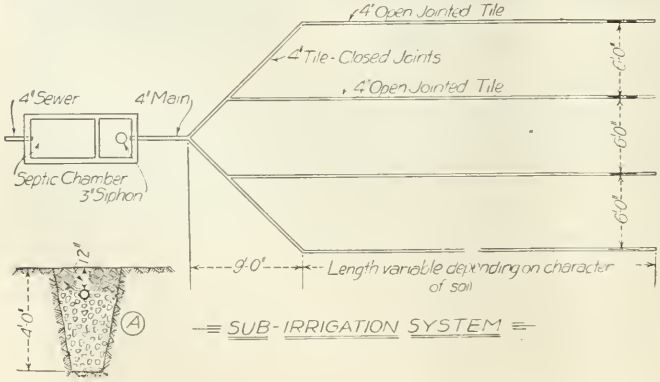
A properly designed septic tank should have not fewer than two compartments. House sewage is discharged into the first of these compartments (sometimes called the sedimentation chamber), where bacteria develop, multiply, and feed on the sewage, so to speak, thus breaking up and changing a portion into relatively harmless compounds. Such processes as occur in this first compartment, however, do not render the sewage entirely harmless. The bacterial process occurring in the first compartment, which must be dark and practically air-tight, represents one of two successive stages necessary for sewage purification. The second, which consists of a combination of oxidization, nitrification and filtration, must be performed in the presence of light or air, or both. The order of purification must always be as indicated, first, the bacterial action; second, aeration and nitrification, never the reverse.

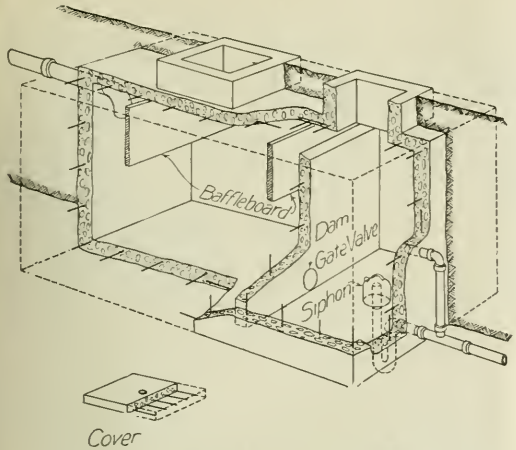
Final disposal may be carried on in either of two ways. Where possible to do so, surface or broad irrigation is satisfactory, which means discharging the sewage from the septic tank upon the land, where it is allowed to spread over the ground and be acted upon by the sun and certain other bacteria which live in the upper layers or portions of the soil. The plat of ground used for this purpose may be cultivated land or may be an area of waste land. In either case it should be located as far as possible from the source of domestic water supply, this distance never being less than 200 feet. Care should be taken to keep dairy cattle from grazing over the disposal area.

Discharges from the tank should be carried to the disposal field by a tile line having sealed joints and emptying into an open ditch about 12 inches wide and 6 inches deep, with laterals at right angles to it and about 6 feet apart, dug with sufficient grade so that the liquids will spread quickly and evenly over the whole area.

Another method of disposal is frequently practiced. This is called sub-surface irriga-

I. PLAN OF SEPTIC TANK *with final disposal system after the sub-irrigation method, showing also a section of trench which may sometimes be necessary when tile are laid in tight soil.*





II. SEPTIC TANK, *for use where sub-irrigation is practiced, showing tank interior partly exposed as if a portion of the tank were cut away.*

tion, and consists of discharging the tank contents into lines of 4-inch drain tile laid with open joints, from which the fluids leach or filter into the soil. The grade of such a tile line should be not greater than 2 or 3 inches per 100 feet.

To prevent soil from entering the tile line thru the open joints, these may be covered with flat stones or pieces of broken tile of larger diameter.

Sub-surface irrigation is in a way similar to broad irrigation, in that the final stage is filtration; the intermediate step, namely, aeration and nitrification, being carried on immediately beneath the surface of the ground instead of on its surface.

Fig. I illustrates the disposal method by sub-irrigation. Lengths of drains necessary will be governed by the nature of the soil. If this is loose and sandy, 200 feet is sufficient, altho in tight soil it may be necessary to double its length.

Generally speaking, the method of disposal by sub-surface irrigation is best adapted to the single residence. This system usually requires less attention to secure satisfactory operation; furthermore, the sewage is entirely hidden from sight after discharged from the tank, and this is a desirable feature.

Sub-surface irrigation is not well adapted to firm or dense soils. In such cases a plan sometimes adopted is illustrated at "A" (Fig. I); that is, the tile are laid on a gravel or cinder filling in trenches, then covered with about a foot of earth. In heavy clay soils an additional line of tile in the lower portion of trench to drain it is frequently necessary.

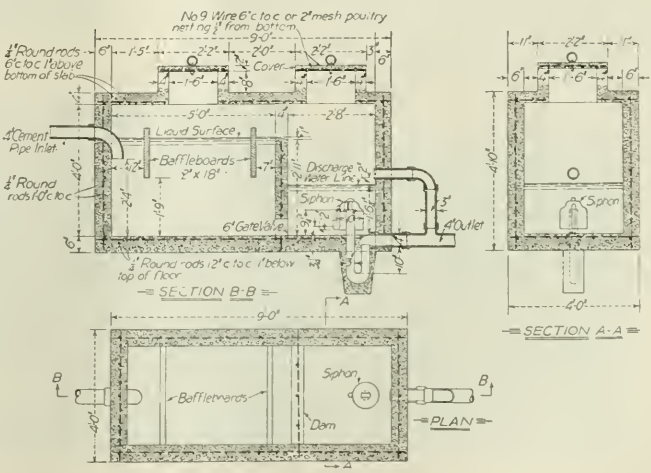
Figs. II and III show sections of a septic tank. This type will be found to operate effectively where final disposal is accomplished by sub-surface irrigation. This system once started is self-operating, due to the intermittent siphon shown in the second, or right-hand compartment, which at regular intervals empties the contents and discharges them into the line of tile, from which the liquids leach out thru joints into the soil. In a tank constructed as shown in the design mentioned, it is very important to use a siphon to empty the second compartment at intervals instead of allowing a continuous outward flow of contents, because of the tendency for drains to become clogged when liquids are constantly trickling thru.

The size of tank required for residence use depends upon the quantity of sewage to be handled in the first chamber during a day of twenty-four hours, therefore, this compartment should be large enough to contain an entire day's flow. This frequently amounts to from 30 to 50 gallons per person per day, so the required capacity can readily be computed from these figures, but it must be remembered that the required depth for the tank should be figured from the top of the concrete baffle wall or partition which separates the first and second compartments. Another point to bear in mind is that the width of the first compartment should be about one-half its length.

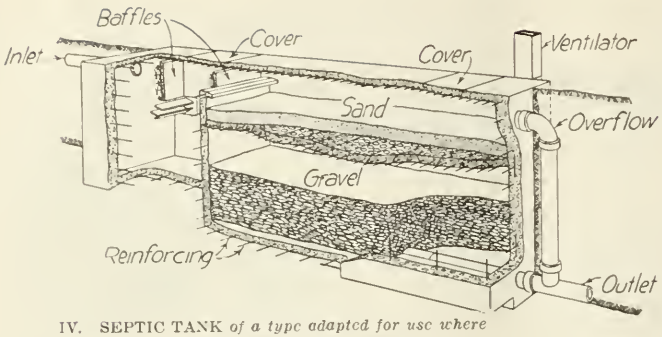
Where broad irrigation is practiced because of dense soil or where the fall of ground does not make the sub-surface irrigation system practicable, then the design shown in Figs. IV and V will be found effective. If the length of the first chamber is 3 feet 9 inches, the tank will accommodate the wastes from a household of six persons, figuring that an average of 50 gallons of sewage per day for each member must be disposed of. If a family of eight is to be served, the length "A" should be made 5 feet. It is estimated that one day will be required for a given amount of liquid to pass thru the first compartment, under the baffle and over the weir or partition wall, upon the sand filter.

In both of the designs presented, it will be noticed that baffle boards are shown. These are for the purpose of preventing any disturbance of the scum which forms on the surface of the liquid in the first compartment, because efficient bacterial action is dependent upon keeping this scum motionless and preventing any of it from being carried out of the compartment. These baffles break up eddies and currents caused by the flow coming into the tank and in the first design consist of two 2 by 18-inch boards set in slots formed in the tank walls at the time concrete is placed.

In the second design concrete baffles are shown, as well as three 1 by 6-inch boards so placed at the inlet side of the first compartment that they will break currents from sewage entering the tank. These boards are secured in position by toenail-



III. PLAN *and two sections of the septic tank shown in Fig. II.*



IV. SEPTIC TANK *of a type adapted for use where final disposal is made by means of broad irrigation. This view shows the construction as tho partly cut away to expose the interior view.*

ing at the ends to small pieces of lumber set into the tank walls when concrete is placed. Both designs show manholes which permit access to the tanks for cleaning, tho the necessity for this is infrequent.

Septic tanks are best constructed of concrete, which should be mixed in the proportions of 1 sack of portland cement to 2 cubic feet of coarse sand graded up to ¼ inch,, to 3 cubic feet of screened gravel or crushed stone, the particles of which vary in size from ¼ to 1½ inches. Enough water should be used to produce a mixture of quaky consistency so that the concrete when placed will settle into all parts of the forms when slightly jogged or puddled with a spade or similar tool. Spading assists in removing air bubbles from the concrete and produces a denser mass. Tank walls should be 6 inches thick, reinforced as shown on the drawings.

In Fig. IV concrete baffle walls extend down from the cover slab a distance of about 1 foot 6 inches. These are reinforced by means of ¼-inch round rods spaced 6 inches center to center, both vertically and horizontally. Between the two chambers there is a weir or dividing wall 4 inches thick extending from the floor to within 6 inches of the cover slab. This wall is provided with a lip so that the sewage cannot trickle down the face of the wall but will at once be discharged upon the sand filter. This lip is reinforced by bending the ends of the vertical reinforcing in the weir wall at right angles to it and by one horizontal rod near the edge.

The sand filter is 6 inches deep and 2½ times the length of the first compartment. It is supported by a 3-inch concrete slab, 35 inches wide, divided into three sections, reinforced with ¼-inch round steel rods, and contains a large number of conical openings. These are made in the slab by setting tapered pieces of wood into the concrete before it has had time to harden. When the slabs are placed, these openings are filled with small pebbles to prevent the sand from passing thru to the gravel filter below. In order to simplify the work of building the filter board, a suggestion for another type is shown at the lower right-hand corner of Fig. V. This board is made of 2-inch lumber with gimlet holes drilled as shown. A 3-inch ledge projecting from the side wall serves as a support. The three sections permit easy removal in case it is desired to secure access to the gravel filter.

To prevent liquids from running along the side walls, two end pieces of the above slab are set into slots, in which clay has previously been daubed to form a tight joint. Clay may be used also to fill the openings between the ends of the slab and the side walls, as the slab is made of lesser width than the chamber, to permit easy removal.

Perforating this slab causes the filtered sewage to be sprinkled upon the coarse gravel filter below, and as it falls, it passes thru an 18-inch air space which is ventilated by means of air shafts at opposite sides of the structure. A difference of at least 8 feet in the height of these air shafts is advised in order to create as much draft in the upper portion of the gravel filter chamber as possible. A ventilator placed upon the taller shaft would assist in this respect.

Gravel in the lower filter should not be smaller than one-half (½) inch and is well cleaned and screened before placing, as it is desirable that the sewage be thoroly aerated as it passes downward toward the tile which drains the plant. Air which enters by means of this tile also serves to supply ventilation to the gravel bed. If it is desired to make use of the gravel filter feature where the natural fall of ground does not permit draining, the perforated slabs can be omitted, raising the floor of the gravel chamber 1 foot 9 inches. The discharge from such a tank can be distributed over the surface of the ground with no fear that odors will cause a nuisance. (It will be seen that the gravel filter in this plant performs the same service as the gravel in the trench "A," Fig. I.)

The size of reinforcing rods, their spacing and location are all shown on the drawing in such a manner that there need be no doubt as to these features of construtcion.

The Universal Portland Cement Co. supplied the plans illustrated, together with the notes detailing construction requirements.

FIG. VI. CONCRETE SEPTIC TANK *similar to the type shown in Fig. II. This shows both compartments as they appear before placing the concrete roof or cover slab. Reinforcing rods from the side walls are bent over to form part of the reinforcing for the cover.*

ROADS AND PAVEMENTS

Fibered Asphalt for Road Surfacing

Fibered asphalt, the use of which on the streets of Charleston, W. Va., was described in MUNICIPAL ENGINEERING for May, 1915, has been used for resurfacing some miles of bituminous macadam highways by the State Highway Department of New York to reduce the excessive cost of maintenance of these roads. These roads are reported to be very satisfactory after about one year of use.

In June, 1916, the Iowa Wood Fiber Asphalt Company, of Davenport, used the material for surfacing a telford-macadam road from which the macadam had practically all been worn away and little was left but the large stones of the telford

I. PART OF BLACKHAWK TRAIL, NORTH OF DAVENPORT, IOWA, TELFORD MACADAM, WITH THE LARGE STONES OF THE FOUNDATION PROJECTING.

base, the spaces between which were more or less solidly filled with the finer macadam material. The area covered with the fibered asphalt wearing surface is on a rather steep grade, as shown by the photographs, a part of the Davenport-Cadda road and of the Blackhawk Trails, north of Davenport, and a short distance beyond the city limits. Traffic is quite heavy. One hour's count in July showed 60 automobiles, 6 heavy motor trucks, 7 buggies and 8 large dump wagons, hauling stone. On account of the grade, and perhaps the drainage, the section requires much repair and is seldom in as good condition as ae road in general.

The macadam base is 16 ft. wide and on much of the length resurfaced the shoulders had been worn down well below the top of the telford base, so that it was necessary to build them up to serve as shoulders for the new fibered asphalt surface.

The white spots in the photograph of the road before improvement are the projecting large stones of the telford base and indicate the difficulties in the way of securing a uniform thickness of the surfacing material, especially since the crown must be flattened.

It was necessary to remove a few of these stones and to knock the tops off of others, but as little of this was done as possible for the reasons that these stones form the foundation of the road. In a few instances the thickness of the fibered asphalt layer over the top of a stone is less than an inch, but the pavement seems to be quite as durable at these points as elsewhere. When the thickness was found to be less than a half inch the pavement was cut into, the stone removed and the hole filled with the fibered asphalt mixture.

All the dirt and loose stones were removed with pick and shovel, followed by sweeping with stiff brooms. The second photograph shows the removal of this material, which in this particular spot consisted of the remains of some gravel dumped on the road in the maintenance of the old road. Just before laying the asphalt layer, the dust was thoroly swept off the road, as shown in the third photograph.

Any material depressions in the surface, and the holes left when large stones were removed, were filled with the hot fibered asphalt mixture, which was tamped in with hot tampers, as shown in the fourth photograph.

After a final sweeping, the fibered asphalt mixture was spread and rolled in the same manner as an asphalt wearing surface, except that no special edging was required, either along the sides or at the end of a batch, as shown in the fifth photograph. A 10-ton tandem roller was used.

No cushion coat is required under the fibered asphalt wearing surface and it was intended to make the average thickness 1½ in., but the irregularity of the surface and especially the projecting large stones of the telford base, made it necessary to increase this average thickness materially in some places

II. CLEANING OFF THE DIRT AND LOOSE STONE DOWN TO THE SOLID BASE.

III. Final sweeping of the dust from the surface ready to lay fibered asphalt cover.

in addition to filling the deeper holes with tamped material ahead of the laying of the regular course.

The sides of the layer were brought out near the edge of the macadam base to full thickness and were tamped so as to give a slope of about 1 to 1. The effect of this tamping can perhaps be seen in the fifth photograph. The roller was then run out to the edge and caused very little spreading of the material, less, in fact, than was allowed for.

IV. Tamping fibered asphalt mixture into the deeper depressions in the road surface.

VI. The completed fibered asphalt surface on an old Telford-macadam base.

V. Rolling the layer of fibered asphalt mixture as spread. Note character of tamped edge along the sides and that rolling does not cause the asphalt to creep in any direction.

After very thoro rolling, a squeegee coat of asphaltic cement was spread, a thin coating of stone screenings and dust was thrown uniformly over it and another thoro rolling was given the pavement. Before this final rolling, the shoulders of the road were built up with a road grader, some gravel being deposited next to the asphalt, and the shoulders were rolled with the pavement so as to make a uniform surface in the cross-section, including both pavement and shoulders. The contractor learned that it is important to have the shoulders well built up and that the gravel must not be too clean, that the rolling may thoroly compact them and not make the side slopes too steep.

In the last two photographs it will be noted that the crown of the asphalted part of the street is quite flat. This was insised upon by the consulting engineer of the Wood Fiber Asphalt Company, of Charleston, W. Va., under whose patents the pavement was laid, because of the steepness of the longitudinal grade. At the bottom of the hill, on the level, a heavier crown was used.

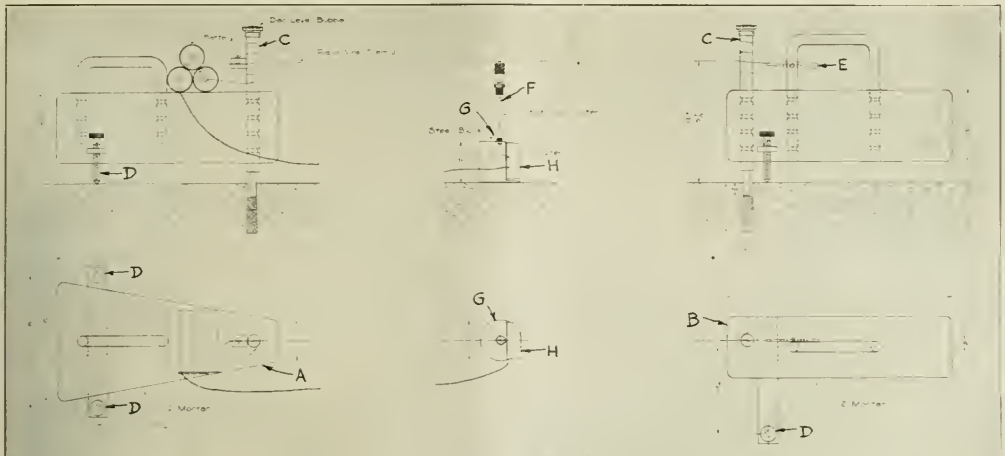
The last photograph shows the completed roadway.

The reports from the road show that it is in excellent condition and that it carries the heavy traffic with very little marking, even with a temperature of 98 degrees in the shade. The edges of the pavement at the ends, where traffic comes onto it, have thinned out to less than ¼ in. and are as tenacious and hold their places as well as the pavement in general with no tendency to break off or disintegrate.

Resistance of Concrete Roads to Wear

In a letter to the editor, P. St. J. Wilson, assistant director of the U. S. Office of Public Roads and Rural Engineering, gives an outline of the plans of his department for testing the ability to resist wear of the materials of which concrete roads are built, and of the finished road, from which the following is prepared:

"For use in concrete road construction it seems to me, in



U. S. OFFICE OF PUBLIC ROADS.

INSTRUMENT FOR MEASURING WEAR OF ROADS.

view of the fact that many gravels differ in their resistance to wear, some sort of test should be included in this specification, governing the wear resisting qualities of the gravel. At the present time this office is developing an abrasion test for gravel concrete aggregate, and the method at present pursued is as follows:

"Five hundred grams each of material passing 1½-inch and retained on 1¼-inch, passing 1¼-inch and retained on 1-inch, passing 1-inch and retained on ¾-inch, passing ¾-inch and retained on ½-inch, and passing ½-inch and retained on ¼-inch, making a total of 2,500 grams, are run in a Deval abrasion machine, together with twenty 1¼-inch steel balls, for 5,000 revolutions. Material passing 1/16-inch is screened out and the residue washed and dried, rescreened as above, and each increment weighed. Pieces retained on each sieve are counted before and after, and the percentage of loss of material under ¼-inch, ⅛-inch and 1/16-inch is obtained. This test seems to be very promising and should aid in selecting a proper gravel for use in gravel concrete roads.

"Relative to abrasion tests on finished concrete, let me say that it is our purpose to make a number of wear measurements on concrete roads already constructed, where the traffic conditions are known. Tests will also be made on the aggregate composing the concrete. It is not believed that this will be of any benefit in permitting of the development of a specification for any particular kind of material, but will rather furnish a comparison of the behavior of the different materials in service. I am enclosing herewith a drawing of the apparatus and a photograph of it in use."

The following description of the drawing will show the construction and method of operation of the apparatus:

Pieces A and B are made of cement mortar and have embedded in them steel rods, C, drilled with holes slightly inclined with the horizontal. A fine piano wire about 0.01 of an inch in diameter is passed thru these holes and is stretched across the road from block A to block B. The tops of these rods are each provided with a disk-level bubble, so that when placed in position in the road the rods may be adjusted to a vertical position. Block A, which is heavier than block B, is provided with two adjusting screws, D, for adjusting rod C to the vertical. Block B rests on two points only, one the lower end of rod C and the other the end of adjusting screw D. Constant tension is produced in the wire by the weight of block B, which is pivoted about the bottom of rod C and is adjusted to a horizontal position by means of rack E, provided at the end of the wire. As the weight of block B is constant, the tension in the wire, and consequently the amount of sag for like spans, must remain the same. A very definite and fixed datum is thus provided, which should remain constant from year to year and which is very easily established by merely placing the end blocks of the apparatus in their proper position on the road.

The bottoms of rods C are spherical in shape; and when in use on concrete roads, they rest on the flat tops of bronze plugs cemented in the road surface. These plugs are ½ inch in diameter and are 1¾ inches long. They are set ¾ inch below the surface, and their tops are protected by means of a brass pipe plugged with a bituminous-sand mixture during the long intervals between readings.

In obtaining the wear measurements a chalk line is first snapped across the road between the bronze plugs, and the points at which it is purposed to take readings are marked on this line. At these points a steel block, G, 2 inches in diameter, is placed, in order to avoid measuring the small local inequalities in the road surface. In the top of this block a flat-bottomed cylindrical recess is made, and an ordinary in-

side micrometer is held in the recess, while its upper end is adjusted to contact with the steel wire stretched across the road. An electric buzzer, H, is mounted on the side of this block, and when contact is made between the micrometer and the wire an electric circuit is completed thru the buzzer. With this instrument readings for wear may be taken to the nearest 0.001 inch, altho this degree of accuracy will not be necessary.

Holes in the road in which the bronze plugs are set are drilled by means of a special hand-operated drill press carrying a star drill.

In the photograph of the apparatus in operation, the method of mounting the apparatus in the road and its manipulation are plainly shown. On the right is the heavier end block carrying the batteries, and on the left is the lighter block the weight of which supplies constant tension to the fine steel wire, extending between the blocks. The cord extending on the road surface from the heavier block to the small steel block carrying the micrometer is one of the leads from the battery to the electric buzzer. Placing the buzzer in this position near the operator obviously is advantageous, especially when the instrument is to be used amidst the distracting noises of traffic. The end blocks are set as near to the sides of the road as practicable, in order to permit measurements being taken across almost the entire width of the road. Should longitudinal cracks develop thru the sections measured, the readings so taken will be rendered useless; and in order to eliminate this difficulty, sufficient plugs must be set to permit obtaining readings at uncracked sections.

Wear measurements of this kind taken of the actual road surface should prove of great future value if the traffic conditions and the physical characteristics of the concrete materials likewise are known, and should help to decide present moot questions regarding concrete roads and road materials. Not only may concrete surfaces be measured for wear in this manner, but the wear of vertical movement of other kinds of road surfaces may likewise be determined by the use of this instrument.

The Value of Concrete for Roads

The Iowa State Highway Commission has published its first technical report, prepared in co-operation with the Good Roads Section of the Engineering Experimental Station at Iowa State College. It is entitled "An Investigation of Concrete Roadways," and its authors are T. R. Agg and C. B. McCullough. It is intended to supply the information concerning road surfaces, so far as concrete is concerned, which is asked for constantly by city and county officials and others. The city of Des Moines, in particular, has aided in the investigation that it might have the results as soon as possible for its own use.

The earlier chapters are studies of the failures in concrete streets in the city of Des Moines, showing the influence of classified factors producing the defective pavements, eleven classes of defects being attributed to inadequate specifications, fifteen to lax inspection and two to incorrect design. The lack of maintenance is also shown in its effect on condition of pavements.

Recommendations relative to specifications and inspections are given in one chapter, which goes into detail as to subgrade, methods of mixing and laying materials, joints, reinforcements, cement, fine, coarse and mixed aggregates and water.

The methods of making field and laboratory examinations and their results are given in much detail, with full reports of the data obtained from the individual streets examined.

Laboratory tests of concrete pavement samples are also fully discussed.

The last chapter, in an appendix, presents a theory of the wear of concrete roadways in first and second stages, transverse cracks and longitudinal cracks, and the book closes with a tabular analysis of current concrete paving practice.

Many of the matters treated will be discussed in detail later and communications on the subject are invited from our readers after they have had an opportunity to study the report.

National Aid for Good Roads

Congress has finally passed a good roads law, which is perhaps as good a law as could be expected at this time. It sets aside $10,000,000 to construct roads in the national forests and provides for distributing to the states $75,000,000, beginning with $5,000,000 the first year and increasing $5,000,000 each year until $25,000 is reached in the fifth year. Of this sum one-third is to be distributed among the states in proportion to their area, one-third in proportion to population, and one-third in proportion to mileage of star and rural delivery mail routes.

It is intended that none of this money shall be expended except thru a state highway department, and then only when the state appropriates an equal sum, so that the United States Government will not pay more than half the cost of any road. However, in the few states not now having state highway departments, smaller subdivisions of the state can obtain shares of the money if they act before the legislature meets. After the state has had such an opportunity to establish a State Highway Department, and has failed to do so, it cannot receive any part of the appropriation.

The Department of Agriculture must approve of the locations and specifications on which the roads are to be built and of the completed roads, before the government payments can be made.

These provisions will doubtless cause highway departments to be established in the few states without them, and also the appropriation of state funds for road construction in the larger number of states which have not yet made any such appropriations.

There have been some of the usual objections to national appropriations on the ground that road construction is a local problem. It is quite as local as the tariff problem, but scarcely more so under modern conditions of intercommunication. This argument might be good with the committee of a certain legislature, who did not need any one from the state or national capitals to tell them how to build roads; they knew what kind they wanted and how they should be made. Most of the committee belonged also to that portion of the community which emphasizes states' rights. But apparently most of the population approves of the national appropriations, provided they are expended on thru routes between states and not upon purely local mail routes, with little or no other travel.

Good Roads Notes

In 1905 there were 48,000 motor cars in the United States; in 1915 there were 2,445,664, an increase of 5,000 per cent. In 1905 less than three-tenths of 1 per cent of the money spent on account of building rural roads and bridges was derived from motor vehicle traffic; in 1915 nearly 7 per cent was derived from this source.

The help that a state highway department can give to local road officials in saving the taxpayers' money embraces many things which are not often anticipated. For instance, the Montana Highway Commission compiled a schedule of the prices paid for road material in the counties of that state and found a variation of 100 per cent in the cost of culvert pipe to the different counties. The attention of the local authorities was called to this variation, and as a result the prices thruout the state have become more uniform and the former very high prices ruling in a few counties have been reduced.

MISCELLANEOUS

The March of Events

August 29-31, at Johnstown, Pa. League of Cities of Third Class in Pennsylvania. F. H. Gates, secretary, Wilkes-Barre, Pa.

September 4-8, at Lexington, Ky. Southern Appalachian Good Roads Association. Joseph Hyde Pratt, secretary, Chapel Hill, N. C.

September 13-15, at Tacoma, Wash. Washington State Association of County Commissioners. J. C. Hansen, secretary, Port Angeles, Wash.

September 14, a joint session will be had of the State Associations of County Commissioners, County Engineers and City Engineers.

October 2-6, at Grand Rapids, Mich. Playground and Recreation Association of America. H. S. Braucher, secretary, 1 Madison avenue, New York.

October 9-13, at Robert Treat Hotel, Newark, N. J. American Society of Municipal Improvements. Charles Carroll Brown, secretary, 702 Wulsin Building, Indianapolis, Ind.

October 17-20, at Chicago, Ill. American Gas Institute. Geo. G. Ramsdell, secretary, 29 West Twenty-ninth street, New York.

December 6, at New York. Society of Gas Lighting. Geo. G. Ramsdell, secretary, 29 West Thirty-ninth street, New York.

December 6-8, at Washington, D. C. National Rivers and Harbors Congress. S. A. Thompson, secretary, 824 Colorado Building, Washington, D. C.

December 5-8, at New York. American Society of Mechanical Engineers. Calvin W. Rice, 29 West Thirty-ninth street, New York.

December 26-31, at New York. American Association for the Advancement of Science. L. O. Howard, Smithsonian Institution, Washington, D. C.

January 20, 1917, at Kansas City, Mo. Western Paving Brick Manufacturers' Association. G. W. Thurston, secretary, 416 Dwight Building, Kansas City, Mo.

January 23-25, at New York. American Wood Preservers' Association. F. J. Angier, secretary, B. & O. Mt. Royal Sta., Baltimore, Md.

Civil Service Examinations

The United States Civil Service Commission will hold examinations at the usual places as follows:

August 8: Senior highway engineer in the Office of Public Roads and Rural Engineering, Department of Agriculture, at $2,200 to $4,000.

August 23, 24: Laboratory assistant in the Bureau of Standards, Department of Commerce, at $900 to $1,200.

Publications Received

The proceedings of the Second National Conference on Concrete Road Building in February have been received from the office of the secretary, J. P. Beck, 111 West Washington street, Chicago, Ill. The price is $1.

"Markets for Machinery and Machine Tools in Argentina" is the title of a 63-page report by Special Agent J. A. Massel, published as No. 116 of the Special Agents' Series of the U. S. Bureau of Foreign and Domestic Commerce. The price is 20 cents.

Report for 1915 of City Comptroller of St. Paul, Minn. W. C. Handy, comptroller.

The March bulletin of the New York State College of Forestry, Syracuse, N. Y., contains "Suggestions for Proper Procedure in Systematic Street Tree Planting for Towns and Cities of New York," by Henry R. Francis, assistant professor of landscape extension.

Water Purification Plants and Their Operation, by Milton F. Stein, assistant engineer of design, Cleveland filtration plant. A manual primarily for operators of water purification plants and also of interest to water works chemists and engineers. Cloth, 247 pp., $2.50. John Wiley & Sons, New York.

Forestry in Relation to City Building, by T. P. Lukens. Bulletin of Throop College of Technology, Pasadena, Cal.

The Model T Ford Car, Its Construction, Operation and Repair, by Victor W. Page. Cloth, 300 pp., $1. Also the Ford Trouble Chart. 25 cents. The Norman W. Henley Publishing Company, New York.

Municipal Accounting, by Dewitt C. Eggleston, M. E., C. P. A., Fellow of American Association of Public Accountants. Half leather, 456 pp., $4. Ronald Accounting Series, the Ronald Press Company, 20 Vesey street, New York.

Conservation of Water, by Walter McCulloh. Yale University Press, New Haven, Conn.

Conservation of Water by Storage, by Prof. George F. Swain, Harvard University. Yale University Press, New Haven, Conn.

Annual report of the city engineer of Cambridge, Mass. L. M. Hastings, city engineer.

Report of Water Department of Atlantic City, N. J., for 1915. L. Van Gilder, engineer and superintendent.

Design and Construction of the Massachusetts Institute of Technology Buildings, by Sanford E. Thompson, 141 Milk street, Boston, Mass. Paper, 21 pp.

Tests of Three Large-Sized Reinforced Concrete Slabs Under Concentrated Loading, by A. T. Goldbeck and E. B. Smith, reprinted from the Journal of Agricultural Research of the U. S. Department of Agriculture; also, A New Penetration Needle for Use in Testing Bituminous Materials, by Charles S. Reeve and Fred P. Pritchard.

Annual Report of Water Commissioner of Somerville, Mass., for 1915. Frank E. Merrill, water commissioner.

Railways as a Part of a System of National Defense. An

address by W. L. Park, vice president Illinois Central Railroad, before the International Association of Railway Special Agents and Police, at New Orleans, La., May 25, 1916.

The report of the County Highway Commission of Milwaukee county for 1915, which has just been issued, and in which there is much valuable information for those who are considering concrete roads. Mr. H. J. Kuelling, commissioner of Milwaukee county, has been responsible for a great increase in concrete roads in Milwaukee county during the past two years. Maintenance figures on concrete taken from Mr. Kuelling's report furnish more corroboration of experiences in maintaining well-built concrete pavement. The average cost per mile of maintaining the concrete was $35.01, equal to a square yard cost of .0034 cent. These figures are deduced from maintenance work involving 46.47 miles of Milwaukee concrete pavement.

Report of the operations of the Engineer Department of the District of Columbia for year ending June 30, 1915. Major Charles W. Kutz, engineer commissioner, Washington, D. C.

The National Board of Fire Underwriters, New York, has issued a proposed standard schedule for grading cities and towns of the United States as to fire prevention and extinguishing conditions and facilities which covers all the fire hazards, public and private, and the methods of offsetting them. If adopted it should eliminate much of the controversy over inequitable insurance rates by putting all cities on the same basis and putting it up to them to reduce their points of deficiency and thus elevate their class standing and lower their insurance rates.

Farmers' Bulletin No. 698 of the U. S. Department of Agriculture describes machinery of all sorts suitable for trenching for laying tile drains, from plows and scoops for small jobs, to wheel excavators, endless chain excafators and scraper excavators for jobs large enough for the use of greater or less power. The outfits range in price from $18 for a ditching plow to $6,000 for an elaborate power machine.

"A Handbook of Civic Improvement," by Professor Herman G. James, is published by the author at the University of Texas, Austin, Tex., in paper, at $1. Its 119 pages show what is to be expected of a city government in the line of civic sanitation, and what civic organizations can do to improve conditions. It has a brief bibliography of books on branches of the subject, which is not very complete, and series of questions for thoro surveys of communities upon each of the special subjects treated.

Suppression of Disease Carriers

The recent epidemic of poliomyelitis, or infantile paralysis, has again emphasized the necessity of getting rid of flies, as well as of other insects and small vermin.

The gradual elimination of the horse in the city will greatly reduce the fly nuisance, but meantime the greatest results can be obtained by applying to the removal of all refuse the same sanitary principle of promptness which is proposed for street sweepings in New York. Manure from stables, as well as from street sweepings, can be made practically fly-proof by treatment with chloride or hypo-chlorites, with little or no injury to its use as fertilizer, or in time of danger it can be incinerated with other waste and garbage, tho difficult to burn alone.

Sanitary closed cans for the deposit of garbage by householders and prompt collection of the cans or of the garbage in closed wagons, into which the cans can be emptied without opening them to the air, will do more than anything else a city department can do to eliminate not only this, but rats and other vermin, stray cats and dogs. All the city's refuse is subject to suspicion as to its sanitary condition, and similar care should be taken in its removal. If the incineration plan of disposing of all the city's refuse is used, by far the most sanitary method, all refuse and garbage can be collected together, the sanitary closed cans being used for everything, including ashes, except wood, old mattresses and other material too large for them.

The clean-up week in the spring, before fly time has begun, will do much to delay, at least, the development of the fly nuisance and is a valuable adjunct of the city's campaign for cleanliness. St. Louis has two clean-up weeks a year, and takes care of them without strain by making the extra collections in districts, stretching the week far enough to let all the districts in, each on its fixed days for the special collections.

Personal Notes

O. E. Carr is city manager of Niagara Falls, N. Y.

Frank Lotz is city engineer of Vader, Wash.

Ralph L. Rizer has been promoted to city engineer of Cumberland, Md., by the new city commission.

H. Moseley is city engineer of Dallas, Tex.

E. S. Hathaway is city engineer of Missoula, Mont.

Monty Hulse has been appointed city engineer of Sumner, Wash.

F. R. Marsh has been appointed city engineer of Great Falls for another two-year term.

Oscar D. Chrisman has been promoted to city engineer of Springfield, Mo.

Burger and Clarke is the title of the firm of patent attorneys at 2 Rector street, New York, which succeeds to the offices of Moore and Clarke and C. L. Burger.

J. C. Schmutz is city engineer of Pawnee City, Neb.

H. G. Roby has been appointed city manager of Alpena, Mich.

George Summers, recently chief engineer of the Citizens' Gas Company and now its consulting engineer, has opened offices at 904 Hume-Mansur building, Indianapolis, Ind., for practice as consulting engineer, appraiser of public utilities and efficiency expert.

George W. Tillson, M. Am. Soc. C. E.; Henry G. Shirley, M. Am. Soc. C. E., and Arthur H. Blanchard, M. Am. Soc. C. E., a commission of engineers, appointed by the Wilmington Chamber of Commerce, have recently submitted a report on the administration, construction and maintenance of highways which are under the jurisdiction of the Levy Court of New Castle county, Delaware.

The Dayton, O., office of the Morgan Engineering Co., of Memphis, Tenn., has been incorporated as The Dayton Morgan Engineering Co., with Arthur E. Morgan as president; L. L. Hidinger, vice president; M. H. Sayford, treasurer; S. B. Hutton and C. A. Bock, secretaries. Their specialties are flood control, drainage and reclamation engineering.

N. A. Kramer, of Magnolia, Miss., has been elected State Highway Engineer.

J. Ellingston has been promoted from city engineer to city manager of Sherman, Tex., vacancy left when Karl M. Mitchell, former city engineer and Mayor J. W. Hassel resigned.

Stephen L. Selden has resigned as vice president of J. G. White & Company, Inc., and has resumed the practice of the law. He has associated himself with Hardie B. Walmsley and Francis L. Kohlman, heretofore the firm of Walmsley & Kohlman, at No. 61 Broadway. The new firm will practice under the name and style of Selden, Walmsley & Kohlman, and will have its offices at No. 61 Broadway.

Wm. F. Cocke has been appointed State Road Commissioner of Florida.

Frank H. Zouck is the new chairman of the Maryland Road Commission.

MACHINERY AND SUPPLIES

The Dorchester Tunnel Under Boston Harbor

By George E. Wolcott, Boston, Mass.

A tunnel-driving project of considerable importance is under way at the present time in Boston, Mass. This is an extension of the subway system from the city proper to South Boston, under Fort Point Channel in Boston Harbor, a distance of approximately one mile under the water. The work is being done by P. McGovern & Company, contractors, who were the successful bidders, at about $2,500,000. The entering shaft is at a point near the South station of the New York, New Haven & Hartford railroad and the exit at West First street and Harrison avenues, South Boston.

The tunnel comprises two separate parallel tubes, each 24 feet in diameter. These are being driven by the caisson method from the South Boston end. One has advanced about 1,700 feet in blue clay, while the other, which has encountered hardpan and coarse gravel, has been driven about 1,000 feet. The rate of progress averages 15 feet per day in the clay, and 12 feet in the gravel. The work is, of course, continuous, the men working in eight-hour shifts.

As the tunnels are being driven wholly in compressed air, the most vital and important part of the power plant consists of the air compressors. These are three in number, all being class "WC" Sullivan tandem compound Corliss air compressors, with steam cylinders 16 and 28 inches, air cylinders 24 and 14½ inches in diameter, and a common stroke of 24 inches. Two of these machines are arranged for single stage compression, eachhaving a displacement of 2,058 cubic feet free air per minute, at a normal speed of 120 r.p.m. and are suitable for a maximum pressure of 30 pounds to the square inch. The third machine, while of the same dimensions, compresses air in two stages against a maximum pressure of 120 pounds, and has a displacement of 1,500 cubic feet free air per minute at 120 r.p.m. A fact worthy of note in this connection and applying with particular force to a plant of this kind, where both high and low pressure air is being used or required, is the case with which this tandem type of Sullivan air compressor can be converted from compound or two-stage to single stage and vice versa without any change necessary other than the removal or attaching of the inter-cooler and re-arrangement of inlet and discharging piping. These compressors also secure the highest possible steam economy, due to the fact that both high and low pressure steam cylinders are equipped with full Corliss valve gear, the point of cut-off being automatically varied to operate the compressor in the most economical manner by means of a special speed and pressure regulator, which is under the influence of the receiver pressure.

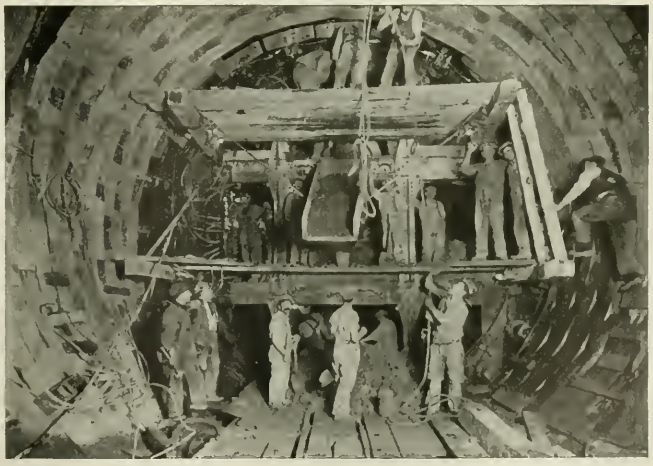
The boiler plant comprises four 150-h.p. Hodge horizontal return tubular boilers. The steam pressure is 150 pounds and a large condenser of the jet type is used. Large after-coolers are attached to the discharge pipes of both of the low pressure compressors, in order to reduce the temperature and humidity of the air in which the men have to work.

The splendid performance and economy already secured by the above plant as a whole is a source of much satisfaction to the owners, altho as yet it is operating below its full capacity. It is anticipated that even better results will be secured when the full power of the equipment is required as the work progresses.

Up to the present no rock whatever has been encountered, nor is any anticipated, aside from boulders, as the formation or deposit under the greater part of Boston Harbor, as well as under the eastern section of the city proper, thru which the existing subways have been driven, consists chiefly of blue clay with very little, if any, rock. At greater depths, under the clay, soundings indicate a slate formation, but this is not likely to be reached in the driving of the present tunnel.

The air pressure required in the shield thus far has not ex-

HEADING *in the Dorchester tunnel, showing the shield, hydraulic apparatus, and lining forms.*



ceeded 21 pounds to the square inch, altho it is expected that it will be necessary to increase this to 25 or 27 pounds when maximum depth under the harbor is reached at approximately 60 feet below the surface of low tide.

The two caissons or shields were furnished by the Boston Bridge Works and have cutting edges 26 feet in diameter. Each is forced ahead by twenty-four hydraulic jacks having a possible maximum water pressure of 100 tons behind each jack. They are thus capable of exerting a combined force of 2,400 tons if necessary to advance the caisson.

The progress thus far made in the driving of the tunnel has been somewhat more rapid than anticipated and it is expected that the work will be completed about October 1, 1916.

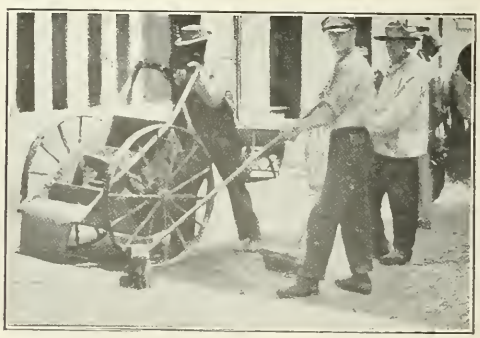
Atlantic Pumping Engines for Sewer and Conduit Repair Work

One valuable application of the Atlantic pumping engine, sold by Harold L. Bond Co., 383-391 Atlantic Ave., Boston, Mass., is to pumping water from manholes in sewers or conduits and then supplying air to the men making repairs therein. The plants are built for continuous operation with engine set in center of the hand truck, diaphragm pump at one end and blower at the other. The pump capacity is 2,500 to 4,000 gallons an hour according to speed at which pump is operated. They require little attention to keep them supplied with fuel and in condition for continuous operation. The engine cylinder is 4-bore, 4-stroke, generating 2 h. p. The pump is the No. 3 Atlantic shear-pin-beam diaphragm and the blower is No. 4, with belt coupled up ready to operate. Suction and discharge hose, couplings, valves, strainers and diaphragms are supplied to suit the individual needs of the purchaser.

The Jaeger Grout Cart

We are illustrating the Jaeger grout cart as used by prominent contractors in brick paving construction.

This outfit is equipped with paddles which keep the grout in constant state of agitation until finally deposited upon the pavement. The grout is first thoroly mixed in a moderate sized concrete mixer and is then deposited in the grout outfit, which is wheeled to the spot to be grouted. The mixer is placed with material at intersection or side of road or street. After the grout is mixed the entire batch is discharged from the mixer into one of the grout carts which is pushed by one man to the exact spot desired. Paddles inside revolve as the cart moves along, keeping the well-mixed grout assorted and preventing the sand from settling. When the proper place is reached, the cart is tipped and discharged and partly spreads the grout ready for the broomers to squeegee or finish. It is claimed that this method not only improves the quality of the grouting in every way but reduces the cost of labor to one-third of the hand method, as well as causing the grouting operation to be done in considerably less time than by the old puddling tub. This type of cart is made by the Jaeger Machine Co., Columbus, O.



25,000-Gallon Concrete Reservoir

By J. A. Currey, Portland, Ore.

The new reservoir for the city of Monroe, Ore., is shown in the course of construction in the accompanying illustration. The view shows the Hy-Rib reinforcement in place before any concrete has been applied.

To complete the reservoir all that is necessary is to plaster the cement mortar on the reinforcement. No wood forms whatever are necessary in constructing the walls. The thin concrete shell is made up entirely of plaster coats of cement

mortar. The thoro reinforcement prevents any cracking under the strains of water pressure. This new reservoir has a capacity of 25,000 gallons, and an idea of its size is given by comparison with the men standing beside it. The reservoir is used in connection with the water system of the city of Monroe, which is a center of a large farming district in Oregon. The reservoir has proven highly satisfactory, and Mr. Francis has expressed himself as highly pleased with the results.

The reservoir was constructed by W. D. Straisser, Portland, Ore., under the direction of Mr. Charles Francis, chairman of the water board. Hy-Rib reinforcement was furnished by the Trussed Concrete Steel Company.

Detroit-Superior Bridge Construction

The recently completed 591-foot 3-hinged arch span of the Detroit-Superior high level bridge at Cleveland is said to rank third in span length in this country, being exceeded only by Hell Gate arch and Niagara arch.

Work on the east end of this arch was begun July 25, 1915, and on the west end August 26. The closure was made October 8. The actual working time on the west half was 32 days of 8 hours each, during which time about 1,250 tons of steel were placed. So accurate was the design and construction of the two halves of this arch that they lined up within a small fraction of an inch.

The equipment used for handling the steel put in this structure consisted of four 25-ton stiff-leg derricks, electrically operated, two being on each side. The material was hoisted from scows in the river.

The steel for this space was fabricated by the King Bridge Co., of Cleveland, and it was erected by the Ferro Construction Co., of Chicago, of which concern F. C. Fisher is president and F. F. Buck, superintendent of construction. The concrete arch approach work for the structure was done by the Hunkin-

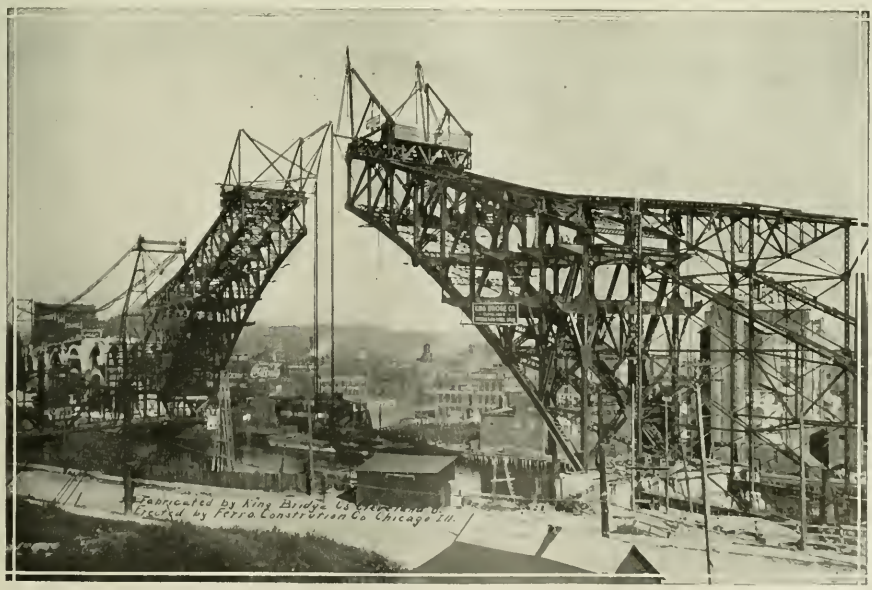
AFTER THE ARCH WAS CLOSED THE DERRICKS WERE USED TO ERECT THE DOUBLE-DECK FLOOR STEEL, BEGINNING AT THE CENTER AND WORKING OUT.

Conkey Construction Co., and this part of the work was described in MUNICIPAL ENGINEERING for August, 1915.

This bridge complete has a total length of 2,880 feet. It spans the Cuyahoga river and the wide valley adjacent to it, and connects Detroit avenue on the West Side with Superior avenue on the East Side. Two decks are provided, the upper deck to be used for highway traffic and the lower for street railway traffic. The upper deck is to have a 44-foot, 9 inch roadway and two 12-foot sidewalks, while the lower deck will carry six street railway tracks.

The two illustrations herewith are shown thru the courtesy of the A. Leschen & Sons Rope Co., St. Louis, Mo.

A VIEW OF BOTH SIDES OF THE ARCH. THIS ILLUSTRATION WAS MADE FROM A PHOTOGRAPH TAKEN SEPTEMBER 29. THE ARCH WAS CLOSED OCTOBER 8.



New Motor Truck Chair Car

The Interurban Motor Transportation Co., is operating McKeen highway motor coaches, between Minneapolis and St. Paul, Minn., with great success.

This type of motor chair-car introduces a new epoch in city, rural and interurban passenger transportation facilities. It discards the antiquated details of vehicular construction and incorporates the new and up-to-date designs of the McKeen railway gasoline motor car. It removes the universal criticism of the common bus—the discomfort due to unevenness of the road surface, all shocks, jars, etc., being entirely eliminated by its especially designed, patented, new, air-cushioned, steel spring, individual seat.

Its owners state that it is not an omnibus, nor a street car, nor a jitney, nor an electric car. It runs on paved streets.

The individual chairs with which this highway coach is equipped create a sensational advent in public service utilities. It is a new (patent applied for) pneumatic shock-absorbing cushioned seat, the remarkable elasticity and resiliency of which are obtained by four air cushions differentiated on each other and operating in conjunction with a 2-foot spiral steel spring.

MOTOR TRUCK CHAIR CAR. SEVERAL STEPS IN ADVANCE OF THE JITNEY BUS.

Adequate heating facilities are obtained from the waste product of the truck engine, there being twice the necessary heat units available for maintaining proper temperature of the car interior in the coldest of winter weather. The expense of installing and operating separate equipment for heating is therefore eliminated.

Entrance to the car is gained thru two-leaf, paneled, outward folding door beside the driver's position, the prepayment fare collection being under his supervision. Exit is thru double-leaf, paneled, outward folding doors in the side near the rear.

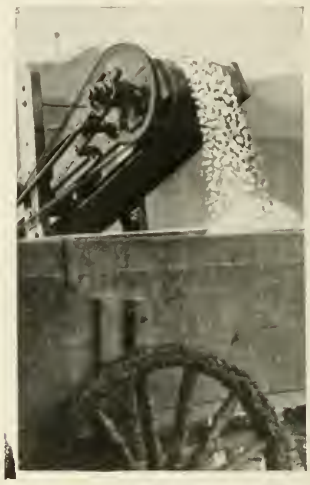
Passengers enter the car at the curb, thereby avoiding the congestions in street traffic. The entrance being only 15 inches from the ground makes the initial step from the curb approximately 7 inches.

This motor chair-car, as described, is designed and built by the McKeen Motor Car Co., Omaha, Neb.

The Burch Stone Unloader

The Burch stone unloader, as illustrated, requires that a small pit be dug under the track at the unloading point. This pit, next to the elevator, should be approximately 30 inches deep, about 32 inches wide and 20 inches deep at opposite side of track.

The stone is dropped from cars upon the platform, the feed doors of which can be opened one at a time and regulate the feed to the belt. The stone is conveyed to wagon by a continuous belt which runs at a speed of 225 feet per minute, delivering the stone to wagon at a rate of one cubic yard per minute. This machine, which is made by The Burch Plow Works Co., Crestline, O., is capable of handling any size stone that will be used on road improvement, it being necessary to regulate the width of opening in feed door according to size of stone.



The belt is a regular coveyor belt, is 16 inches wide, 4-ply, ¼-inch rubber top covered and made especially to insure durability. The machine is so constructed that the elevator can be set at an angle of 26 degrees and with ground, where wagon sets, level with track, end of elevator will be 7½ feet from ground. Machine is guaranteed to carry stone at an elevation of 29 degrees, so it can be raised much higher than 7½ feet if necessary.

A clutch is provided at end of elevator within reach from wagon and when wagon is driven under it the driver simply throws in clutch, fills his wagon, then throws clutch out, and machine is waiting on next wagon, the engine running continuously. It will thus be seen that belt is always loaded to end of elevator ready to throw stone on wagon the moment clutch is thrown in, thus avoiding any delay in waiting for stone to be carried from car to end of elevator before starting to load.

Ford Pulls Ore Cars

We are indebted to "Popular Science Monthly" for the illustration showing a Ford automobile, which on fast reaching the end of its usefulness in a mine in Texas, was recently knocked apart, put together again on a short, heavy chassis, and mounted on railroad wheels for use on a narrow-gage track Altho the automobile has been driven more than 12,000 miles, it fell to its new task with a will and has been behaving admirably ever since.

The weight of the full load pulled by the improvised locomotive, consisting of three 2-ton ore-cars, is about 16,800 pounds. Dragging this weight between various points about the camp it travels on an average of 18 miles a day, consuming during that time about 4½ gallons of gasoline and 1 gallon of oil.

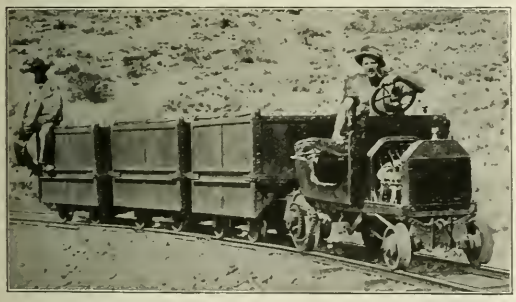
The cost of converting the touring car into a day laborer was $150.

Mr. E. M. Glenn, superintendent of the Presidio Mining Co., Shafter, Tex., in explanation of this conversion, writes:

"We haul three 2-ton, side dump ore cars, the total load being about 16,800 pounds, but with roller bearings it is possible that we could haul three more or a total of six, but in our case there is no necessity for doing so.

"About 1 per cent is the maximum grade we have, but there are many sharp curves. The track is 24-inch gage and laid with 20-pound rails. It is about 1 mile between terminals and at each terminal we have a turn-table.

"In converting the automobile to a motor, we shortened the driving shaft and moved the differential close to the transmission case, cut off the rear axle and used it for a jack-shaft, driving from it to the rear wheels with sprockets and chain. The gear reduction by the sprockets being 2:1, the small sprocket on the jack-shaft having 18 teeth and being 6 inches in diameter; the large sprocket on the rear wheels having 36 teeth and being 12 inches in diameter. The wheels are fitted with roller bearings and run on axles which are 1¾ inches in diameter. The channels of the frame were stiffened with heavy angle iron and a heavy iron strap made to take the place of the forward point of suspension, the strap passing under the engine and being fastened to the channels on either side. It was found that the machine does not work well using the built-in magneto of the flywheel and we put on a Bosch magneto, which gives reliable service and at least 30 per cent more power. In order to get traction it is necessary



A FORD AUTOMOBILE WHICH WAS CONVERTED INTO A MINE LOCOMOTIVE AT A COST OF ONE HUNDRED AND FIFTY DOLLARS. (COURTESY OF POPULAR SCIENCE MONTHLY.)

to place a heavy weight on the platform over the rear wheels.

"There were no other changes made than the above mentioned. The motor travels about 18 miles per day, consuming about 4½ gallons of gasoline and 1 gallon of lubricating oil. The total cost of making the changes, not including the Bosch magneto, was $150. We have two of these motors in service and one of them was driven as an automobile some 12,000 miles and has been pulling ore cars for two years. The cost of repairs is small.

"I do not know the maximum grade these machines could be used on, but I should think with a 3:1 gear reduction they might handle the load on a 2½ to 3 per cent grade."

Electric Tractor Shifts Cars

We are illustrating an electric tractor as used by the Pennsylvania Railroad Company to shift freight cars in the streets of Jersey City. On one of the wheels is a Kelly-Springfield sectional block tire which has seen twenty-two months' continual service.

It has been estimated that this tractor does the work of twenty mules. This outfit is equipped with two motors, each

GIANT ELECTRIC TRACTOR WHICH DOES THE WORK OF TWENTY MULES.

having a capacity of 20-h.p. It weighs 28,850, each wheel alone weighing a ton. The wheels are 60 inches in diameter. The truck straddles the railroad tracks, which, in city streets, are laid flush with the pavement. As showing the capacity of the tractor, it can start a draft of six loaded, 50-ton freight cars on the mountain grade of the Pennsylvania railroad—that part of the railroad from Altoona, Pa., to the crest of the Allegheny mountains.

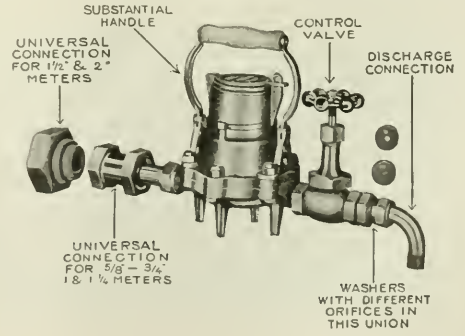
Portable Testing Water Meter

We are illustrating a portable testing meter, as devised by the Buffalo Meter Co., Buffalo, N. Y., which may be used in the meter repair shop or carried from place to place and the service meters tested without removing them from the pipes.

The test is made by connecting the testing meter in tandem with the service meter so that the same volume of water passes thru both, any error in the service meter being shown by the difference in registration of the two meters.

The testing meters are made in two sizes—the smaller, or ⅝-inch size, is provided with a connection for attaching to all meters of sizes from ⅝-inch to 2-inch, inclusive; the larger, or 1½-inch size, has a connection for attaching to 3-inch, 4-inch and 6-inch flanged meters. Each size consists of the meter with handles, connecting fittings, control valve, orifice washers and discharge connection. The dials indicate cubic feet or United States gallons at buyer's option.

The method of testing a meter in service is as follows: Shut off water at stop and waste cock; disconnect service meter on outlet side; attach the testing meter direct to the service meter by means of the universal fitting; open control



valve of testing meter; turn water on slowly at stop and waste cock, allowing several cubic feet to run so as to expel all air from the meters; then shut of water at testing meter control valve so as to stop the first hand of the service meter exactly at 0.

Next turn the frictional set back hand of the testing meter to O. The meters are now ready for the actual test, assuming that provision has been made for running off the discharged water thru a hose or otherwise.

If a test of any size meter from ⅝ to 2-inch is being made with the ⅝-inch testing meter, run thru either 10 cubic feet or 100 United States gallons of water (according to style of dial) and stop hand of service meter exactly at 0. Then see if the amount registered by the testing meter is different from the service meter; in a test of this quantity each of the numbered graduations on the circle of the testing meter represents 1 per cent from which the percentage of inaccuracy of the service meter (if any) may be immediately read.

Example: A service meter has registered 10 cubic feet and the testing meter 10.4 cubic feet. The service meter is therefore about 4 per cent slow.

If it is desired to test the service meter on smaller flows, disconnect the union at discharge end of testing meter, insert one of the orifice washers, and proceed with test same as before.

The method of testing with the 1½-inch testing meter is the same, tho it is often necessary to tap the pipe or change it some to connect the testing meter.

It is customary to adjust new meters to measure within 2 per cent of absolute accuracy. Old meters in service are not usually expected to measure quite as closely.

However, if they are found to be too far off, they may be adjusted by means of new change gears with more or less teeth. The change gears are just beneath the indicating mechanism.

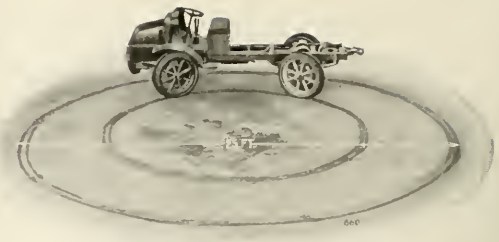
Walter Four-Wheel Drive Tractor

The Walter four-wheel drive tractor, as illustrated, which drives, steers and brakes on all four wheels, is quite extensively used in foreign military service. While it has not as yet been placed on the market for contracting work in this country, it nevertheless possesses obvious advantages, as the application of power to each of the four wheels makes each wheel a pulling unit, prevents skidding, and enables the tractor to climb over obstructions and negotiate hills, mountainous country, muddy and sandy roads, etc. This outfit is designed to carry a two-ton load and haul up to eight tons, on one or more trailers, depending upon the condition of the road and grades. A powerful four-cylinder, four-cycle, vertical engine, designed especially for tractor service, furnishes the power and operates at a normal crankshaft speed of 1,200 revolutions per minute.

This tractor possesses the added feature of being equipped with irreversible, positive drive differentials, of a special type, which give positive drive to all four wheels and eliminates the use of a separate differential lock. These differentials are of a new and distinct type, and are so designed that the entire motive power is applied to that particular wheel or wheels having traction, although one, two or even three of the wheels are on a slippery surface.

These irreversible, positive-drive differentials make it possible to drive this tractor even though the condition of the road offers traction to only one wheel, and on striking soft roads none of the momentum of the tractor is lost by the necessity of stopping to throw in a differential lock, as is required with the ordinary type of differential.

The steering gear is so designed that all four wheels can be turned to an angle of 30 degrees, which enables the tractor to turn (either forward or backward) within a circle of only 25 feet in diameter. The wheels are heat-treated open-hearth steel castings with hollow spokes and rims, provide maximum strength, and are mounted on oversized taper roller bearings. Both front and rear wheels are equipped with dual 1000x100 m.m. solid rubber tires.



THE WALTER FOUR-WHEEL DRIVE TRACTOR MAKING COMPLETE TURN IN CIRCLE 25 FEET IN DIAMETER.

A spring drawbar located at the extreme rear end of the frame takes up the starting and stopping strains and road shocks when hauling trailers.

A powerful winch, equipped with 100 feet of ⅝-inch cable and driven by a worm gear, is also provided, for extricating the tractor (either forward or backward) from soft ground, muddy and sandy places that offer no traction to the wheels, and for pulling up trailers for coupling, assisting in loading, etc.

The trailer hook, which is of ample strength, is mounted in the rear cross-member of the frame, and is provided with an automatic lock, which allows the instantaneous application of a ring or trailer drawbar to the hook and securely locks it in place in such a manner as to positively prevent accidental disengagement. The trailer hook is also provided with a large helical spring, so wound as to take up the road shocks and starting and stopping strains (when hauling trailers), thus insuring a smooth change of gears.

The powerful winch, equipped with 100 feet of ⅝-inch cable and driven by a worm gear, is located at the rear end of the tractor. The winch head is 13 inches in diameter and 18 inches long between its flanges, and may be disconnected from the worm gear to permit the unwinding of the rope or cable from the drum without operating any part of the driving mechanism. The winch worm gear is operated by a lever at the extreme right of the driver and is actuated by a shaft, driven and controlled from the transmission gear case.

New Trigonometric and Numerical Computer

To simplify and extend the use of the slide rule a new circular computer has been devised. It is shown in the illustration, and consists of two graduated dials rotating concentrically, with a running arm, and a transparent protecting cover.

This computer solves at one setting of dial three factors, including trigonometric and exponential terms. The answer appears at two different points of the dial, one proving the other.

The scales, beginning with the outermost, are:

1. Degrees, 0° to 360°; for measuring angles.
2. Radians, 0 to 2 Π (6.283); for circular measure.
3. A scale of equal parts, 0 to 1000, to read logarithms.
4. Scale N, for setting the first number and reading the answer.

The scales on the inner dial are:

5. Scale M, like scale N, but reversed, to set multipliers.
6. Scale D, like scale N, to set divisors.
7. Sines and cosecants, 6° to 90°; cosines and secants, 0° to 84°.

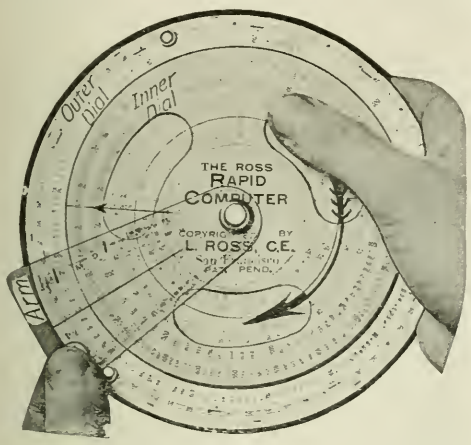
8. Sines and cosecants, tangents and cotangents, 37′ to 6°; cosines and secants, tangents and cotangents, 84° to 89° 23′.

9. Tangents and cotangents, 6° to 84°.

10. A scale of squares.

11. A scale of cubes.

With this arrangement of scales computations can be made with a minimum number of settings, because each movement of either the arm or dial performs an effective calculation, there are no blank movements as in multiplying 3x4x5 with the ordinary slide-rule; moreover, the answer never runs off the scale, and appears simultaneously on both dials, thus checking against both personal errors of misreading, and against any instrumental errors. The trigonometric scales are full and complete, obviating the necessity of taking com-



plements of angles or reciprocal functions. Equivalent ratios and reciprocals of numbers may be read at a glance; the operation for multiplication and division is identical.

The conventional method of graduations, which requires months to master, has been dropped entirely, and a simple system of 3 and 4-figure numbers adopted, so that anyone who can read a foot-rule can use the rapid computer directly. The length of scale is 21 inches in the 8-inch computer; so as to read numbers to three or four places, like: $24.67 \times 8.69 = 214.4$, or $24.67 \div 8.69 = 2.839$.

The instrument is made in two forms; one of weather and wear-proof celluloid; the other of bronzed metal discs, with engraved graduations, like a compass or transit, for office use. The computer has been invented by Louis Ross, civil engineer, of San Francisco, and is made by the Computer Mfg. Co., 25 California street, San Francisco.

Special Motor Car for Movie Men

Probably the first specially built motor car to be used in gathering moving pictures of actual warfare was built recently by The Thomas B. Jeffery Company, Kenosha, Wis., and delivered to the Selig-Tribune Company, of Chicago. It is now along the Mexican border and is taking daily trips into the

war-ridden republic, getting scenes for a news film released twice weekly.

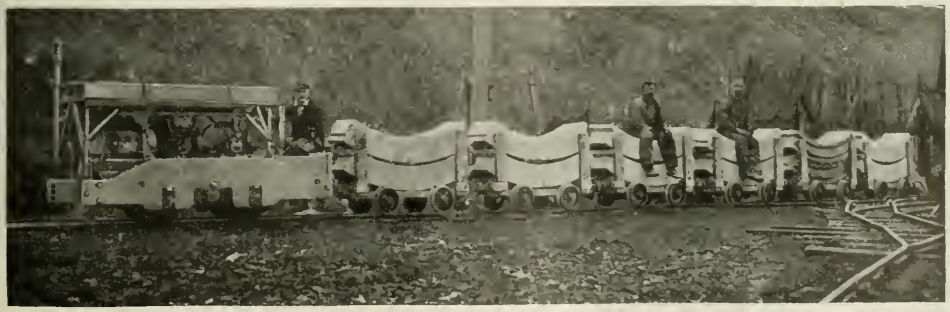
The body of this car was built on a standard Jeffery Four chassis. Mounted on the frame behind the driver's seat is a large square box, which is used both as a carryall and by the camera men. A sloping khaki top may be raised to protect the outfit from both sun and rain. The box is so constructed as to be able to carry a machine gun, in the event that one is necessary.

Two large tanks are suspended from the rear of the body box. One is for oil and water, having a capacity of 15 gallons of water and 8 gallons of oil. The larger tank carries 50 gallons of gasoline. The size of these tanks is rendered necessary by the long distances the outfit must travel over arid wastes.

Plymouth Gasoline Locomotive

We are illustrating a $2\frac{1}{2}$-ton Plymouth gasoline locomotive as operated by the city of Cleveland, O., in the construction of the East Side water works tunnel. This engine, which is manufactured by the J. D. Fate Company, Plymouth, O., and as shown in the view, was used for the hauling of large cement blocks from the cement block plant to the opening and

PLYMOUTH LOCOMOTIVE AS USED BY CITY OF CLEVELAND, O., ON EAST SIDE WATER WORKS TUNNEL CONSTRUCTION.



part way in the tunnel, where the blocks are then picked up by a compressed-air locomotive, which operates in the tunnel and out to the work. At the present time this is about two miles out from shore.

The compressed-air locomotive is used in the tunnel in accordance with the state law of Ohio, which does not permit of a gasoline locomotive being used in a mine or tunnel.

This type of gasoline locomotive is also quite extensively used in road work.

The Largest Drag-Line Excavator

The P. & H. drag-line excavator, class 210, shown in the accompanying photograph, is the largest yet built. It has a revolving frame supporting a boom and internal combustion engine, an A-frame, a drag drum, a hoisting drum, a boom topping lift drum, a tubular water cooling radiator, an air compressor, a centrifugal water circulating pump, a gasoline tank suspended from beneath and a compressed air tank also suspended from beneath.

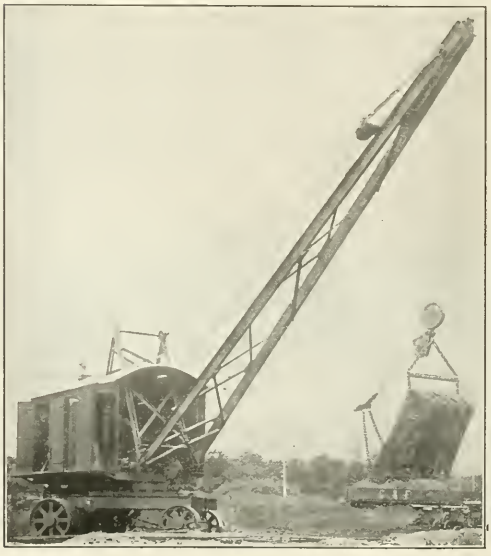
All machinery, including boom and A-frame, is sustained on two heavy girders. All the necessary clutches are provided for swinging upper frame and for propulsion. Drum band frictions are operated by compressed air rams. This upper frame rotates on the lower frame by rack and pinion and revolves on four 2-wheeled trucks, treading upon a 60-pound rail circle. Truck frame wheels and center castings are made of annealed steel.

The lower frame is of I-beam construction, designed for taking all the heavy strains that are imposed upon it.

The excavator is self-propelling either on broad-faced power-traction wheels or corduroy grips. The engine house consists of angle-iron framing incased in double beamed and matched yellow pine ceilings. The roof is of the same material and covered with heavy canvas. The whole is thoroly painted. Water circulation and force feed lubrication is entirely automatic.

Length of boom is 40 feet; capacity of bucket, 1 cubic yard; horsepower of engine, 70; rotating speed, 2½ revolutions per minute; diameter of turn table, 8 feet; traction wheels are cast steel, provided with three sets of spokes.

The four corduroy grips are driven from live axle by internal steel sprockets and chain from back axle. The front axle suspension is three point for traveling. The upper frame is rigidly held in position by jack nuts when working. The back, or driving, axle is a solid steel forging. The front axle is built up of 12-inch I-beams with stub ends for removing in case of wear.



All bearings are provided with the necessary grease or oil cups. All gears are of annealed cast steel. Spur gearing is cut from solid steel blanks.

The weight of the machine is 30 tons.

This machine can be equipped with either steam, internal combustion engine or electric power taken from outside sources or the current can be generated on the machine, if so desired. It is made by Pawling & Harnischfeger Co., of Milwaukee, Wis.

Trade Publications

A recent booklet on the Koehring mixer describes and illustrates its use on one of the contracts on New York's biggest job, the subway, as operated by the Rapid Transit Construction Company.

An excellent idea in showing results is that in a recent booklet of the Pioneer Asphalt Company, Lawrenceville, Ill., which uses inserted half-tones good enough to pass for the original photographs. They show the use of Pioneer asphalt of the proper grades in asphaltic concrete pavement, asphalt pavement, Topeka mix road, open type asphaltic concrete, penetration road and road resurfacing, thus showing at once the adaptability of this company's products and their success.

Brownhoist tram rail systems, trolleys and electric hoists are shown in catalog D, 1916, of the Brown Hoisting Machinery Company, of Cleveland, O.

The Diesel engine, in the central station service of the Northwest Light and Power Company, at Hutchinson, Minn., and its economy are shown in a recent handsomely illustrated circular of the Busch-Sulzer Bros.-Diesel Engine Company, St. Louis, Mo.

Concrete edge protection is the subject of a circular of F. W. Stocker, Inc., engineers, 1031 Clinton street, Hoboken, N. J., which shows the flexibility and adaptability of the Stocker anchoring curb bars and corner protection bars for concrete corners in any situation.

"The Medusa White House" is the title of a handsome booklet showing the excellent results of the use of Medusa white cement in the construction of houses, for exterior surfaces, steps, railings, columns, cornices, door and window casings, decorative panels, pergolas, etc., in which the artistic effect is a consideration. It is issued by the Sandusky Portland Cement Company, Cleveland, O., and will be sent on request.

The "Service Manual" issued by the Service Motor Truck Company, Wabash, Ind., goes into detail as to the construction and operation of each part of the machine, so that it is in truth a manual of the truck for practical use.

The Sterling-Kindling motor squeegee street washer, a combination of the Kindling squeegee and the Sterling motor truck, is made by the Sterling Motor Truck Company, West Allis, Milwaukee, Wis., and is fully described in an illustrated circular issued by them.

The American Rolling Mill Co., Middletown, O., distribute several circulars containing articles from various periodicals on particular installations of Armco pure iron in corrugated culvert construction, for electrical and other purposes where a very pure iron is required.

The Sandusky Cement Co., Cleveland, Ohio, issues a folder on Dry Basements a Reality, which contains an unsolicited testimonial from H. T. Liebert, a prominent architect, of Wausau, Wis.

The American Blower Co., Detroit, Mich., have a book on washed air which they will send on request.

VOL. LI. — No. 3.

Municipal Engineering

The World's Leading Municipal Publication

SEPTEMBER 1916.

BUILD THE ROAD FOR THE TRAFFIC

The title of one of the papers to be presented at one of the October conventions indicates the tendency in some quarters to limit the weight and speed of traffic to the condition of the roads to carry it. The opposite of this tendency is the title to this editorial. Either one, pushed to the limit is bad, but progress demands that the emphasis be put on the improvement of the road to suit the increase in the traffic.

There are practical limitations to the increase in the weight which can be carried on motor trucks, for example, such as strength of bridges and culverts, sufficiency of pavement foundations, steepness of grades and the like, which would require entire rebuilding of whole systems of roads, but these limitations are accompanied by the limitations in the economy of operating the trucks, which must be taken into consideration in planning the wholesale reconstruction suggested.

An example may be taken from the railroad field. Standard methods of construction, fixed widths, heights and strength of bridges and tunnels, location of platforms and buildings and sharpness of curvature. These prevented increase in dimensions of cars and of locomotives with certain increases in the demands of traffic and the first cry was to restrict the traffic to the roads as built. But new roads built according to the new demands demonstrated the economy or lack of economy of the methods used to meet these demands, and when the principles thus developed were applied to the old roads, they were rebuilt or not according to the judgment of the engineers as to the economy of the reconstruction.

The same lessons are being learned with respect to highways. Millions of dollars have been wasted in new highway construction because the increase in traffic was misjudged, and still more because the roads were built for the existing traffic rather than for that which the better road would develop.

It will be necessary to restrict weight and speed of traffic on the old roads, but the slogan for the new roads should be "Build the Road for the Traffic" with a long look into the future. When the economy of this method of building roads has been demonstrated then the question of rebuilding the old roads will be merely one of the local conditions.

In the process of testing out the economy of the new roads built under this slogan, the economy of transportation in large or small units, self-propelled or drawn, will also be tested, and, just as in the railroad case, weights and speeds will find their limits in the units of transportation, when economy of transportation has its full consideration, and the roadbed itself will be a secondary matter in this study of economy.

"Build the Roads for the Traffic" is the watchword which will lead to true economy and result in expansion, not restriction of traffic.

In a continuous performance such as the development of traffic economy wins in the end, tho much money may be wasted in learning what is true economy.

HOW TO BUILD PAVEMENTS

The standardization of pavements has progressed by means of the standard specifications adopted by the American Society of Municipal Improvements, an organization composed of the expert municipal engineers of the country and the officials of many cities, and therefore well qualified to prepare authoritative specifications. This organization recognizes the fact that improvements are made from year to year and retains its expert committees to modify the specifications to include all the changes which are real improvements. But one specification, that for wood block paving, remains under discussion without adoption, and it bids fair to be agreed upon at the Newark convention in October.

There have been many new improvements in the use of nearly all the prominent paving materials, and the list of newly patented pavements is very long.

This seems to be an opportune time to begin a series of articles upon the practical design, construction and maintenance of pavements, bringing the text-books down to date and including mainly the practical construction details which are not found in the ordinary text-books.

The first article of this series, on the design of brick pavements, appears in this number and will be followed by articles on construction and maintenance of brick pavements. It is the purpose to cover in similar fashion the standard forms of street and road surfaces and such of the special forms as are demonstrating their adaptability to the conditions of every day use on streets or roads.

The articles will be of every-day value to engineers, roads and street superintendents and to contractors, for they will be written by or based on data and information furnished by engineers and contractors directly connected with and engaged in the daily work of construction and maintenance.

The business department will try to anticipate the demand by keeping in stock enough copies to supply all requests for subscriptions beginning with this series, but early application is recommended in order to secure every number.

Our readers who have worked out special designs suitable for particular conditions or who have developed special methods or apparatus for construction are invited to contribute them to the series, that it may be as complete as possible. All acceptable contributions will be paid for.

STREET AND ROAD PAVEMENTS

THEIR DESIGN, CONSTRUCTION AND MAINTENANCE

EDITED BY CHARLES CARROLL BROWN, M. AM. SOC. C. E.

THE DESIGN OF BRICK PAVEMENTS

By the Editor

The intent of the series of articles of which this is the first is indicated by its title. The various pavements will be taken up in detail as to design, construction and maintenance, the general treatment of the subject of design being indicated by this article upon the design of brick pavements. It is intended to make the series a practical guide for engineers in design, contractors and engineers in construction and street and highway supervisors and superintendents, contractors and engineers in maintenance.

The various articles will be written by theoretical and practical experts in the three lines, with such collection and editing of material gathered from these authoritative sources as will make the articles coherent and readable and a consistent whole.

It is hoped that the readers of the series will from time to time supply any omissions or deficiencies and discuss any unsettled questions which they may be moved to reply to and especially to contribute such practical descriptions of materials and methods as they may have devised or used, that the completed series may be as full as possible of usable hints and descriptions of methods and results for the benefit of engineers, contractors and street and road supervisors.

The design of the brick pavement has been a development in this country for the 40 years or more since the first pavement was laid, progressively toward the monolithic construction, which is the latest development for this form of paving.

The first brick pavement laid in this country, probably, was a small area laid by a property owner in Charleston, W. Va., in front of his store, where the lack of drainage made an almost continuous mud hole. This piece of pavement seems to have been laid on a foundation of boards, laid practically in the mud, a cushion of sand being used to give the bricks a uniform bearing. Possibly the boards were dipped in tar. The date of this construction was probably 1872. This pavement lasted for nearly 40 years before it was replaced by a modern bitulithic pavement. It was so successful that within a few years a considerable length of street was laid in about the same manner, and this in turn lasted nearly 40 years. It was removed in the spring of 1915 and the boards forming the foundation were, many of them, still in fair condition, perhaps because they were dipped in tar and in part, perhaps, because the poor drainage of the sub-soil kept them almost continuously wet. At any rate, they were far from rotted away when removed.

Bloomington, Ill., long claimed the honor of laying the first brick pavements, and perhaps deserves the honor since larger areas were laid. These pavements attempted to get the uniform bearing necessary to keep the surface reasonably smooth, first with a sand cushion on a slightly compacted sub-grade and then by means of a layer of brick laid flat on a sand bed and with a sand cushion on top of which to lay the wearing surface of bricks on edge.

None of these forms of construction really made a uniform surface, and the irregular settlement of individual bricks on account of disturbances and displacements of the foundation below, caused rapid wear of the surrounding bricks, breakages and exceedingly rough surfaces for most of the life of the pavements.

To reduce these irregular displacements of bricks, the concrete foundation was adopted, retaining the sand cushion, and almost all brick streets for the past 20 to 25 years have been built with such foundations.

The better foundations emphasized some of the other defects in the early brick pavements and started movements toward their improvement. Thus the reduction in the unequal settlement of bricks gave a better opportunity to show that the formation of holes in brick pavement surfaces was due to the unequal wear of bricks of varying hardness. A soft brick in the midst of an area of hard bricks gave way under the stress of traffic, and the hole thus formed was just as ruinous to the good bricks surrounding it as tho the brick had settled.

Some of the earlier pavements were really laid with well-selected, hard-burned, common building brick, but, being well selected, they were uniform in quality and their wear under traffic was therefore fairly uniform. When the first attempts to make vitrified brick hard enough to stand the traffic were made, the product of the kilns was irregular and so the wear in the street was irregular.

Again, the sand used in filling the joints was not a protector of the edges of the brick, nor did it do much to keep the bricks in place. One result of this trouble was the invention of the repressed brick, which attempted, by rounding the edges of the bricks, to prevent the undue wear of those edges resulting with the wire-cut bricks. This introduced other complications, and in an attempt to reduce the number of joints the size of the bricks was increased, each manufacturer having a different idea of what the size should be, largely based on his observation of the action of his own bricks in pavements.

Another line of effort to prevent the wear of the edges of the bricks was the improvement of the filler. Tar and later asphalt were used, and but little later the use of a cement grout filler was tried. This was not very popular for some time, first because the high cost of cement at that time made the cement joint filler expensive, and, second, because the rounded corners of the popular repressed blocks caused the thin edges of the cement filler over them to chip off and the joint to wear faster than the brick. It was considered necessary to have lugs on these repressed blocks to hold them

far enough apart in the laying so that the cement grout could get in and fill the joints, and this aided in retaining the popularity of the repressed block until the wire-cut lug block was invented. Since the latter combines the advantages of the wire-cut brick as to sharp edges of bricks and greater density, with the lugs, which seemed to be the principal advantage of the repressed form, their use has rapidly increased. The cement filler is specially adapted to the joints of the wire-cut lug blocks.

The increase in the solidity of the pavement in other respects ultimately called attention to the occasional displacements of the sand cushion and consequent displacement of the bricks resting on it, which is more pronounced and frequent with sand or soft fillers than with the cement filler, and has led on the one hand to the invention of the monolithic construction of brick pavements.

The more uniform wear of bricks of uniform quality, set solid, leads to the suggestion that the bricks need not be of so great depth, and with the monolithic construction there is a strong tendency to reduce the vertical dimension of bricks to 3½ or even 3 inches, instead of the standard 4 inches.

One development of the asphalt filler for joints has been to spread the asphalt over the wearing surface of the brick also, the wire-cut bricks being laid on a wire-cut, or so-called flat, side so as to give a rough surface for its adhesion to the brick, and providing a thin bituminous wearing surface. This is the so-called vertical fiber brick pavement.

The difficulties in the manufacture of brick as to variations in sizes, irregularities in structure, in hardness, in burning and other technical qualities have been attacked by the brick makers with energy and under the advice of experts in both the chemistry and the mechanics of the processes, and the quality of brick has been greatly improved. The ability of brick makers to meet a definite specification is much greater than in the past, and the standardization of materials, sizes, methods of manufacture, of handling, of shipping and of the finished and delivered product is each year more nearly complete.

This brief statement of the history of the development of the brick pavement will give the reasons for every item in the present standard specifications for brick pavement.

The concrete foundation, or its equivalent in a perfectly drained and thoroly compacted foundation of other material seems to be a necessity for the best results with any block pavement, and for heavy traffic cannot be dispensed with under any circumstances, even solid rock sometimes requiring enough concrete to even up the irregularities in natural surface or produced in excavating to grade.

The thickness of the concrete foundation depends on the one side upon the weight which it must support and distribute over the soil beneath. On the other side it depends on the character of the material beneath it and the thoroness with which it is drained. The effect of water in the soil under a concrete pavement is described below, and each year the economy of so draining the sub-soil that all water shall be removed before it can reach that portion under or affecting the pavement is becoming more apparent.

The systems of drainage proposed are numerous. A popular system has been to run drains down the center of the pavement, with outlets to ditches or catch basins, or other drains at intervals along the line of the road or street, but since the object is to keep the water from reaching the subsoil under the pavement, as well as to remove it, it would seem to be better engineering to lay the drains at or outside the edge of the pavement, where they would serve both purposes, unless, indeed, the sub-soil is so bad that drains must be laid more thickly to carry away the water coming to it from below or from sources that cannot be cut off by the side drains. The depth of the drains must depend upon the nature of the soil; ordinarily they need be laid only so as to be free from frost, and the trenches must then be filled with broken stone or coarse, clean gravel so that water entering the soil from the surface can be intercepted before it gets under the concrete. The size of drains depends upon the amount of water they may be expected to gather. Ordinarily the smallest sizes of drain tile, 4 or 6 inches, are sufficient unless

SECTION OF LINCOLN HIGHWAY 5 MILES LONG, ELKHART COUNTY, INDIANA, PAVED WITH WIRE-CUT LUG BRICK IN 1915; PHOTOGRAPHED A YEAR LATER. BRICK PORTION 16 FEET WIDE BETWEEN 6-INCH CURBS, OR EDGINGS. CEMENT-GROUT FILLER USED.

the distance to an outlet is great, in which case the size must be increased as the water gathers.

Whether the concrete foundation should be re-enforced for the highest, most permanent type of pavement, is a question not yet considered of great importance.

The provision in the standard specifications for brick paving adopted by the American Society of Municipal Improvements that the width and depth of bricks shall not vary more than $\frac{1}{8}$ inch and the length not more than $\frac{1}{2}$ inch is evidence of the ability of manufacturers to produce bricks of uniform dimensions, something which was said to be impossible a very few years ago. The standard size of small paving brick is fixed at $2\frac{1}{2}$ inches in width, 4 inches in depth and $8\frac{1}{2}$ inches in length. The more general practice is to use the larger size of block, $3\frac{1}{2}$ inches in width, 4 inches in depth and $8\frac{1}{2}$ inches in length. It is now possible to secure bricks of any standard make, of these dimensions, within the limits of variation given, showing that the manufacturers are now able to predict the size of their finished product and make the molds to produce it. Also the manufacturer can so burn his brick and select them from the kiln as to bring a shipment within the variations permitted. If bricks are so selected and classified as to come within the $\frac{1}{8}$-inch limit of variation, bricks of different sizes can be used in different parts of the same pavement. This practice will tend to bring bricks of about the same degree of burning, density and texture together, and aids in securing uniformity in wearing qualities.

One possible advantage in allowing the slight variations in size is the ease of repair with other kinds of brick. This is not an unmixed advantage, however, unless the bricks used in the repair are equal in hardness and toughness to the original brick, so as to restore the uniformity of quality and surface which the original pavement was supposed to have.

The top surface of the concrete foundation is required to be true, uniform and parallel to the surface of the finished pavement. This is the general practice, made necessary for the drainage of the surface of the pavement and the almost universal custom of making the two sides of the street alike with gutters on both sides. When streets have considerable slopes, say 4 per cent. or more, the crown need not be so high and the cross-section will have more nearly a straight line for its upper boundary. Where there is considerable slope across the pavement, as on side-hill streets, it may be possible to put the gutter on one side only and make the slope across the street a straight line. The same is frequently possible on country roads.

The reason for making the cross-section straight rather than curved is found in the almost irresistible expansion of the brick surface under the influence of the sun's heat. If the crown of the street is arched there will be a strong tendency for this expansion to raise the crown of the arch to allow for the lengthening of the arch with the expansion. This results in the rumbling so often observed on account of the vacancy between the brick and the cushion. And it results in cracks and in the spalling of the edges of bricks at the joints, all of which are unsightly and ultimately cause a disintegration and excessive wear along such cracks and joints.

If curbs are not set very solidly they may be pushed out by this expansion, damaging sidewalks, inlets, catch-basins, etc. The longitudinal expansion joints along the curbs have been devised to diminish these evils, and if properly constructed are reasonably efficient.

That expansion joints are not necessary when the brick surface is a plane surface and there are no tendencies for the surface to rise in any portion, and the temperature stresses are absorbed by strains in the pavement materials themselves, is shown by the fact that transverse expansion joints are unnecessary so long as the grade or slope of the street is uniform.

A pavement on South Sixth street in Terre Haute, Ind., was laid some 25 years ago without any expansion joints, and in the blocks between street intersections is still in excellent condition. But at each street intersection there was introduced a crown in the pavement of the intersecting street which interrupted the straight line of the pavement along Sixth street, and at each intersection the force of the expansion of the Sixth street pavement was sufficient to lift the arch of this crown and so the pavements at the intersections were broken up and had to be relaid with due provision for expansion. This same tendency to lift the pavement is found wherever the grade of a street changes, so that the longitudinal profile is convex upward and cracks or even explosions occur at such points. If the profile is concave upward the stress comes on the surface of the brick and joints may be pinched out or crushed and edges of bricks spalled off.

The location and character of expansion joints is one of the problems in brick paving which has not yet been solved satisfactorily. It has led many engineers to use bituminous joint fillers, tar or asphalt, which solves the expansion problem but introduces others already mentioned.

The expansion of the concrete base is only less than that of the brick surface because it is protected from the sun's heat by the brick and cushion above it.

There is another source of cracks in pavements in unequal settlements in the foundation. These do not have so pronounced an effect in city streets as in country roads, because city streets are more thoroly compacted by years of use and the spots of settlement are mainly limited to trenches cut for pipes, areas about manholes, spots softened by leaks of water pipes, and the like, which are small in area or at least in width and can be spanned by the ordinary street concrete base, which will carry all but the heaviest concentrated loads if well constructed. On country roads, however, it is seldom that the well compacted area of the old road fits exactly the concrete foundation of the new brick wearing surface, and settlements over portions of the sub-grade along the edges of the pavement, which are insufficiently compacted, or washed out or loosened by drainage improperly provided for, are not infrequent. These settlements are most probable along the edges of the pavement, and when they occur the surface above, as well as the concrete, is cracked on lines roughly parallel with the road and occurring within the middle half of its width.

Again, when the drainage is not properly taken care of, water may seep into the soil under the edges of the pavement, and, if it remains long enough to freeze, the expansion of the water in freezing will lift the edges of the pavement enough to produce cracks quite similar to those described above. These cracks also appear in country roads rather than in city streets, because the latter are usually better protected by curbs, which cut off the water from outside, at least until it is led below the ordinary frost line, and there are more frequent drains by means of sewer gas and water pipe trenches, inlets and catch-basins.

There is a tendency in modern designing of pavements to make the concrete base level across the bottom, giving a crown to the pavement by thickening the concrete in the center. This strengthens the concrete against the bending actions described as the center of the road is approached. Steel reinforcement is sometimes used where the sub-grade is particularly treacherous and cannot be replaced at reasonable expense.

The standard specification for thickness of concrete is 6 inches. This is apparently the least thickness which is safe under all ordinary circumstances, and a greater thickness increases the cost without a corresponding increase in value.

However, bad sub-soil, the condition of which cannot be wholly relieved, will require thicker concrete and perhaps a stone block foundation under it, with sometimes steel re-

inforcement. Thru a marsh not to be drained at reasonable expense a timber raft foundation may occasionally be desirable, on which to lay the concrete. The design of such a foundation is a special problem depending mainly on the local conditions.

Thinner concrete may be used under very favorable conditions, especially with the monolithic construction described below.

The sand cushion on top of the concrete foundation, on which to lay the brick, has been a subject of study no less interesting than that of the brick itself. The requirements as to the sand have varied from the standard specification of "clean, sharp sand, free from foreign matter, except that it may contain not to exceed 10 per cent. of loam," and graded from ¼ inch to that retained on a No. 50 standard mesh sieve, and including broken stone or slag of the same grading, according to the ideas of engineers regarding the function of the sand cushion.

The sand cushion was first introduced simply to even up the soil used as foundation and was made deep enough to cover all inequalities. Its use was continued when boards, brick laid flat, and concrete were used as foundations, for the same reason. When concrete was adopted as the foundation, enough sand was required so that no brick would rest on a projection of the hard foundation and so be subject to breaking across under a heavy load or blow. Smoothness of the upper surface of the concrete was specified until the thickness of the sand was reduced in some specifications to one inch.

Until recently the sand was simply spread and luted to fit the crown of the street and the bricks were laid on this loose sand, on the theory that it was a soft cushion which would distribute itself so as to carry and distribute the loads coming on the pavement, but it was soon found that the sand would compact very irregularly, especially if slightly damp, and might afterward shift to some extent, so that the brick surface, unless made monolithic by perfect jointing with cement grout, was not thoroly stable. But it has not been customary to compact the sand before placing the brick until quite recently, the standard specification now requiring that the cushion be slightly moistened and rolled over its entire surface with a hand roller not less than 36 inches in diameter, 24 inches wide, weighing not less than 10 pounds per inch of width and having a handle 12 feet in length, the cushion being completed by drawing the template over it to finish it exactly to the required surface.

The latest development is the elimination of the cushion entirely. This was done first by mixing cement with the sand used for the cushion before the concrete base had fully set, laying the brick and grouting them, the water from the base and the grout being assumed to be sufficient to make a mortar cushion, so-called, out of the cement-sand mixture. This has now been improved by using only enough of the sand-cement mixture to insure a closely fitting bed for the brick on top of the freshly laid concrete. In this manner the brick pavement is made monolithic, concrete base and bricks being bound into one mass by the mortar and the grout filler.

Due regard to economy as well as to the probable weight of concentrated loads on such monolithic pavements suggests in the minds of some engineers the reduction in depth of bricks to 3½ inches and in depth of foundation to 5 inches, so that a pavement which under the standard design would be 11½ or 12 inches in depth becomes 8½ inches, with a saving in cost of brick and of concrete and the elimination of the cost of cushion, as well as a reduction in the cost of excavation for the pavement. The wear of this pavement should be uniform, the protection of joints complete, and the base to distribute the weight of traffic over the earth foundation is 8½ inches instead of 6.

With these general principles of design as guides it should

CURVE ON GOSHEN-FT. WAYNE SECTION OF LINCOLN HIGHWAY, IN ELKHART COUNTY, INDIANA, PAVED WITH WIRE-CUT LUG BRICK ON AN OLD GRAVEL ROAD FOUNDATION IN 1915. PHOTOGRAPHED A YEAR LATER. CEMENT-GROUT FILLER USED. SUPER-ELEVATION OF OUTSIDE OF CURVE, 10 INCHES.

be possible to solve any special problem when all the data are secured. It is a problem of several variables, character of soil, drainage, weight and amount of traffic, material available for base of pavement, machinery available for construction purposes, quality of brick, and in each item cost of materials and putting in place, and money available. The variations in these items must be studied and combined in various ways until the most satisfactory pavement obtainable for the money available is discovered. The engineer cannot always build the best pavement possible, but must be satisfied with what can be built with the money available. The best engineer is he who secures the best results with the least expenditure. Somtimes he must be satisfied with a poorer pavement so as to cover the ground. Sometimes it is best to build only a part of the pavement, and build that in the highest style of the art, trusting to it to demonstrate the economy of raising money enough to finish the job.

One of the principal factors in the development of the modern brick pavement has been the National Association of Paving Brick Manufacturers, of which W. P. Blair was the organizer and has been the only secretary. Its work was begun 25 or 30 years ago under a committee of the National Brick Manufacturers' Association, which became large enough some 10 or 12 years ago to warrant an independent organization. Another very important factor in the last five years or so has been the engineering organization of the Dunn Wire-Cut Lug Brick Company, which has been very active in developing improvements in methods of constructing pavements as well as the bricks themselves. An active factor in the Southwest has been the Western Paving Brick Manufacturers' Association, which has done much in its peculiar lines toward the encouragement of brick paving in that territory.

MUNICIPAL BATHING FACILITIES

By Frank Koester, City Planner and Consulting Engineer, New York.
Author of "Modern City Planning and Maintenance."

While many municipalities have provided public baths, they seldom have been provided in sufficient number with proper equipment.

Such baths should be on a large scale and be what may be termed aquatic gymnasiums. There should be a large swimming pool some 100 feet or more in length and 40 to 50 feet wide, varying from 3 to 15 feet in depth at different parts, with spring boards for diving and artificial waves.

Steam rooms, sweating rooms and shower baths should be provided, with both hot and cold water. The showers should be arranged to jet either from above, from the wall at the side or from the floor upwards.

The gymnasium should include the various forms of gymnastic apparatus, and it is desirable also to have a running track, which may be constructed as a gallery arranged around the building walls.

A heating plant must be provided for keeping the water heated to the proper temperature, and also for keeping the rooms at a uniform temperature. Arrangements should be such that the pool may be drained and refilled in a short time. Such baths should be in charge of a skilled swimming master, for the instruction of those who wish to learn to swim. Attendants should be at hand to massage those who desire such service.

It is advisable to supply the baths with as many features as possible, in order that they may be utilized to the fullest extent. The price of admission should be low, just sufficient to cover the cost of operation, provided it is not free, while fees for special service, as swimming lessons and massage should be turned into the general fund.

Separate municipal baths should be provided for women, but if this is not feasible, certain days of the week should be set apart for their exclusive use.

The city of New York maintains and operates twelve free public interior baths and eleven free floating baths.

For the use of these institutions, there is no charge whatever, the only requisite being respectable and orderly conduct on the part of the patrons, compliance with the rules, and that the bathers furnish their own towels and soap. This has been the policy almost from the opening of the first public bath, although at the opening of one of the municipal baths the city did undertake to furnish towels and soap at a nominal charge to the bathers. However, it was soon found that the loss of towels was very great; the shower rooms were plastered with waste soap, the floors slippery and the drains choked. Besides a certain percentage of danger from contagion existed unless the towels were laundered under surveilance. All these evils were at once remedied by patrons furnishing their own requisites and the scheme of supplying towels and soap was discontinued.

The United States Volunteer Life Saving and the Women's National Life Saving League have swimming instructors at the pool during certain hours to teach swimming. These hours vary from time to time. Aside from these instructions, an attendant who is a competent swimmer is required to be on duty constantly at the pool, with instructions to pay attention to all swimmers.

During the year 1911, there were 5,400,567 free baths given by the city of New York in both floating and permanent baths. The average cost per bather during that year was a little over 4 cents. During the summer months of 1911, the attendance at the Rivington Street Bath often reached as high as 3,000 in one day.

During the month of December, 1911, each bather used on an average 9.9 cubic feet of water and required the consumption of 8.8 pounds of coal.

The floating baths are all built about on the same plan, as follows: They are 95 feet long and 60 feet wide, and are floated on eight pontoons, placed four on each side of the bath. In the center there is a large well, divided into two parts, one 93 feet long and 34 feet wide, for adults and one 70 feet long and 8 feet wide for children. The depth of the water in the large well is 4½ feet and in the small one 2½ feet. There are 68 dressing rooms opening upon a small gangway around the edge of the well.

The floating baths, like the interior baths, are free, but the former are used only during the summer.

IRON AND STEEL SEWER PIPE

By J. F. Springer, New York.

While the use of cast iron and steel for sewer pipes is not general, there are some places in which their use is necessary and this article on the methods of laying and testing pipe and protecting will be of value to many engineers and contractors. The special machinery and apparatus described will be of particular interest.

IRON and steel pipe are used for sewer construction in diameters from 4 to 60 inches or more. While these materials are not often used, they are very important when used, and their design should be made on proper principles.

The thickness of the pipe depends upon the allowance for deterioration. Approved practice considers ¼ inch the proper amount for water pipe, but sewer pipe, laid in locations where there is unusual exposure to corrosive influences, may require a greater allowance. It also depends upon the internal pressure, which is affected by the hydrostatic head, the internal radius of the pipe, the tensile strength of the iron and also by water hammer. The same formulas are used for determining thickness as for water pipe. But practically the pipe is chosen as standard, light or heavy, according to the stresses expected and the catalogs of the pipe makers. Again thickness may depend upon the pressure from without, especially if steel pipe is used, and buried deep in the soil, as later described.

Some practical points in handling pipe follow:

It is often necessary to provide special appliances for handling cast-iron pipe during construction operations, even a 4-inch pipe weighing about 200 pounds per 12-foot length, while a 36-inch pipe will weigh 3,800 pounds. A very convenient device is the sulky derrick. This is scarcely a derrick at all. It consists of an A-frame, to which is hinged a simple leg. The hinge is attached at the top of the A. This arrangement straddles the trench and provides a suitable support for a block and tackle. The drum or windlass which operates the block and tackle is mounted in the A-frame in such position that the two twin wheels controlling the drum clear the vertical ropes, carrying the weight of the pipe length. When it is desired to shift the derrick it may readily be moved by making use of the wheels. A simple brake may be arranged to control one or both wheels, and so the lowering of the pipe.

If cast-iron pipe is to be laid on a curve, special castings will be advisable, even when the curvature is very gentle—say, 1 degree from length to length. This would mean a radius of curvature in excess of 500 feet. This degree of deviation may at times be obtained by withdrawing the spigot about ¾ inch.

Cast-iron pipe lengths have been successfully bent, as in a line which conveys water of the Guayabo River to the town of Preston in Cuba. Thru some oversight the piping for the line was shipped without any curves or sleeves. The route was quite crooked and the delay to wait for the specials would be serious. Steel and wrought iron pipes had previously been bent in connection with work, so a local engineer determined to test the possibilities of cast iron. The pipe had a diameter of 10 inches, a wall thickness of 9/16 inch, and weighed about 760 pounds per length of 12 feet. Old rails with the proper curvature were set up to form a cradle in which the pipe lengths might comfortably lie after they were bent. Half a dozen or more lengths were placed side by side on the cradle, the lengths forming chords in the arcs made by the rails. A fire was built of hardwood in such a way as to heat the pipe-length, but to leave the extremities outside of its active influence. The purpose served by not heating the ends was the prevention of the collapse of the piping. In the course of 1½ to 2 hours the metal would be sufficiently softened to permit the lengths to settle into the cradle of their own weight. About 40 lengths were bent in this manner. The curvature varied, the minimum radius being 50 feet.

Large cast-iron piping is sometimes laid on block supports. These are placed two to a length and near the ends. There is disadvantage in using blocks because they tend to nullify the distribution of the load and to concentrate it upon themselves. On the other hand, the use of blocks means that the points of support are known locations.

Smaller sizes of pipe, say from 8 inches down, may be lowered into the trench by two men with rope slings, one at either end.

A locomotive crane may be used on sewer work. It is unnecessary to provide a track as the broad-wheel type may be employed. Whether this apparatus is economical in a given case depends upon the conditions. If the locomotive crane is used for excavation as well there will naturally be an increased opportunity to secure advantage.

Cast-iron pipes are ordinarily joined by means of hot lead. Jute packing is driven into the joint as a preliminary. The space is closed in with a jacket of wet clay and yarn or an asbestos jointer. The lead is then poured, and should be poured continuously until the joint is full. No dross should

A FIVE-FOOT RIVETED STEEL SEWER FOR TEMPORARY USE IN CONNECTION WITH NEW YORK SUBWAY WORK. AN A-FRAME DERRICK, AS DESCRIBED IN THE ARTICLE, HANDLES THESE PIPES.

INVERTED SEWER SIPHONS OF CAST-IRON USED IN CARRYING SEWERS UNDER THE SUBWAY IN NEW YORK SUBWAY CONSTRUCTION. THE TWO LARGE PIPES ARE FIVE-FOOT STORM SEWERS. THE SMALLER PIPE IS A 24-INCH SEWER TO CARRY THE DRY-WEATHER FLOW OF SEWAGE. NOTE THE SPECIALS AT THE BEND AT THE LOWEST POINT IN THE SIPHON.

be allowed to collect in the pot. The calking may be done with a hammer and special tools.

Lead wool has been used. This is a fibrous material which consolidates under the blows of the pneumatic hammer. This is a cold operation all through. An authority mentions still another method as possibly useful where the trench is wet. "A soft lead pipe wrapped around the pipe and calked into the joint at the same time" is the suggestion. If the cast-iron pipe is quite large, the inside of the joint should also be calked.

Steel pipe is also used in sewer construction. It has thin walls, because of the high tensile strength of rolled steel, which give but a slight margin for deterioration of the metal. The coating put on the pipe to protect it must be very carefully preserved up to the time the pipe goes out of sight under the back-filling operation. Persons with hob-nails in their shoes should not be permitted to walk on the pipe or within it. Indeed, in one case, on the Little River Works of Springfield, Mass., a covering of canvas or equivalent material at least 30 inches wide was kept on top of the pipe in the trench until back-filling was in progress on the spot, and no person was permitted on the pipe without rubber or felt soles on his shoes.

Sheet steel pipe of considerable size will ordinarily need more or less bracing within, especially during the back-filling. The lower part of the back-filling should be well tamped. It is recommended that in putting in the upper part of the back-filling a commencement be made at the middle of the length of pipe. This procedure leaves the field joints to the last, and so prolongs opportunity for the hydrostatic testing of the joints in advance of covering them up. Naturally, a sheet steel pipe will sag somewhat under back-filling. The braces will hardly prevent this entirely. However, after the removal of the braces subsequently to the back-filling, the sag should be moderate in amount. If the major and minor axes differ no more than 5 per cent. from each other, this difference may be viewed as permissible.

Jersey City has a big sheet steel sewer. The diameter is 6 feet and the standard length 18 feet. These sections weighed very much less than would cast-iron pipe of the same diameter and length. Nevertheless, the individual lengths weighed 6 tons. The laying of sheet steel pipe is facilitated by the possibilities of handling it in long lengths. This reduces the number of field joints and so reduces the total liability to leakage. A steel sewer pipe was laid in St. Louis some years ago for the water works in which the lengths were 28 feet each.

Where cast-iron pipe of considerable size has to be installed in deep vertical sections it may be advisable to have the surfaces of contact machined to true planes. Otherwise, the lower courses will be supporting great weights on uneven surfaces. The cast-iron mains used in the Astoria-Bronx Gas Tunnel beneath the East River at New York pass down and

TWO CAST-IRON STORM SEWERS BELOW, EACH FIVE FEET IN DIAMETER. TEMPORARY STEEL PIPE FLUME ABOVE TO CARRY SEWAGE DURING CONSTRUCTION OF THE INVERTED SIPHONS UNDER CONSTRUCTION BELOW.

up vertical shafts perhaps 225 feet in depth. This pipe is very large, being 6 feet in diameter. The contact surfaces are machined. This pipe stands, however, without the support of a back-filling.

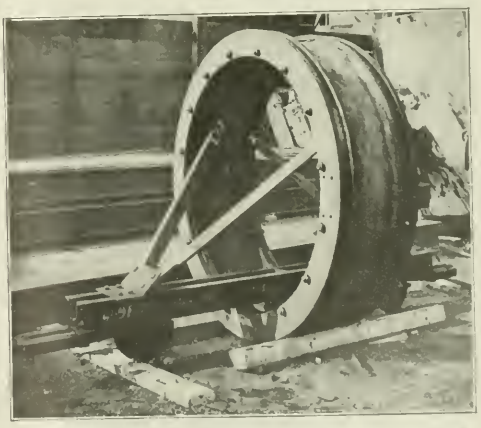
We may learn lessons valuable in connection with metallic sewers by paying attention to experiences gained in laying cast-iron and steel pipe for other services, particularly pipe laid as water and gas mains.

In the laying of sewers it is sometimes necessary to cross a stream or other body of water with the pipe line, a problem the same as if the pipe were part of a water supply system. Reference may be made to the cast-iron siphon across the Narrows at New York, this siphon being part of the new Catskill Aqueduct. A movable skidway, one end of which was held above the surface by a barge, was used in laying the pipe. The joints were made on the barge and above the water level. As length was added to length the barge would shift and thus permit 12 feet more of pipe to slide off the bottom of the skidway which reached down to about the lowest level of the trench. As new lengths took their place in the trench the joint had to undergo flexure. The method of meeting this problem was described by the present writer in MUNICIPAL ENGINEERING for September, 1915, vol. xlix, p. 92.

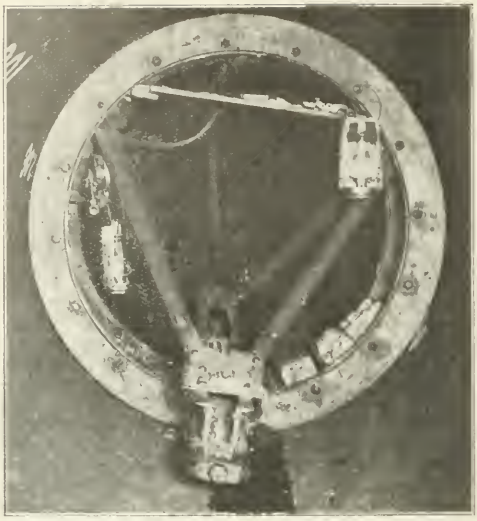
At Boston a similar problem had to be solved in laying two pipe lines beneath the water separating Deer Island from the city proper. One line had a diameter of 8 inches, the other of 12. In both cases ball and socket joints were employed. That is to say, lead poured into the joint clung to either the spigot or the bell, the spherical surface of contact being supplied by this lead and the bell or spigot, respectively. The iron surface to which the lead was to cling immovably was provided with suitable irregularities. In the case of 8-inch pipe the spigot was provided with circumferential ridges and the bell was given a concave spherical surface. An objection to the form of joint used was that a flexure of the joint would expose the lead, which by a reverse flexure would be liable to be skived off. The 12-inch pipe was laid later and seems to have avoided this objection. The bell was provided with two circumferential grooves and a ridge. The spigot was given a convex spherical surface. The ridge within the bell was set well within its mouth, and, in fact, formed the interior limit of the lead. This ridge contacted with the curved surface of the spigot in a circumferential band 0.6 inch wide. "The lead is held within the bell and does not emerge when the pipe shifts position." The pipe was assembled and the joints were made on shore. A large runway was provided and the pipe was set on rollers in it. The water to be crossed was 500 feet in width. A capstan set up on the shore opposite to the pipe in the runway provided a means of hauling the pipe across. This 12-inch pipe had a wall thickness of 1 inch. Later on some 4,000 feet of 4-inch pipe was laid in the water separating Long and Spectacle Islands. This pipe was very heavy, weighing about 350 pounds per length of 12 feet. The water in which it was laid had a maximum depth of about 28 feet. Here the skidway-and-barge method was followed. The skidway was quite long for the moderate depth —115 feet being the length.

Sheet steel pipe may be given a lining of Portland cement mortar. This was done in connection with the construction of the steel siphons to the north of New York City in the line of the Catskill Aqueduct. In a typical case the lining was made two inches thick, of 1:2 mortar. Another similar example was the wrought-iron pipe laid at Charlestown, near Boston, many years ago. The cement lining was 1¼ inches thick. On the outside was a coat 2 inches in thickness, the intervening iron having had, originally, a thickness of 0.16 inch. After about 30 years some of this 30-inch wrought iron, cement-covered pipe was taken up in order to relay with cast-iron pipe. "The reason for relaying was in no way caused by a failure of the old pipe, part of which is still in use, and which, when laid in unyielding soil, has given good satisfaction."

Steel pipe unprotected by cement or cement mortar is liable to undergo perforation from the corrosive activity known as pitting. The obvious remedy, if the use of Portland cement is not possible, is to use a thickness of metal in excess of that necessary by considerations of pressure. An authority—Mr.



THE TESTING BULKHEAD FOR APPLYING THE PNEUMATIC TEST TO JOINTS IN CAST-IRON PIPE LINES, AS DESCRIBED IN THE ACCOMPANYING ARTICLE. PIPES ARE SEVENTY-TWO INCHES IN DIAMETER.



THE TESTING BULKHEAD FOR APPLYING THE PNEUMATIC TEST IN PLACE, READY FOR MAKING THE TEST.

Allen Hazen—says in this connection: "It is my feeling that it will not generally pay to increase the thickness of steel plates very greatly because of this consideration (viz., that thickening the plates will not cure the trouble, but will merely prolong the life of the metal), but that the money will be better spent in better coating and in more careful inspection of the steel plates, or, in other words, by preventing the pitting instead of trying to make the plate thick enough so that the pitting will not go thru it." Steel pipe lines are more or less subject to deterioration, due to electrolysis, caused by electric currents escaping from trolley lines, etc. The same authority advocates special protective measures rather than an increase in the wall thickness of the pipe. Such protective measures are the use of insulation joints and the provision of an insulating envelope around the pipe in the neighborhood of the trolley lines, etc.

The backfill is the focus of one of the problems connected with the use of sheet steel pipes. For ordinary depths the minimum thickness may be taken as follows: Pipe 36 inches in diameter should have a thickness of at least 3/16 inch; 48 inches, 1/4; 60 inches, 5/8; 72 inches, 7/8. If the trench is deep and the backfill accordingly weighty, the thickness should be increased. Naturally, if the thickness is sufficient for the backfill, but inadequate to the internal pressure, it will have to be made greater. It seems that proper tamping has a great deal to do with the ability of the steel pipe to resist the backfill. A competent engineer related: "I had the pipe (a drain) put in and it failed; and I had it put in again and great attention paid to the ramming of the earth below and at the sides of the pipe, and it then stood the pressure of the fill."

Attention has already been given to flexible joints used in laying heavy metal sewers under water. At Seattle, Wash., some 48-inch cast-iron pipe was laid in tidal water for perhaps 1,100 feet out from the shore line. The sewer runs out perpendicularly to the shore to a point in Puget Sound, where the discharge is 40 feet below high water. The sewer was laid in a trench 4 feet deep. The excavation was very difficult because of the hard material and its sub-aqueous location. The first excavation operation consisted in the removal of mud and loose rocks. A dipper dredge performed this service. A diver would go down beneath the water, where he would drill the hardpan or rock and blast some of it loose. A suction dredge assisted in removing the spoil. The pipe was laid, one length at a time. A double pontoon would support between its two floats a 12-foot length of pipe and lower it to position, the pontoon being anchored all the while. A diver down in the trench or nearby would attend to placing bags of concrete beneath and against the pipe length. This work had to be carefully done, as upon it depended alinement and grade. The joints were made by calking lead wool into the crevice. The pipe after being laid and jointed was covered over with concrete in bags. The concrete used for this purpose was made according to the formula 1:3:5—that is, it was not made impermeable.

Another method of placing metal piping under water proceeds by floating a line of connected-up lengths to a position over the final site. This method is readily applicable to sheet steel tubing, but somewhat less so, perhaps, to cast-iron pipe. A steel pipe has a gross volume a good deal in excess of the volume of water having the same weight. Accordingly, by putting in temporary bulkheads at either end, we have an unsinkable boat or pontoon. With cast-iron pipe the wall thickness is necessarily great and this means a heavy weight. The big cast-iron mains in the Astoria-Bronx Gas Tunnel are heavy enough to remain in position in the event of the tunnel being flooded at any time. A length of 12-inch cast-iron pipe weighs about 810 pounds; but the water it displaces weighs only about 700. Consequently, if it were closed at the ends and thrown into the water, it would sink. But there is no such problem with steel pipe.

At Rochester, N. Y., a big steel discharge pipe for the sewage disposal works was laid by the flotation method in the waters of Lake Ontario. The pipe is 66 inches in diameter and the wall thickness ½ inch. On shore the 30-foot lengths were riveted into sections of 120 or 150 feet in length. These

A CAST-IRON SEWER CONNECTION OF LARGE SIZE.

were bulkheaded and then launched, after which they were towed to position over the site. Here a section would be supported by cables secured to two groups of piles which had been placed one at either end of the location. The bulkhead valves were now opened when the pipe section would begin to sink. The cable supports would be slackened so as to maintain control over the sinking. A diver below would take care of the details in connection with the settlement to final position. The joint into the preceding section was of a special character, easy to make under water. That is to say, bell and spigot forms were given to the two pipe ends by riveting on suitable pieces. In addition, an angle bar was riveted into the piece forming the bell in such a way as to provide a fixed flange. Another angle-bar ring was arranged back of the spigot end, where it formed a loose flange. A ring of lead pipe would be set in between this movable flange and the spigot re-einforcement. A series of holes in one flange corresponded to a series in other. The joint was made by passing bolts thru corresponding holes and drawing them up tight. The effect of tightening these bolts was to squeeze the lead pipe and thus produce a seal.

Cast-iron and steel piping are frequently tested hydraulically after installation to determine the tightness of the joints. Generally, if not always, this is done by putting an entire section of the line under pressure. An innovation in a similar connection has been introduced recently which is adaptable to testing the joints of iron and steel sewers. The gas mains in the Astoria-Bronx Tunnel, already mentioned, were required to have joints capable of withstanding a pneumatic pressure of 20 pounds per square inch. A special device was employed by means of which the joints were not only individually put under pressure, but also only the two ends of the pipe lengths were actually involved, and these merely for a radial distance of a few inches. That is to say, a "bulkhead" in the form of a short cylindrical ring with an exterior circumferential groove or channel was placed so as to provide with the aid of the pipe ends an annular compartment into which air might be pumped until the desired pressure was reached. In order to provide end walls that could be expanded and contracted and so provide for a tight seal and later on for a shifting to the next joint, rubber tubes of fine automobile inner tubing were suitably mounted. Air under pressure when admitted to these tubes produced the desired expansion and when allowed to escape provided for collapse. After the bulkhead was in place and the seal properly made by blowing up the two tubes the device was ready for use in testing the joint. Pressure air was admitted to the space bounded by the cylindrical wall of the "bulkhead," the two tubes and the pipe walls on either side of the joint. There seems no good reason why water under pressure sould not be employed in this space. The pressures would ordinarily be higher than the pneumatic pressure required here, but the air pressure in the tubes could be increased to provide sufficient resistance at the regions of the seal.

The Public Service Commission of the First District, New York, has the oversight of much construction. Some of the sewer work falls under its control. Several of the photographs here shown are illustrative of such work.

Meter Boxes Given Away

The Terre Haute (Ind.) Waterworks Company, in twenty minutes, recently distributed more than 600 meter boxes to be used by the citizens of that city as flower receptacles for growing plants.

Mr. Dow R. Gwinn, president and manager, furnishes the following explanation of this free will offering:

"We set 3,000 meters in the early part of the season. These meters come packed five in a box; the length of the boxes is about 33 inches and they are about the right size for flower boxes.

"Instead of burning up the boxes we removed the lids carefully and saved them until a certain date in May. Coupons were printed in the papers which, on presentation at the proper time, would entitle the holder to one of the boxes which could be used for flower boxes on porches or in windows. The time set for giving the boxes away was 9 o'clock. At that hour the street in front of our office was practically blockaded by crowds of people and vehicles of various kinds. At 9:20 the boxes had all been given away. Several photographers were present to take pictures for their respective papers and these were reproduced."

Denver City Government

The power of persistence and a forceful character are shown in the rejection of the commission form of government by the city of Denver, Col., after some years of trial, and the adoption of a form similar to that which has been in operation in Indianapolis for nearly twenty-five years and in other cities for a shorter time. The mayor is supreme in all executive and administrative matters, making all appointments and dismissals, and the council is supreme over appropriations. Unlike Indianapolis, Denver has an auditor, who is independent of both.

Denver retains the initiative, referendum, recall and preferential ballot, so that it has some checks which Indianapolis does not possess.

In changing its form of government Denver has returned to a mayor of the old days when partisan politics was supreme in its city government, and both friends and opponents of Mayor Speer are watching his course as an independent operator of a benevolent despotism, as the form of government is designated by Ellis Meredith.

One difficulty with the many-headed commission was the stoppage of public improvements thru lack of ability of the commissioners to agree upon the improvements to be made. There will be no such difficulty hereafter, as these questions are now in the hands of the Mayor. If he goes too fast he will be turned out by the voters at the next election, if one may judge from the experience in Indianapolis, and if he goes too slow he will do so against very strong pressure from many sides.

GRANITE PAVEMENT CONSTRUCTION

IN BROOKLYN, N. Y.

NEW MACHINERY AND METHODS

This article describes two new and labor-saving machines and their use in street paving. The excavator has demonstrated its efficiency and economy and its ability to speed up the work of the contractor. The new filler mixer shows on this job its economy of labor, and when the experience gained on this job has been used in improving the details it will become a very efficient and rapid worker in its peculiar line.

BROADWAY, in Brooklyn, N. Y., from Havemeyer street to Myrtle avenue, has exceedingly heavy traffic, has a double street railway track and the elevated railway.

The records of the highway bureau of Brooklyn show that Broadway was paved in 1905, from Havemeyer street to Patchen avenue, with asphalt block, costing $2.12 a square yard, including foundation, or a total of $72,809.28. This pavement lasted less than two years, tho under a five-year maintenance bond, and the contractor was permitted under his guarantee to replace the wearing surface with sheet asphalt, late in 1906, without additional cost to the city. Later the contractor abandoned his contract, and the city then repaired the street each year until 1912, at a total cost for the period of $6,868. The surface was then again relaid with wood block in 1912, with a mortar cushion, at a cost of $2.07 a square yard, or $71,092. The contractor for this work also abandoned his contract, and the city has paid repairs estimated at $22,000 on this pavement. The total cost of the pavement for 1905 to 1916 was therefore about $172,800. Two of the accompanying photographs show the condition of the street prior to the new improvement. This statement is made to show the very severe conditions to which the pavement is subjected, and it may be added that it is reported that the original foundation was very poor.

KEYSTONE STEAM SHOVEL EXCAVATING OLD WEARING SURFACE AND DUMPING INTO WAGON. NOTE CLOSE QUARTERS IN WHICH MACHINE WORKS AND ITS ADAPTABILITY TO THE PECULIAR CONDITIONS.

KOEHRING PAVING MIXER LAYING CONCRETE FOUNDATION. THIS MACHINE DEVELOPED A CAPACITY MORE THAN 35 PER CENT. GREATER THAN ITS RATING. NOTE OLD GRANITE BLOCK PAVING IN STREET RAILWAY TRACKS NOT REMOVED IN MAKING THE IMPROVEMENT.

The granite blocks seen between the tracks in the photographs were laid twelve years ago, when the asphalt block pavement was first laid.

In October, 1915, a contract was let for the improvement of Broadway, from Havemeyer street to Myrtle avenue, to Chas. A. Myers Contracting Co., of Brooklyn, with modern granite block pavement, under the latest specifications for the improved type. The total area of the pavement is 34,464 square yards, and the total cost, including a new concrete foundation, is about $126,000.

The specifications provide for a 6-inch concrete foundation, a 1-inch sand cushion, and the latest improved blocks 3¾ to 4¼ inches wide, 4¾ to 5¼ inches deep, 8 to 12 inches long,

VIEWS SHOWING CONDITION OF BROADWAY, BROOKLYN, NEW YORK, BEFORE THE PRESENT IMPROVEMENT. WOODEN BLOCK PAVEMENT UNDER UNUSUALLY UNFAVORABLE CONDITIONS. NOTE THE PATCHES WITH OLD STONE BLOCKS.

cut with smooth heads to lay with ⅜-inch joints. No pea stone are used in the joints which are filled with a tar and sand mixture.

Mr. Myers is using the latest machinery in the work and has made some records as to speed and quality of work with them. One of these machines is a steam shovel, designed and built by the Keystone Driller Co., which is specially fitted for the work of tearing up the pavement, and afterwards the concrete and loading the fragments into wagons standing alongside. The presence of the elevated road structure over the street was allowed for in the plan for work, so that there was a minimum of interference with the work of the machine on this account. The thousands of loaded trucks and the hundreds of street cars pasing during the day demanded the maximum of speed with construction, that the obstructions to traffic might be removed at the earliest possible moment.

It will be seen from the photograph that the ½-yard bucket is mounted and slides back and forth on the I-beams forming the boom of the machine. The boom is lowered and its end dropped until it is parallel with the surface and the bucket then dragged forward and digs its teeth into the layer to be moved until it is full. The boom is then raised and turned until the bucket is over a wagon, when the catch holding its flap bottom is pulled by the engineer and the bucket-load is dropped. Two men only are required to operate the machine. In addition there are a foreman and two laborers who bring up teams and level up for planks laid for the machine to move itself forward on.

The removal of the wood block layer is comparatively easy. Then the concrete layer is attacked; most of it is thoroly broken up by the bucket teeth, but large slabs are sometimes picked up, having areas of 4 to 8 square feet.

The pavement was constructed first on one side of the street railway tracks and then on the other. The wagons stood on the railway track for loading, and there were delays for driving out of the way of cars, but the shovel tore up and loaded the wood block pavement, 11 feet wide, advancing 600 feet a day; and removed the 5-inch concrete at 400 to 600 feet a day. Laborers followed the removal of the concrete and took off 3 inches of the soil below to make room for the new 6-inch foundation and the size of the granite blocks, which is larger than that of the asphalt blocks of the pavement for which the old 5-inch concrete foundation was laid.

This subgrade was thoroly compacted with a 10-ton steam roller.

The roller is followed immediately by a Koehring paving mixer with a rated capacity of 100 square yards a day. It has been laying on the job 137 square yards of the 1:3:6 concrete, using the extension boom which can be seen in the photograph.

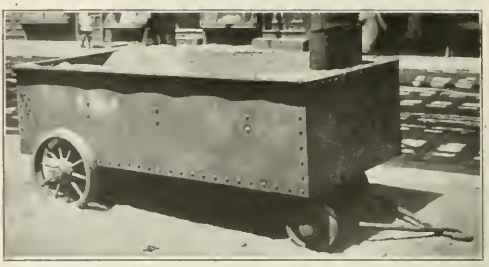
ASPHALT HEATER IN REAR, AND FILLER MIXER, IN FRONT. HOT SAND DUMPED FROM WHEELBARROW ON THE LEFT. POURING JOINTS ON THE RIGHT. NOTE ACCURACY WITH WHICH POURING IS DONE.

One inch of sand is spread on this concrete after it has set and the granite blocks are set and poured as shown in one of the photographs, with a mixture of one part tar and one part fine screened sand.

One of the special pieces of apparatus used on this job was the machine for mixing asphalt and sand for the filler, devised by Fred Hesse, one of Brooklyn's granite paving contractors.

The machine and the tank for heating asphalt will be seen in one of the photographs, and the tank for drying and heating sand in the small photograph accompanying.

The tank of the mixing machine has an axle with 3-inch blades on it spaced seven inches apart, which is rotated by the man holding the handle. The materials are supplied thru the top in proportions of one of tar to one of sand, both heated to 250 to 325 degrees, and when mixed the filler is drawn off thru the pipe seen in the photograph. The men catch the hot filler in the pails and pour it into the joints as shown. An improved machine, now under construction, will connect the mixer directly with the tar heater so that the fluidity of the mixture can be controlled better. In this machine the mixer axis will be turned by a gasoline engine. The mixer saves the labor of five men ordinarily used. The pails are round with a triangular pouring lip or chamber on the front so that the filler can be poured directly into the joint with but little spreading over the surface of the blocks, as may be seen in the cut.



HEATER FOR DRYING AND HEATING SAND FOR FILLER.

THE COMPLETED PAVEMENT ON SUNDAY. COMPARE JOINTS AND SURFACE OF THE NEW PAVEMENT LAID UNDER THE LATEST IMPROVED SPECIFICATIONS WITH OLD GRANITE BLOCKS IN THE STREET CAR TRACKS LAID SEVERAL YEARS AGO UNDER THE OLD SPECIFICATIONS.

The first pouring of the joints fills them full, but a gradual flow to the bottom of the joints, and perhaps into the sand cushion, with some contraction or cooling, make a second pouring necessary, when the joints are filled full to overflowing slightly.

The completed street is shown in one photograph, taken on Sunday, which shows the special conditions met with, excepting that the traffic is practically nothing.

H. H. Schmidt is the chief engineer of highways of Brooklyn, and E. D. Rhame is the division construction engineer in direct charge of the work. The Charles A. Myers Contracting Co., of Brooklyn, are the contractors.

A SUCCESSFUL MUNICIPAL LIGHTING PLANT

Some time since a description of the new municipal lighting plant of Crawfordsville, Ind., was published in MUNICIPAL ENGINEERING. The plant has passed thru some difficulties on account of failure of the appropriating authorities to provide promptly for necessary construction and extensions, but they were ultimately provided and the report for the year ending with June, 1916, shows that the plant is now operating efficiently and economically.

Most of the commercial service is metered, the receipts from such lighting service being $40,584.75 and for power $22,404.23. Flat rate services amount to only $1,996.27.

The city is charged $13,296.58 for municipal light and other utilities paid $4,150.65 for power service. Other income from merchandise and labor on installations, interest and rents brought the entire receipts to $85,958.58.

Expenditures are $20,143.05 for operation and maintenance of the steam power plant; $1,059.11 for maintenance of the transmission and transformation service; $1,777.54 of the distribution service; $1,737.24 of the consumption service; $578.67 of the commercial service; $5,292.14 general expenses, largely salaries; $1,594.13 for undistributed items, such as injuries and damages, insurance, stationery and printing, stores, automobile and wagon, the two last taking over half the total of the items. The expenditure on buildings and ground was $74.60; depreciation was charged at $12,000 and interest on bonds was paid, $3,036. The total expenses were $47,272.49, which is 55 per cent. of the income.

From the net profits $8,677.95 was paid for construction and equipment.

The cash on hand amounts to $33,650.20 in the general fund, $6,122.02 in the sinking fund, $20,228.81 in the depreciation fund.

The steam plant burned 8,957 tons of coal to produce 3,114,400 kw. hr., or 5.7 per pound of coal, costing 1.4 cents per kw. hr. generated.

The peak load of 1,050 kw. occurred at 8:35 a. m., March 22, 1916. The maximum daily load was 11,350 kw. on February 4, 1916, and the minimum was 3,000 kw. on July 11, 1915.

The number of consumers is 1,945, an increase of 143 during the year.

Receipts increased $11,557.45.

Expenses decreased $744.75.

Current generated increased 1,033,222 kw. hr.

Coal burned increased 1,859 tons.

Coal burned per kw. hr. decreased 1 pound.

Peak load increased 300 kw.

Maximum daily load increased 4,750 kw.

Originality in Street Lighting Standards

By Albert Marple, Tropico, California.

If the designs are artistic, distinctive light standards may add much to the beauty of the city streets as well as give a special point of interest to the visitor or traveler to remind him of it when he is telling other visitors where to go. The same idea is carried into the marking of transcontinental lines of automobile travel. This brief article shows what the birth-place of the idea is doing in the way of emphasizing the trade-marks of its towns, if we may be permitted to use a commercial term.

IT IS probable that nowhere in this country is so much originality exhibited in the street lighting line as there is in Southern California. The officials of the various cities seem to be trying to outdo one another in presenting ornamental electroliers for both business and residential streets, and some very attractive lighting features have been devised and constructed ,which enhance the individuality of the particular cities and towns.

So distinctive are a great many of these lighting standards that places are referred to as having this or that kind of lighting posts. They are in reality new landmarks by which the towns are known. Many of the cities of Southern California have nick names, and in nearly every case the electroliers are designed to suit the nick-name in some way or other. For instance, San Bernardino is known as "The City of the Arrowhead," and the lighting standards of that place resemble as nearly as possible regular arrowheads. Riverside is called "The Mission City." The electroliers of that place are built along Old Mission lines, with their crosses, square corners, bell-shaped globes, etc. Alhambra is known as "The Crescent City," and in the lighting fixtures of that city one or more crescents have been incorporated.

The accompanying illustrations serve to illustrate what is being done along this novel electroller line. The two first illustrations show two attractive arrow standards in San Bernardino. The standard in Figure 1 is located in the business section, while the one in Figure 2 is one of a series of a hundred or more located along one of the principal residential streets. The Riverside Mission standard is shown in Figure 3, while Figure 4 shows the attractive crescent electrolier to be found in Alhambra.

In Bairdstown may be seen the fixture shown in illustration No. 5, which serves three distinct purposes at one time. In addition to being a street light, it shows the name of the street and the block number. Another electrolier along this

THE ARROW-HEAD DESIGN USED ON BUSINESS STREETS IN SAN BERNARDINO, CAL.

THE ARROW-HEAD DESIGN AS USED ON RESIDENCE STREETS IN SAN BERNARDINO, CAL. ADDITIONAL LAMPS CAN BE USED TO OUTLINE THE DESIGN WHEN SPECIAL ILLUMINATIONS ARE MADE.

THE DESIGN USED IN THE CRESCENT CITY, ALHAMBRA, CAL.

THE BAIRDSTOWN, CAL., DESIGN COMBINES BEAUTY WITH USEFULNESS, AS IT ILLUMINATES NOT ONLY THE STREET, BUT ITS NAME AND THE NUMBER OF THE BLOCK.

PASADENA'S LAMPS ARE SET AT FREQUENT INTERVALS ALONG THE BLOCKS AS WELL AS AT STREET CORNERS, AND EACH SHOWS THE NUMBER OF THE HOUSE BEFORE WHICH IT STANDS.

UPLAND, CAL., HAS A DESIGN WHICH IS DISTINCTIVE, BUT NOT SO WELL ADAPTED TO USE ON A STREET-LIGHTING POST AS MOST OF THE OTHERS SHOWN.

THE DESIGN OF THIS CONCRETE POST, IN USE AT CULVER CITY, CAL., IS LESS DISTINCTIVE THAN OTHERS SHOWN, BUT STILL IS SUFFICIENTLY DIFFERENT FROM OTHER POST DESIGNS TO BE EASILY RECOGNIZED AS INDIVIDUAL TO THE CITY.

SAN FERNANDO'S SPECIAL DESIGN IS ALSO ON GENEBAL LINES, BUT THE FLARING BASE GIVES IT AN INDIVIDUALITY WHICH ATTRACTS ATTENTION, PERHAPS BECAUSE IT IS RATHER HEAVY FOR ITS PURPOSE. IT IS BUILT OF CONCRETE.

THE MISSION DESIGN, WHICH IS DISTINCTIVE IN THE STREET-LIGHTING SYSTEM OF RIVERSIDE, CAL.

line is the one in photograph No. 6, found in Pasadena. This standard shows the number of the house before which it is located, so that the person driving along the street may tell without alighting just where the house that is being sought is located. There are several of these standards between corners as well as at the street intersections. A pretty little standard built on the Mission line is shown in Figure 7. This is located at Upland. It is entirely of concrete, and represents an arched bridge with a series of arches forming the rail. Another all-concrete standard is shown in illustration No. 8. This is located at Culver City and is one of a series of about a hundred. The last illustration, Figure 9, shows an artistic concrete standard located at San Fernando. Standards of this type line both sides of this street and add greatly to its general appearance.

No one has a monopoly on the unique ideas that may be incorporated in the lighting standard, and for this reason it is possible for each city to have electroliers which will, in addition to serving as supports for street lights, have the effect of adding attractiveness to the city in general.

WORKERS IN THE FIELD

"Miracles" vs. "Mysteries" in Highway Construction

Editor of MUNICIPAL ENGINEERING:

Sir—In Mr. Reed's interesting discourse on the "Mysteries of Concrete Road Construction," published in your issue of July, he resorts to rather biting sarcasm to emphasize his views. He makes it clear, however, that in spite of two national conferences on how to build concrete roads, unanimity of opinion is still lacking.

The following paragraph relating to a single feature of concrete road building discloses the present status of affairs:

"There you are! Suspended, mentally dangling in the air, even on the question of joint protection plates. We don't appear to know what we know when we know it."

Mr. Reed concludes with the following statement:

"The answer to all my seven listed mysteries is concentrated in this: Lack of thoroness in the American people—plus short-sightedness of the cement manufacturers in not more actively discouraging inferior workmanship. Because of said short-sightedness and the cement manufacturers' frequently evidenced disposition to boost the price of cement, I sometimes wish there was an open season for cement manufacturers."

But a careful analysis of the paper shows that Mr. Reed, like those he criticises, is obliged to fall back upon that small but very significant word "if." Why does he say "if a cement-concrete pavement could be constructed so as not to develop any cracks," etc. If road-builders of Mr. Reed's experience, keen perceptions and analytical mind are still in the "if" stage of the game, what can be expected of the average county engineer or contractor who essays to build his first concrete road? Mr. Reed is surely mistaken in charging cement manufacturers with failure to discourage inferior workmanship. On the contrary, they have exerted every effort to bring the concrete road to a state of perfection. They have provided free inspection, and on two occasions have called together in national conference all of the concrete road experts of the United States. What more can they do?

But Mr. Reed's paper does present one very important fact. Concerning a concrete road built under his supervision, he says it became "infamously" known as a deplorable failure, and he continues as follows:

"And yet—and herein is one of the allurements of a cement-concrete road, which is always on tap—we charitably hid its shame by humanely spreading a sheet of asphalt over the residue. And lo! there was a metamorphosis to a No. 1 sheet asphalt pavement. That's a miracle which can't be successfully performed on any other type of disintegrated pavement."

In this one paragraph Mr. Reed has laid bare the supreme folly of road-builders in departing from definitely ascertained and satisfactory results to wander in the bogs of theory and conjecture.

What are some of these results?

The street that bears the heaviest traffic in the world is the Thames Embankment, London. It is simply a solid old stone thorofare, with a wearing surface of natural asphalt macadam, the latter put down in 1906. As stated, this street sustains the heaviest traffic in the world.

The Thames Embankment ten-year test of the durability of an asphalt macadam wearing surface is convincing.

Few thorofares carry more traffic than Riverside Drive, New York. It is merely 6 inches of concrete, with a 3-inch wearing surface of asphalt concrete.

Riverside Drive shows what concrete will sustain when used as a road base or foundation.

But for economic reasons we cannot provide newly-constructed country roads with the thick stone base of the Thames Embankment. Neither should we give country roads a 3-inch wearing surface of asphalt concrete. But we can use the concrete base of Riverside Drive and place thereon the asphalt macadam wearing surface of the Thames Embankment. We can increase or diminish the thickness of either to meet varying requirements of traffic.

A sections of the Belair road leading out of Baltimore was constructed in this way in 1914, including concrete curbs as an integral part of the base, the latter 4 inches thick. The road carries excessive traffic to and from Baltimore, and thus far has cost nothing for repairs.

Monroe county, Michigan, is building the same type of road, with the base increased to 5 inches.

The streets of Newton, Kans., were constructed in this way, and some of them have been under traffic for ten years without necessity for repairs.

Philadelphia's great Northeast boulevard has roadways of the same type.

Notwithstanding the demonstrated efficiency of these highways, in which the concrete does not crack, heave or buckle, hundreds of thousands of dollars are being expended in the effort to force it into the strained position described by Mr. Reed.

Furthermore, the cost of the composite type of road is lower than some states are paying for water-bound macadam. The Michigan road contract was let at less than $12,000 per mile. Even Northeast boulevard was constructed for approximately the same price.

Mr. Reed might have presented an eighth mystery—why the engineers and taxpayers of the United States continue to spend money in experimenting with a type of road costing more than those described, and which, even if successfully built, will not, as Mr. Reed says, meet every requirement of traffic, owing to "lack of resiliency," something highly essential where horse traffic prevails.

Mr. Reed's proposed remedy, "an open season for cement manufacturers," is a poor one. They are to be commended for developing the best road foundation material extant.

What is really needed is a closed season for common sense; in brief, a return to the intuitive perception of the fitness of things that induced the cement manufacturers themselves to first oppose all-concrete roads and which led Mr. Reed to cover his disintegrated concrete road with asphalt—treatment to which the concrete responded with such admirable results that he proclaims it a "miracle."

Let us substitute miracles for mysteries.

DANIEL T. PIERCE.
Barber Asphalt Paving Co.

Cost Data for Asphaltic Macadam Pavement by Day Labor

The Editor of MUNICIPAL ENGINEERING:

Sir—The following cost data are for an asphaltic macadam pavement laid by our own street force under the suprvision of the writer. The pavement was laid on an old macadam base and was 2½ inches thick after rolling. No grading was necessary but the fine stone used contained about 75 per cent. dust and it was necessary to screen all this stone before placing same on road. All the stone was loaded with shovels, which accounts for the high cost of hauling it.

Aztec asphalt was used for the binder.

G. C. BREHM, City Engineer,
Waynesboro, Pa.

Docks to Be of Concrete

On and after July 15, 1926, all docks in Chicago must be constructed of concrete. In the meantime the wooden docks at present in service may be maintained where in good condition.

Repairs to present docks can be made by submitting detailed plans for the work to the commissioner of public works and having these plans approved. The commissioner of public works may, in his discretion, refuse permits for repair of docks and require their replacement with concrete

The ordinance contains no specifications for concrete docks, but it is the intention of the department of public works to draw up general plans to which all docks must conform, but which plans will be sufficiently flexible to provide for any special conditions that may arise.

Garbage Collection and Disposal in Springfield, Mo.

The inefficiency of the ordinary contract for collecting garbage without control or provision for disposing of the collected garbage is shown again by recent experience in Springfield, Mo., where the contractor, who was paid $650 a month for the work, was enjoined from disposing of the garbage because his method produced a nuisance. The city officers have not yet recognized the necessity of providing a sanitary method of disposing of the refuse of the city, as it is again proposed to let a contract for the collection alone.

COST-DATA 6122 SQ.YDS. ASPHALTIC MACADAM BY DAY LABOR AT WAYNESBORO, PA., By G.C. BREHM City Engr.

UNIT	AMOUNT	RATE	TOTAL COST	SQ.YD.	TOTAL SQ.YD.	REMARKS
3" and 2" STONE	696.2 tons 20.5 "	.90 .80	643.30	.10508		
HAULING	505	.50	252.50	.04124		One Mile
SPREADING	235	.16	47.20	.00770		
ROLLING	74	.25	18.50	.00302		
COAL	2500 lbs.	.002	5.00	.00081		
OIL	1½ Gal	.50	.75	.00012		
SUPERVISION			15.00	.00245	.16042	
ASPHALT	13507 Gal.	.061	823.93	.13458		
HAULING	53 58	.50 .16	35.78	.00584		
APPLYING	108 342 233	.20 .18 .16	167.80	.02740		Pouring Cans
WOOD	6 Cord	6.00	36.00	.00588		
OIL and Waste	21½ gal. 15 lbs.	.12 .15	5.55	.00090		
SUPERVISION			60.00	.00980	.18440	
1" and ¾" STONE	99.2 tons	.90	89.28	.01458		
HAULING	83	.50	41.50	.00678		One Mile
SPREADING	139	.16	22.24	.00363		
ROLLING	20	.25	5.00	.00081		
COAL	1500 lbs.	.002	3.00	.00049		
OIL	3 qts.	.125	.37	.00006		
SUPERVISION			8.00	.00130	.02765	
½" STONE	49 tons	.90	44.10	.00720		
HAULING	51	.50	25.50	.00418		One Mile
SPREADING	123	.16	19.68	.00321		
ROLLING	15	.25	3.75	.00061		
COAL-OIL and SUPER.			9.35	.00152	.01672	
MISCELLANEOUS			121.00	.01978	.01978	Dep. Machinery Clean Up Etc.
TOTAL			2,504.08		.40897	

FIRE DEPARTMENT

Fighting Fires in Early Chicago

We are indebted to Mr. Francis A. Eastman, City Statistician, city of Chicago, for the following information relating to fire fighting in Chicago in the early days.

The first fire ever reported in a Chicago newspaper broke out on October 11, 1834, at the corner of Lake and LaSalle streets. Three dwelling houses, a grocery store and a cabinet shop were destroyed. By that event the Board of Trustees was moved to take further action; they held a meeting, in which the citizens generally participated, and passed an ordinance declaring that thereafter it would not be lawful for any person or persons to carry firebrands or coals of fire from one house or building to another within the limits of the town, "unless the same be carried or conveyed in covered earthen or fireproof vessel, under penalty of $5 fine for each and every offense." Complaint was made at the meeting that there was not a fire-bucket in the place. On September 19, 1835, the trustees resolved to order two fire engines for the use of the corporation, "of such description as the president of the board should deem necessary, and also one thousand feet of hose, on the credit of the corporation." The president gave over the duty and responsibility of making the purchase to William B. Ogden, as agent. A month later the trustees ordered the buying of two fire-hooks, with chains and ropes, two ladders, sixteen feet long, four axes and four hand saws. Such articles were bought at the cost of $26.63. Thereupon a hook and ladder company, consisting of twenty-five citizens, was organized. In the list of names of members are found a number that afterward became distinguished in the city of Chicago and beyond. On November 4, 1835, the trustees adopted measures for the organization of a regular fire department, to consist of a chief engineer, two assistant engineers, four fire wardens, in addition to the trustees, who were designated as wardens ex-officio.

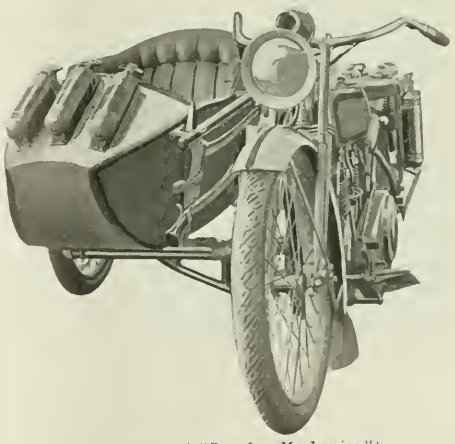
"Self-Propelled" Apparatus in 1877.

Some time in 1877 the fire department invested in self-propeller machines, which, attached to fire engines, made havoc on the streets, tearing up pavements, running into other vehicles, and crashing against lamp-posts. There were three such purchased and put in use; two on the West Side, one on the South Side. The wheels were shod with thick steel bands stuck full of spikes, to prevent skidding. But in that case prevention did not prevent; at the speed they were driven, when turning a corner, they skidded frightfully. Finally one of the self-propellers struck against the head of an old wooden bridge that stood at Adams street, and did to the bridge and itself much damage. Then all were put out of service. But they had anticipated or predicted the auto-truck of the present day.

In 1893 the fire department comprised four fire boats, eighty steam fire engines, three hand engines, twenty-six chemical engines, one hundred hose carts, carriages and wagons, thirty-one hook and ladder trucks, sixty chemical extinguishers, thirty-one portable pumps, and one water tower. The uniformed force was nine hundred and eighty-four; not uniformed forty-six, making a total of one thousand and thirty-seven men in the fire service. Of horses, there were six hundred and sixty-six.

Record for Year 1914.

During the year 1914 the fire department responded to 14,977 alarms and the number of actual fires for the same period amounted to 10,534. There were a few fires of considerable magnitude from a spectacular standpoint, and where the energies of the firemen were thoroly taxed, but the financial losses were not great comparatively, such as the U. S. Express Stables April 17, involving a loss approximately $190,000; another, May 27, where the loss approximating $35,000, was inconsiderable compared with the area burned over and number of communications, and the fire on Christmas Eve in the department store at Forty-seventh and Ashland avenue.



(Courtesy of "Popular Mechanics.")

HARLEY-DAVIDSON & PYRENE SIDE-CAR FIRE FIGHTING DEPARTMENT OUTFIT.

OKLAHOMA CITY MOTOR FIRE APPARATUS EQUIPPED WITH GOODYEAR TIRES.

which, with the smaller buildings it communicated to, approximated a loss of $225,000.

The forces of the department for the year 1914 were the fire marshal and six assistant fire marshals, 159 chiefs of battalions, 159 captains, 162 lieutenants. The total numerical force was 1,988 men, officers and privates. The aggregate cost of the department was $3,461,584, or $1.43 per capita.

There were transmitted during the year 3,333 box alarms, 102 second alarms, 26 third alarms, 34 combined second and third alarms, 47 special calls and 11,435 still alarms, making a total of 14,977 alarms, an increase of 294 over the preceding year.

New Fire-Fighting Motorcycle

In this issue we are illustrating a Harley-Davidson-Pyrene motorcycle for fire department usage. This outfit forms a very efficient piece of fire-fighting equipment for small towns and villages. It is also a valuable auxiliary for the proper equipment of fire-houses of the largest cities.

Such a unit can be shot out on telephone calls, thus saving wear and tear on heavier types of apparatus.

Statistics show that thousands of fires would be confined to curtains, couches, closets or similar limited areas if something could be done at once to check the flames. The motorcycle fireman not only is able to get away from the house faster, but can make up minutes of precious time thru congested traffic, where the larger apparatus would have to slow up frequently in the course of a run. That's making the most of the seconds.

Towns depending on volunteer departments for protection realize the shortcomings of that sort of service. With this outfit it is not necessary to wait for the required number of men to haul the apparatus to the scene of the blaze or to waste precious moments looking up a team. One man can hop onto the motorcycle equipment and pick up ald en route or at the fire and thus insure giving the fire a fight in the early stages and not after it has reached the "beyond control" period.

A Popular Priced Outfit

The village of Galeton, Pa., has recently placed in service an American-La France combination hose and chemical truck (Ford chassis). The truck is equipped with a twenty-five gallon brass chemical tank, to which is connected 100 feet of chemical hose. The rear body is built to hold five hundred feet of regulation fire hose. On the sides hang the fourteen foot extension ladder, the lanterns, hand extinguishers, axes, etc. The price of the apparatus is $1,300.

A Brockway for Guayaquil

Guayaquil, Ecuador, has an efficient fire-fighting force well known thruout South America. It is equipped with the most modern American apparatus, against which no fire of recent years has been able to make serious headway.

Recently another engine was landed here, of the automobile Brockway type, with 800 feet of hose, having a 4-cylinder motor of 35 horsepower. It is provided with a chemical apparatus of 25 gallons capacity, and 200 feet of hose, ejecting a stream of liquid 30 feet, together with two 3-gallon hand

RECENT DEVELOPMENTS IN MOTOR FIRE APPARATUS.

SERVICE HOSE, CHEMICAL SQUAD WAGON, CITY OF WABASH, IND.

JEFFERY 1½-TON COMBINATION (WITH LADDERS). CITY OF MINNEAPOLIS, MINN.

GARFORD COMBINATION (WITH LADDERS), CITY OF WOODBRIDGE, N. J.

FEDERAL SERVICE TRUCK. STANDARD EXPRESS BODY. NO SCREENS. CITY OF DETROIT, MICH.

BOYD COMBINATION AND SQUAD WAGON, EQUIPPED WITH SEWELL CUSHION WHEELS, CITY OF CAMDEN, N. J.

SEAGRAVE TRIPLE COMBINATION, EQUIPPED WITH SEWELL CUSHION WHEELS. CITY OF PASADENA, CAL.

machines, to be used when the more powerful water stream is not necessary. There is also a full equipment of other apparatus required for the work, including a strong acetylene head light and fire bell.

The machine carries 10 men and has already been placed in the service. It was made at Elmira, N. Y.

TWO NEW KELLY COMBINATION HOSE AND CHEMICAL TRUCKS RECENTLY PLACED IN THE SERVICE OF THE CITY OF SPRINGFIELD, OHIO. THIS MAKES A TOTAL OF FIVE KELLYS IN THE SPRINGFIELD FIRE DEPARTMENT AND TEN IN THE CITY SERVICE.

Preparedness of Motor Truck Manufacturers

We are demonstrating every day that our state of preparedness for any emergency is more advanced than we have been thinking. While the Government itself has been discussing the question and Congress has been delaying official progress toward national preparedness, the demands made upon private business on account of the European war have produced a state of individual preparedness which is marvelous. It is evidently possible at any moment by turning commercial factories into Government needs to supply them as rapidly as the materials can be used.

This is true of practically everything but big guns, war vessels and good roads. These cannot be built after a war begins rapidly enough to be of any early service.

The new law making appropriations for building highways, recently passed by Congress, is the first step toward filling one of these needs. Proper selection of roads in each State for first improvement with Government aid will be the next.

One of the latest evidences of private preparedness is the prompt action of the Packard Motor Car Company of Detroit on an order for 396 motor trucks for the army along the Mexican border and the men to handle them, some 636 in number. This will make more than 1,000 of Detroit young men with the army who have gone since the mobilization order to the National Guard.

TWO KELLY HOOK AND LADDER TRUCKS IN THE SERVICE OF THE INDIANAPOLIS (IND.) FIRE DEPARTMENT.

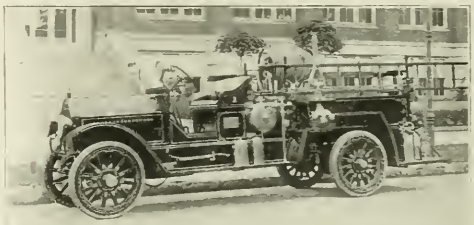
The Packard Company has already furnished 122 men for government service, tho not enlisted in the army, to operate 122 trucks, which they have sent for use in Mexico since March 22, and 109 of the company's men have mobilized with the Michigan section of the National Guard. The naval militia call will take some more.

The 636 men required for the new order for trucks will form complete transport companies, and will be civilian employes of the United States under a year's contract at $100 a month and transportation. The company has issued a call for these men and they are coming in as rapidly as the trucks are ready to turn over to the Government. Some young men refused enlistment in the army on technical grounds or for minor deficiencies are acceptable for this truck work.

Another South Bend Double Duty Combination Delivered

The South Bend Motor Car Works of South Bend, Ind., has recently delivered to the city of Ft. Wayne, Ind., a type "60" Combination Chemical and Hose Carrier.

This piece of apparatus is equipped with a 60-horse power



motor and is of the worm drive type. It is equipped with step type fenders, three-way turret pipe, 40-gallon chemical tank, 250 feet of 3/4 four-ply chemical hose, 1,200 feet hose body and all other standard equipment. It will be noted that this car was delivered on Goodyear Cushion Tires.

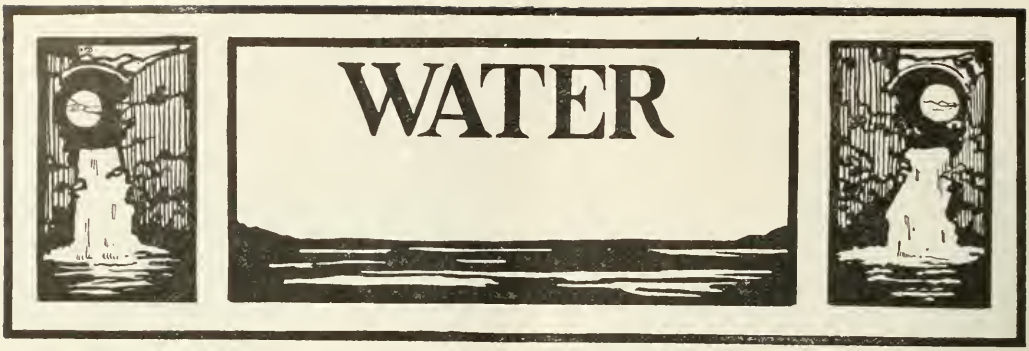
The South Bend Motor Car Works would be pleased to give any one any further information desired on this car.

Garford Worm-Drive Trucks

Garford 1½ or 2-ton worm drive trucks are made with just the simple hose-carrying body, with space of 20 men; with the same body with one or two chemical tanks; the same with a powerful pump attached. These machines have found favor with the fire departments in suburban communities, where the distances are great. On Long Island, for instance, six of these Garford motor trucks thus equipped are in use and other towns are expecting to add these efficient machines to their fire departments immediately. There are two at Port Washington, one each at Oyster Bay, Syosset, East Norwich and Roslyn. Westchester County has two—at Katonah and Mount Kisco—and many other towns around New York are just on the eve of buying.

Property Owner Must Pay Expense of Putting Out Fire

The European principle of fining a property owner if he has a fire on his premises has been established in Brooklyn, N. Y., for the first time in this country. The owner of a building had been notified to instal a sprinkler system, had failed to comply with this fire department order and he had a destructive fire. The commissioner sued for the cost to the fire department of putting out the fire and obtained judgment for $1,500, the estimated cost.



Rapid Sand Filters in Ohio

Experience indicates that the rapid sand filter is best qualified for the purification of the comparatively turbid waters found in the Middle West, and in a paper before the Central States Water Works Association, Philip Burgess shows what an important part in the development of the history and art of water purification rapid sand filters have played in the state of Ohio.

A patent for the use of a coagulant in connection with the filtration of water was granted to J. L. Hyatt in 1884, marking the beginning of the development of rapid sand filter plants for the treatment of municipal water supplies and the first of such plants was constructed in the United States at Somerville, N. J., in 1885.

The first rapid sand filter plant constructed in the state of Ohio was built at Warren in 1895, and was one of the type covered by letters patent issued to J. E. Warren in 1889.

The first rapid sand filter plant in the United States provided for the purification of a municipal water supply and constructed under a guarantee of efficiency was contracted for by the city of Lorain, Ohio, in May, 1896, with the O. H. Jewell Filter Co.

The first municipal water softening plant constructed in the United States was built at Oberlin, Ohio, in 1903, and rapid sand filters of the pressure type were used to filter the softened water.

The largest municipal water softening plant in the world and the second largest rapid sand filter plant in the world are constructed at Cleveland, Ohio, with a capacity of 144,000,000 gallons daily.

The third largest rapid sand filter plant in the world, also, is in Ohio, at Cincinnati, and has a capacity of 112,000,000 gallons daily. Moreover, the Cincinnati filters were the first municipal filters designed for the application of wash water at high rates without any other means of agitation for cleaning the sand. In building the Cincinnati filters, a brass wire screen was placed over the gravel to keep it in place during washing.

The first municipal rapid sand filter plant designed for high rates of washing, and constructed with deep, coarse, gravel layers over the strainer systems without super-imposed screens for holding down the gravel during washing was constructed at Niles, Ohio, in 1910.

The first filter plant at which alum has been manufactured for use as a coagulant is at Columbus, Ohio.

The first municipal rapid sand filter plant at which the disinfectant qualities of common lime have been intelligently and knowingly utilized is at Cleveland, Ohio.

The first systematic investigation by a state board to determine the efficiencies of the filtration plants in a state was made by the Ohio state board of health in the years 1906-8.

TABLE SHOWING PROGRESS IN CONSTRUCTION OF RAPID SAND FILTER PLANTS IN OHIO.

Period	Population served by new plants at end of period	Daily capacity of new plants
1895	7,900	1,450,000 Gallons
1896-1900	35,371	7,870,000 Gallons
1901-1905	123,284	24,520,000 Gallons
1906-1910	777,293	179,650,000 Gallons
1911-1915	930,674	236,200,000 Gallons
Total present daily filter capacity		449,200,000 Gallons
Total population served in 1915		1,940,000

TABLE SHOWING PERCENTAGE OF POPULATION OF STATE OF OHIO SERVED BY RAPID SAND FILTERS.

Year	Total Population of State	Population served	Per ct.
1900	4,157,545	43,900	1.1
1905	4,462,333	185,486	4.2
1910	4,767,121	945,819	20.7
1915	5,071,909	1,940,000	38.3

The total nominal capacity of filters now in operation or under construction in the state is sufficient to provide nearly 90 gallons of filtered water daily for every resident in the state.

Probably the greatest development in the art of water purification has been an appreciation of the fact that the burden to be placed upon the filters should be made as small as possible in order to accomplish the most satisfactory results at the least expense. Within reasonable limits, it is true that the percentage removal of bacteria and impurities by the filters themselves is limited so that, of course, the best results are accomplished by removing all possible impurities by preliminary treatment before filtration. This has been appreciated in the design of modern plants wherein the period provided for coagulation and sedimentation previous to filtration is frequently from three to six hours.

In the same way, there has been a marked development in the design of the filter tanks themselves. The phrase "mechanical filters" frequently applied to rapid sand filters, was derived from the fact that a stirring device, or mechanical agitator, was provided to stir the sand in the filters and thus to assist in the removal of impurities during washage. It is obvious that such a device required a circular filter tank. As early as 1889, it was recommended that air under pressure could be used to agitate the filter sand during washing and the application of this principle, of course, permitted the use of rectangular tanks in place of the circular tanks as previously required with mechanical agitators or rakes. This principle has proven of great value in reducing the construc-

tion cost of the larger mechanical or rapid sand filters, because it has permitted the use of reinforced concrete, rectangular units occupying very much less area than is required for circular tanks of the same capacity.

It is significant of the development of the art of water purification that the last wooden sand filters now operating in Ohio and provided with mechanical agitators very soon will be removed and replaced by rectangular concrete tanks. The old filter tank at Lorain was replaced some years ago by a modern concrete filter plant, but the results accomplished by the modern plant today are no more satisfactory than the results which were accomplished by the old plant before its capacity was exceeded. Moreover, the cost of operation of the new plant is considerably in excess of that of the old plant.

In view of the disadvantages apparent in the closed type of strainer system comprising perforated pipes equipped with sand screens, or valves, engineers have endeavored to develop a strainer system of the closed type in which all parts would be accessible. The first strainer system developed along these lines in Ohio was used at Cincinnati and comprised lateral concrete channels covered with perforated brass plates. The design permits the removal of the plates and inspection and cleaning of all parts of the strainer system. Owing to construction imperfection, especially at the shoulders where the brass plates are supported, some engineers have reverted to the original form of closed or pipe strainer system. Possibly this action has been taken in part because of patents covering the use of depressed channels in filter bottoms.

A further important modification in the design of rapid sand filters was developed at Cincinnati and comprised the use of wash water without either air or mechanical agitation for cleaning the sand. Experiments conducted by Mr. J. W. Ellms indicated that when the wash water was applied at rates greater than 18 inches vertical rise per minute the entire sand body was thoroly agitated and moved by the wash water, so that further agitation by mechanical means or by air under pressure was not required. It was thought at that time that the high velocity of the incoming wash water would require that the filter gravel, placed above the strainer system, be restrained in place by brass screens. Subsequent developments, however, have shown that the screens are unnecessary and during the past two years they have been removed and the gravel layers deepened.

This fact was appreciated in the design of the rapid sand filter plant constructed at Niles, in 1910, under the direction of the speaker, where wash water is applied at a rate of about 24 inches per minute without any disturbance of the filter gravel, which consists of coarse, deep layers not fastened down by screens.

In this connection it may be noted that not the least important development in the design of rapid sand filters has been in connection with the use of larger and deeper gravel layers. In the old Warren and Jewell type filters, such as were built at Warren and Lorain, Ohio, no gravel whatever was placed between the strainer systems and filter sand. This method of construction in fact was continued for a number of years, and until 1910 some filter plants were constructed without any filter gravel. The speaker has known instances where the construction of old filters has been modified by placing gravel above the strainers with the result that much more efficient washing of the filters has been accomplished by the use of very much less wash water. It is undoubtedly true that the gravel layers play an important part in distributing the wash water thruout the filter area, as well as in keeping the sand from passing thru the strainer system, so that the successful washing of filters, especially under high rates, may be largely attributed to the use of coarse, deep, gravel layers.

A considerable part of the expense of operating a rapid sand filter plant is in the necessary coagulant, that most commonly used being filter alum, or aluminum sulphate, which generally is purchased in crystalline form at a cost of about 9 cents per pound. To Mr. Hoover, chemist in charge of the Columbus, Ohio, softening and rapid sand filter plant, belongs the credit for introducing the manufacture of the filter alum directly at the plant. The alum manufactured at the Columbus plant is not filtered or crystallized, but is applied in the crude liquid form. It is obtained at less than one-half the cost of the finished manufactured product and, on account of the fine clay contained in the liquid, has proven even more efficient than the clear crystallized chemical.

Another notable development in the art of water purification has been accomplished by the introduction of disinfectants or sterilizing agents. The three disinfecting agents which have been used on a large scale to sterilize municipal water supplies are hypochlorite of lime, liquid chlorine and quick-lime, or calcium oxide, and the use of these germicides has become so universal that it is the exception where a filter plant effluent is not treated in this manner. The most common treatments are with hypochlorite of lime, or with liquid chlorine gas.

The municipal softening plant at Columbus, Ohio, has offered unusual opportunities to study the germicidal effect of quick-lime, which is used primarily to soften the hard water of the Scioto river, but which is found also to destroy bacterial life in the treated water by eliminating the carbonic acid which appears to be necessary for sustaining such life. Dr. A. C. Houston, chemist of the Metropolitan Water Board of London, England, probably is the first observer to note such germicidal action in lime.

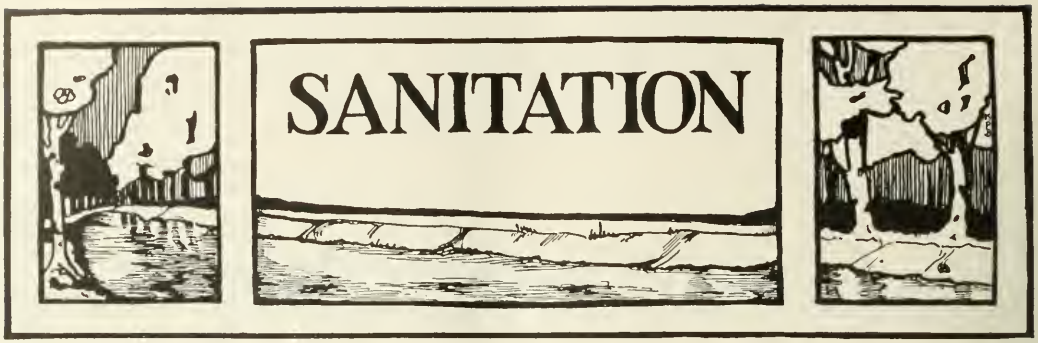
When enough lime is added to water to absorb the free and half-bound carbonic acid to precipitate the magnesium content, the bacteria of the colon and typhoid group are killed in forty-eight hours after being so treated, provided the water does not contain large quantities of organic matter. The germicidal action is effective in from five to twenty-four hours when an excess of one-half to one grain per gallon is added beyond that needed to reduce the temporary hardness to the lowest possible figure.

Quick-lime has an advantage over hypochlorite of lime or liquid chlorine as a germicide, because its action continues indefinitely so long as the lime treated water contains no carbonic acid, whereas the germicidal action of the hypochlorite continues but a short time after the application of the chemical.

The use of lime to treat and soften Lake Erie water at Cleveland, which has an average total hardness of not more than 115 parts per million, is a radical departure from former current practice, because such water, especially in the Middle West where hard waters prevail, would be considered of satisfactory quality for domestic use without softening. It is reasoned, however, that owing to the considerable difference in cost per ton of quick-lime and of alum, it is possible to use about four times as much lime as alum at the same expense. The lime has a continued germicidal action, especially on intestinal bacteria contained in the water, and moreover, the lime will soften the supply, which will thus be made more desirable at but slightly more expense than would be entailed by the usual methods of filtration, using a coagulant such as filter alum.

No Minimum Gas Rate in St. Louis

The Laclede Gas Light Company, of St. Louis, has filed an amended schedule of rates with the Missouri Public Service Commission, which is the same as one recently filed, except that it withdraws a minimum charge of 50 cents a month per meter.



Antiquated Sewage System

The city of Chicago presents the remarkable spectacle of a world metropolis still attempting to make use of a public utility designed for one-twenty-fifth of its present population. The downtown sewerage system, which was the first comprehensive system of any large city, is now notable as being the most inadequate.

In the fifty-five years since E. S. Chesbrough designed and installed the first and only downtown sewerage system many changes have come about. Prairies and marshes have been transformed into residential and industrial districts. Everything about Chicago has changed but her village charter and her sewers. Both have done good service, but they cannot go on forever.

The public has not appreciated the importance of adequate sewers because they are among our unseen utilities. Dirty streets and overflowing garbage cans call forth loud protest, while larger quantities of filth in an antiquated system of sewers go unnoticed. The menace to health is greatest in the unseen danger.

Changes in the character of the business district and large increases in population have made sewers varying from 2 or 3 feet in diameter in the east and west districts and but 1 foot in diameter in the north and south streets grossly inadequate. All space to-day is either roofed or paved. The sewers receive the entire rainfall.

Following heavy rainfall, the sewers frequently become choked. Heavy manholes are blown into the streets. Basements are flooded with deposits flushed from the mains. Numerous complaints result. Nothing is done and the matter is forgotten until the next occurrence.

The sewers are not self-cleaning. The original streets were about 10 feet below the present streets, and the sewers, in consequence, were given very flat grades. The flow is sluggish and sedimentation inevitable. The sewers are half full of mud and water under the most favorable conditions. In some places water pipes have been built thru the sewers, aiding deposits and making cleaning impracticable.

Grease in large quantities from hotels and restaurants finds its way into the sewers and there deposits. Sewers already outgrown are further handicapped. Many drains have been choked from this cause.

Building operations cause the settlement of adjacent streets. Sewers are stopped up and in some cases broken. Five streets in the downtown district of Chicago are now in bad condition from this cause. An investigation would probably reveal others in an equally serious condition.

The pumping of sewage from the deep basements of modern buildings often flushes the deposits in the main sewer into the drains and basements of buildings of the old type. A situation of this character is not only unpleasant, but results in further damaging the old drains.

While the sewers remained changeless, an intricate system of public utility services has been located thru and around the sewers and catchbasins. These obstructions have crowded out many of the catchbasins and made the cleaning of others impossible.

To recapitulate, the downtown sewerage system is outgrown and inadequate. The city faces subway construction, but before subways are built, plans for a new sewerage system should be provided. It will be possible to build sewers now which will serve the central business district for an indefinite period. The new system should also take into consideration possible changes in present sewage disposal.

Use Panama Lesson in American Cities

By R. H. Bishop, Jr., M. D., Health Commissioner of Cleveland.

Sanitary administration continually forces upon public officers the question of square dealing as between rich and poor. It is impossible for a health official to go through such a crisis as was forced upon American cities by the epidemic of infantile paralysis without being impelled to consider what is the minimum that any citizen has a right to expect of his local government.

I am convinced that, among other things, he is entitled to clean streets. This means, of course, that he is entitled to street improvements that are capable of being cleaned.

There appears to be no just reason why the best paving should be provided for the streets of the well-to-do or why these streets should receive the major attention from street cleaning departments. Yet this is often the case. From a sanitary standpoint it would be much better to discriminate on the other side, if ther is to be any discrimination at all.

The poorer portions of any city are more crowded. There is little or nothing in the nature of dooryards, so the street is the place where children play and older people congregate in their spare time. Congestion increases the normal refuse that may be expected in a populated region. It is in such localities that we find the cobbled, cracked and rutted pavements, which defy the best efforts of the street cleaner and which often, perhaps thru discouragement over results, the street cleaner so nearly neglects.

Infantile paralysis has been a peculiarly distressing scourge in cities where it has obtained a foothold. The mortality has been high and in cases where recovery takes place there is probability of lifelong physical defects. The germ has defied isolation. It is not known definitely whether it finds entrance to the system thru the respiratory organs or thru the stomach, or both. Insects are reasonably suspected of transmitting infection in many cases. Warfare against such a germ means elimination of every possible breeding place—every channel of access.

A Sanitary Alley Paved with Vitrified Brick with Cement Filler.

The conditions of this warfare are not satisfied when a broom is passed across the irregular surface of some worn-out pavement, leaving the interstices filled with moist and decayed filth. A street ought to be built like a hospital floor, with a uniform, non-adhesive surface, so drained that the application of water from a flusher will wash the smallest particle of filth from its moorings and carry it clear to the sewer without interruption.

The workingmen who make up the population of congested localities deserve the best that the municipality can do for them. The first thing that I would suggest would be the wholesale tearing up and resurfacing of every battered street in the populous districts. It may be objected that better public improvements would be reflected in higher rents and that the poor man would be simply compelled to move. Such a phenomenon was witnessed in New York when Jacob Riis succeeded in leveling tenement houses for the purpose of creating small parks. The park frontage was soon sought by people who could afford to pay higher rent and the worker, whom Riis tried to benefit, was excluded.

What I propose is not quite a parallel case. With a wholesale repaving program there would be little premium, if any, upon residence on a particular street. Paving is the public function most often financed by frontage assessments. It is a principle well established in economics that assessments upon lots, irrespective of the state of improvement, cannot normally be shifted into increased rent upon the tenant.

Dr. Gorgas' work in Panama only became effective after grouted brick pavements had been laid upon practically every street of the city, thus establishing a basis for public cleanliness. It seems to me that many American cities can learn for themselves what the United States has already taught the tropics.

Even if the subject is approached from the narrow standpoint of upper-class interest, the dangers of permitting disease to breed in any portion of a city can readily be seen. To the casual view a slum district may seem isolated. But the prosperous citizen, before he permits himself to become indifferent, should remember that his washing, his delivering and other of his own household functions are performed by persons who may come from congested and infected localities; that his office is cleaned by women of the tenements and that he brushes against persons of all classes on elevators and street cars.

This is the selfish aspect of the case. I prefer to put my argument for cleanable streets on a different basis—that a man is a man and a baby is a baby, whether the home fronts on an alley or a boulevard.

Garbage Collection in Ogdensburg

The Board of Health of Ogdensburg, N. Y., has just let a contract for the exclusive right to collect garbage in the city under the following conditions: Each householder is required to deposit $1 for a garbage can, each to be 22 inches high and 14 inches in diameter. The contractor specified in his bid the amount that he will charge the householder each month to collect the garbage twice a week and the householder is obliged to pay this amount. The cans are carried away by the contractor and replaced by cleanly washed and sterilized cans. The contractor furnishes $500 bond, and the year's contract can be renewed if the service is satisfactory.

Sanitation in New Orleans

The Board of Health of New Orleans is preparing an ordinance requiring all property owners along the lines of service to connect with them and will abolish all vaults and cesspools. The ordinance of the board, under a new law, will have the same effect as tho passed by the City Council. The law referred to corrects the law previously passed as to penalties and this makes the Board of Health supreme in matters of health. A number of ordinances, including the noted rat-proofing and chicken ordinances over which there was much contest, were declared invalid under the old law and can now be re-enacted. They are essential to the protection of the city against the bubonic plague, yellow fever and the like.

Sewage Disposal for Hermosa Beach, Cal.

The city of Hermosa Beach, Cal., is to construct a sewage disposal plant to protect its beach, in accordance with a resolution passed by the Board of Trustes on August 1, 1916.

The raw sewage will be pumped by two 100-gallon compressed air sewage ejectors, supplied with the necessary electric motors and compressors thru a force main 1,800 feet long against a static head of 43 feet to the sewage treatment plant.

This plant, on the Brosius system of activated and aerated sludge, consists of 8 circular concrete tanks 12.5 feet in diameter and 13 feet deep. It is supplied with electric motor, high-pressure blower and the necessary pipes, and will be covered with an Armco metal building on a wooden frame. After treatment the sewage runs 830 feet in a 12-inch vitrified pipe; thence the pipe and the force main above described run for 700 feet in a timber-lined tunnel 5½ by 7 feet; thence the pipe is a 12-inch re-enforced concrete pipe to the ocean shore; from which the effluent flows in a 10-inch cast-iron pipe laid on the bed of the ocean for 1,300 feet to the point of discharge. The engineer's estimate of the cost is 27,000, and bids will be received about October 15, 1916. C. R. Sumner is the City Engineer.

ROADS AND PAVEMENTS

The Objections to City Paying Total Cost of Street Paving

That Boston streets never will be properly paved until a large part of the cost of putting each street into proper condition is assessed against the property owners in each thorofare so improved, and that the chief reason of the city's lack of funds for this work is "inadequacy of the legal machinery under which it is operating," are assertions made in an interview with George C. Warren, president of Warren Brothers Company, general contractors.

Mr. Warren declared that it is a proposition which cannot be successfully contradicted that cities which pave with city funds entirely have the poorest streets in the United States, while those which assess all, or part, of the costs of paving upon the abutting properties are provided with the best.

He said that Boston is getting nowhere in its endless discussion between mayor, council, finance commision and other organizations. He declares "the arguments being put forward have every appearance of being made for the mere purpose of obtaining some political advantage rather than to benefit the deplorable condition of the streets."

"Something constructive," is the need in Boston now in handling the street-paving problem, Mr. Warren insisted. He said:

"It may be that some saving can be made in the operation of the several city departments which would allow in the future a larger expenditure from current revenue on the streets, but it can be asserted without fear of successful contradiction that the aggregate of all such items will not be sufficient to afford any adequate remedy.

"The real trouble with the streets of Boston is due to the lack of sufficient available funds to properly construct and maintain suitable street surfaces, and the reason for the lack of funds is the woeful inadequacy of the legal machinery under which the city is operating.

"The company with which I am connected is doing a large paving business thruout the United States and Canada, and I have therefore been in close touch with the laws and practices of many cities in the matter of the paving of streets. It can be stated as a maxim that the cities which pay for their street pavements from the general funds without assessing any portion of the benefits upon the property abutting on the improvements are the poorest paved and that conversely the cities which assess a large part of all of the cost of street pavements against the property benefited are the best paved.

"The law under which Boston is operated provides that when a new street is opened a portion of the cost may be assessed against the abutting property, but after such street is accepted, the maintainance thereof must be paid by the city from its general funds. For many years and until quite recently, it has been the practice of the city to accept new streets without requiring that they be adequately paved, with a result that within a few months the pavements must be reconstructed and the expense of reconstruction and maintenance becomes a burden on the city at large.

"Under such a practice, knowing that repairs and renewals will be at the expense of the city, property owners benefited by the opening of new streets use all the influence in their power to have the original improvements made at the lowest possible cost, resulting in a constant heavy drain upon the general funds of the city. Certainly, if the city is to continue to reconstruct and maintain pavements solely from its general funds, it should insist, as the present administration is doing, upon an adequate pavement to start with, the major part of the cost of which to be assessed upon the property benefited.

"Generally speaking, owners of property look with disfavor upon any increase in the tax rate for general purposes, whereas there is comparatively little objection to special assessments for special benefits received. Even if the tax rate for general city purposes were not limited, as it is, by law, the general objection to any substantial increase would result in the defeat at the polls of any administration which had the hardihood to cause it. This, therefore, is a political reason why no remedy can be expected under existing laws.

"Where paving is paid for from the general funds, as in Boston, it is entirely within the power of the administration to designate just which streets shall be paved, and while all the tax payers contribute toward such general funds, only a small proportion receive any direct benefit therefrom. A pavement laid in East Boston does not directly benefit a resident of the Back Bay, altho the Back Bay resident may pay a much greater share of the cost into the general fund than do those directly benefited.

"This lack of direct benefit creates an added objection of taxpayers to contributing for paving thru the general funds of the city. Any taxpayer would prefer to pay a tax of $100 for a pavement in front of his property than to pay a tax of $1 into the general fund and take his chances of getting no direct benefit whatever. In most cases a good pavement will immediately enhance the value of a piece of property a great deal more than the cost of the pavement.

"The present condition is such that the cost of maintenance of the many miles of streets in even passable condition is frightfully high, and this maintenance cost, which is almost entirely wasted, absorbs the funds available out of current revenues to such an extent that no substantial permanent improvements can be undertaken. A competent authority has stated that $10,000,000 are necessary to put the streets of Boston in proper condition, and there can be no doubt that it would be economical for the city to provide the funds as rapidly as adequate construction work can be carried out and thereby save a large part of the present high cost of maintenance.

"It has been stated by those opposed to borrowing money

for street paving purposes that the construction and maintenance of pavements is an expense which should be paid for out of the current income of the city. This view is certainly correct as to maintenance, but it is not true as to the cost of original construction or entire reconstruction of streets. To borrow money for such length of time as the original construction, or complete reconstruction of street surfaces, can reasonably be expected to last is certainly conservative finance, but the loans made for the construction or reconstruction should be paid before it becomes necessary to again reconstruct the streets. The maintenance cost in the meantime can be provided either by requiring adequate guarantees from responsible contractors or from the general funds of the city.

"There are almost as many methods of financing street paving as there are cities. They vary from the wildest realms of high finance, such as in New York city, on the one hand to picayune inadequacy and ultra conservatism, such as in Boston, and there are all shades of methods in between. In New York City it has been customary to pay for the cost of paving and repaving on 50-year loans, and many streets of that city have already been paved or repaved as many as three times each in 50-years, and the first bonds issued therefor are still unpaid and have a number of years to run. New York City has expended upwards of $5,000,000 per annum from funds secured from long time loans. No sane person would advise the city of Boston to emulate New York in the financing of paving, but there should be no objection from any source to the borrowing of money on serial loans, the last of which will mature within the conservative life of the improvement. Many cities borrow money for 20 years for street paving purposes, but this cannot be considered to be conservative.

"A large number of cities borrow on serial loans for 10 years, confining the forms of construction to those pavements which may reasonably be expected to last that length of time with moderate maintanence cost, and this method is generally considered to be conservative finance. More conservative cities borrow for five years under similar conditions, which certainly should not cause complaint. There is no well-paved city in the United States, in my knowledge, which pays for the cost of paving, repaving and maintenance out of the general funds and within the current income from taxes, and I believe there never will be for the reasons given."

Grade Separations in Erie, Pa.

After some years of agitation and conferences with the railroad officials, Erie, Pa., has begun the actual construction on a part of the grade separation which it has been striving for. The railroads are now raising their tracks to the new height and supporting them over Parade and Divisions streets, while the city makes the excavations for lowering the streets, the specified amounts and repaves them. The City Council has appropriated $100,000 for this first step in eliminating the more important grade crossings in the city.

Several changes will be required in the city sewers before the excavations are completed and the new city engineer, F. G. Lynch, is making the necessary arrangements.

Asphalt Paving in Buffalo

The report of the Buffalo (N. Y.) Bureau of Engineering, George H. Norton, City Engineer, is devoted almost exclusively to the records of the street paving in the city. It contains the most complete records of the amount and cost of repairs, per street, per square yard, per year, in summaries, and average which have been kept by any city. It is for the year ending June 30, 1915, but includes the data for all the preceding years since Buffalo began to pave streets in 1878.

For the year of the report the cost of asphalt pavement repairs per square yard of total asphalt surface is 6.81 cents, being less than for several years on account of the thoro repairing of the streets the year before.

Of the 4½ million square yards of asphalt pavement in use, 3,895,997 square yards were laid with Trinidad asphalt, the oldest street now in use having been laid in 1879. No other asphalt was used until 1891 and 192, when rock asphalts from Germany, Sicily and Kentucky were introduced, and of each of these some 20 per cent. of the original areas have been relaid or replaced, except Sicilian, none of which has been replaced. Some block asphalt was laid in 1883, but it was replaced in 1890, 1892 and 1894, when the last disappeared. Bermudez, Alcatraz, Obispo and California asphalts were used in the years between 1898 and 1910, and of the streets on which they were used very little has been replaced, varying from about 1 per cent for Alcatraz to 0 for Obispo. A little natural rock, source not given, was laid in 1904 and taken up within a year or so.

The repairs for the year of the report covered 142,718.73 square yards, much less than the year before, at a cost of $164,987.18. The contract price for repairs was the same as the year before, except for a reduction of 20 cents a square yard on concrete base when it was required. The average cost was $1.1542 per square yard of repair actually made, and per square yard of area of streets repaired was 6.81 cents. Computed on the total yardage of asphalt maintained by the city, streets on which the construction guarantees had expired, the cost of maintenance of the area of 2,928,040 yards was 5.63 cents per square yard.

The repairs were done by two large gangs, consisting each of 4 foremen, 93 to 99 men, 10 teams, roller and rollerman. One gang worked 171 days and the other worked 48 days. A 5-ton auto truck was used 15 days, delivering asphalt, in addition to the teams. There were also 2 gangs, each with one foreman, 5 teams and 3 men repairing cuts made by the water bureau, plumbers, corporations and others. A city gang in March repaired a number of holes in two streets and two viaducts, in advance of the regular repair contract, heating and mixing up old asphalt pavement for the purpose, 235.36 square yards, costing $322, or $1.375 a square yard. The high cost was due to the low temperature and unfavorable weather conditions, but the work was necessary to preserve the streets.

The schedule of prices for the asphalt top under the regular contract was 37 cents per cubic feet of asphalt top; 17 cents of open binder; 18 cents per gallon for asphaltic cement; 51 cents a square yard for labor. This form of contract reduces the uncertainties of measurement to the one item of labor. The inaccuracies in measurement of areas actually repaired give the principal reason for differences in reported costs per square yard of repairs.

The variations in amounts of material used are easily determined.

Thus the two six months' periods of the year show that the average amount of topping used per square yard was 1.3497 cubic feet per square yard in one and 1.3651 in the other; of binder, 0.6438 and 0.7817 cubic feet, and of asphaltic cement 0.1106 and 0.1323 gal. respectively; evidence that the pavements repaired in the last half of the year were somewhat thicker than those of the first half.

The average age of all asphalt pavements out of guarantee in use or removed and replaced is 19.90 years, the difference in favor of streets without street car tracks being 2.88 years.

The average use of all such pavements over 20 years old, laid prior to 1895, of which there are 2,365, 344 square yards, is 21.25 years. The streets without tracks average 2.93 years more life than those with. The pavements laid in 1881 are 34 years old, 8,876 square yards still in use, and the pavements in each year vary in life down to 14 years for those of 1878, replaced in 1892.

The average life of the pavements replaced since 1892 was

19.27 years, with a difference in favor of streets without car tracks of 1.41 years. The streets replaced each year vary in average length of life from 14 years for the pavements of 1878 replaced in 1892 to 26.87 years for those replaced in the year of the report in streets without tracks. In streets with car tracks the variation is between 10 years' life in those replaced in 1902-3 and 22.53 in those replaced in 1913-14.

The average age of the streets now in use and not under guaranty is 20.44 years, with a difference of 4.05 years in favor of those without car tracks. It varies from 10 years for those laid in 1904-5 to 34 years for those laid in 1881, with the future life still to be measured.

Since 1903-4 the tables give the actual cost each year of repairs, the yardage of the pavement and the cost per square yard maintained for each asphalt street in the city.

Data about dimensions, cost, etc., of each street still under contractors' guarantees are also given in full.

Stone and Brick Pavements in Buffalo

The last report of the City Engineer of Buffalo, N. Y., Geo. H. Norton, City Engineer, gives full details of all street repairs in the city. It is the fullest report made by any city on this subject.

Detailed tables are given showing area, cost of repairs and cost per square yard of street maintained for each street and each year in which repairs were made. Summaries are not given for stone block and brick pavements, but the following results have been computed from the data given.

The stone block pavements are of Medina sandstone. Of stone block streets more than 20 years old the average cost of repairs per square yard per year has ranged from 0.29 cents to 11.60 cents, and for streets laid in the past 20 years 45 have required no repairs and the other 27 have had from 0.07 to 6.86 cents per square yard per year expended on them for repairs, all but 8 running below 1.5 cents.

Brick pavement tables are in the same shape as those for stone block pavements. Of the 20 streets over 20 years old two short streets have required no repairs. The repairs on the other 18 streets cost from 0.22 cents to 4.92 cents per square yard per year, all but six costing less than 0.85 cents per yard per year. Of the 50 streets from 10 to 20 years old and out of guaranty, 20 have required no repairs, and the repairs on the other 30 have ranged from 0.04 to 1.58 cents per square yard per year. Only 3 of these cost more on the average than 1 cent a yard a year for repairs.

A Demonstration of Monolithic Brick Pavement Construction on October 6

The National Paving Brick Manufacturers' Association has arranged the details necessary for a study and conference in brick pavement construction, to take place Friday, October 6, at Paris, Ill.

Headquarters of the meeting will be the Deming Hotel, Terre Haute, Ind., from which place those participating will go by interurban railway, an hour's ride, to Paris, Ill., where the construction demonstration will take place.

It will consist largely of steps showing the economy of construction details in building a brick pavement by laying the brick in green mortar, to show how such a pavement can be built with the least possible cost and yet maintain all the essentials of worth.

All persons connected in any way officially or those deeply interested in the roads of this country will be welcome at this conference, which is undertaken not only in behalf of the brick industry, but in the belief that the country itself is bound to be profited by such an opportunity.

Members of the American Society of Municipal Improvements on their way to the annual meeting of that society can spend October 6 at this conference and reach Newark the following Monday.

All those expecting to take advantage of this opportunity are requested to notify the secretary of the association, Will P. Blair, Cleveland, O., in order that they may be fully informed of the program, arrival and departure of trains, etc.

State Expenditures for Good Roads

The total outlays in 1915 by states for permanent road improvements aggregated $95,192,799. Of this amount, $30,247,593, or nearly one-third, was spent for the construction of new roads and the permanent improvement—such as macadamizing or paving—of existing ones. In addition, $12,476,122 was apportioned by the states to their counties, municipalities and other minor civil divisions for use in the construction, improvement and maintenance of roads; and a considerable portion of this sum was employed in construction and permanent improvement. The greatest outlays for roads by individual states were reported for New York, $9,393,756; California, $6,575,260, and Maryland, $3,773,223. The greatest per capita expenditure for construction and permanent improvement of roads, however, $2.82, was made by Maryland. Only twenty-three states—the six New England states, New York, New Jersey, Pennsylvania, Illinois, Michigan, Wisconsin, Minnesota, Maryland, Arkansas, Louisiana, Idaho, New Mexico, Arizona, Utah, and the three Pacific coast states—expended money directly on the construction and improvement of roads during the fiscal year, but a number of the other states apportioned sums to counties, municipalities, etc., which were spent in the construction and improvement of roads. Fourteen states, however, reported neither outlays nor apportionments for this purpose.

Demand for Highway Engineering Graduates

College and university students who specialize in the highway engineering branches of civil engineering courses will find unusual opportunities henceforth of securing early employment and good pay after winning their degrees.

There has long been a decided lack of trained road engineers and the demand for them is increasing rapidly. Probably no other branch in engineering offers such sure reward at this time.

Eighteen state highway commissions out of twenty-four reporting to the National Automobile Chamber of Commerce in New York City state that there is a lack of trained road engineers, and sixteen say that preference would be given to graduates of college highway engineering courses in the appointment of additional road engineers.

Nearly 1,600 engineers are now employed by the twenty-four state commissions, and in addition about 2,000 are employed as county and city engineers in nineteen of the states.

Salaries of highway engineers range from $900 to $5,000 a year. The average is about $1,800.

Highway commissioners report that they anticipate the number of engineers employed by the state highway departments will be doubled at least within five years.

The Philadelphia Parkway to Be Completed in 1917

The great parkway from the Philadelphia City Hall to the Green street entrance of Fairmount Park can now be completed. It has been in process of agitation, design and construction for many years, and a part of the line has been cleared and graded ready for finishing for some time.

At the last primary election a loan of $42,450,797 was voted which will furnish the money needed for the completion of the project. In July the city councils passed an ordinance appro-

priating $8,500,000 for the acquisition of the remaining properties required to supply the ground area, and $500,000 for the construction of the boulevard.

Chief Engineer William H. Connell of the Bureau of Highways states that the entire work will be completed during 1916 and 1917.

An Indiana Concrete Road

The County Commissioners of Elkhart County, Ind., are building a concrete road which is under the supervision of Albert Reith of Goshen, Ind., County Engineer, the work being done by A. M. Smith, contractor, of Goshen, Ind. The price bid for the road was $1.25 a square yard.

Construction was begun in the fall of 1915 and the road will be completed this year. It is 23,365 feet long, 18 feet wide, with 46,730 square yards, of which 2,190 square yards were completed in 1915.

The concrete is 1:2:3 mixture and laid in one course 6 inches thick at the center and 8 inches thick at the sides. The sand used was washed and well graded between 0 and ¼ inches. The gravel was hard, well graded, unwashed.

The re-enforcement used was Kahn No. 22, with 1 foot lap longitudinally and 4 inches transversely. It was placed 2 inches from the top. The expansion joints were ⅜ inch wide, filled with Carey felt and spaced 25 feet apart.

The foundation is a gravelly loam, which was well compacted and the subgrade made flat across the road.

In laying the concrete a Koehring mixer was used, wooden planks for side forms and strike board, and the surface was finished with wooden hand float from a bridge.

Reinforced Concrete Streets in Yankton, S. D.

In May and June, 1915, Yankton, S. D., laid four reinforced concrete streets, three of them 400 feet long, each, and 60, 80 and 90 feet in width, respectively, and one 2,250 feet long and 48 feet in width.

The specifications were prepared by S. H. Edmonds, city engineer, and the work was done by the M. L. Flynn Paving Company, of Sioux City, Ia.

A one-course pavement was laid, 6 inches thick, with proportions of one part portland cement, two parts of sand from the Haywarden Sand Company, and three parts of crushed quartzite from the Wisconsin Granite Company, of Sioux Falls, S. D.

Kahn No. 30 reinforcement was used, being placed 2 inches from the top. Trus-con armor plates were used for joint protection, Carey filler being used ⅜ inch thick. Transverse joints were located 25 feet apart.

The foundations of the streets were of clay, which was plowed, hand-graded to a crown and well rolled with a 10-ton roller. The gradient of two of the streets was 1 per cent., of one was 0.5 per cent. and of the longer averaged 1 per cent., with a maximum of 3 per cent.

Walnut street, 60 feet wide, 2,672 square yards, has a crown of 8 inches and 6 by 18-inch curbs. Douglas avenue, 80 feet wide, 3,555 square yards, has a crown of 11 inches. Broadway is 90 feet wide, having a parkway 30 feet wide in the center and two strips of concrete paving, each 30 feet wide, with 6 by 18-inch curb and a slope of 5 inches in the 30 feet from park curb to gutter. The area of paving is 2,756 square yards. Third street, 48 feet wide, 15,417 square yards, has a crown of 6 inches.

Inspection by the representative of the Trussed Concrete Steel Company shows good work on the whole. On three of the streets the concrete is reported to be high at the joints.

Good Roads Notes

About 85 per cent. of the roads of the country always will be roads of moderate or light traffic which should be improved at a low cost per mile and only about 15 per cent. of the mileage requires the high class of construction now so strenuously urged. If this could be understood by the opponents of highway improvement on account of cost their opposition would largely disappear.

The United States Office of Good Roads has issued a bulletin comparing three methods of paying for road construction. By the sinking fund plan there is always a temptation to use the accumulating fund for other purposes and it can not all of it be loaned all the time. On the basis of the cost of handling the bonded debt of New York it is estimated that the interest payments on a $100,000 loan for 20 years would amount to $148,000. If the annuity plan were used the annual payment would be $8,024 and the total interest paid would be $60,405. If serial bonds were issued, the principal payment each year would be $5,000, and the payment for interest would diminish each year from $5,000 the first year; the total interest payment being $50,000.

Improved roads need care. If the travel tears a little hole in the surface of a bituminous road, the hole will be rapidly enlarged unless it is patched. Sometimes this patching is put off too long, and thus everybody using the road calls it a failure, when the trouble was not due to the original road, but rather to the poor "housekeeping." State Highway Engineer Shirley, of Maryland, has found this to be the best way to do the mending: "First sweep the hole thoroly clean, free from all dirt and dust; paint the cavity with bituminous material; tamp the stone in well, then spread bituminous material over the stone and apply stone chips from ½ inch to ¾ inch in size, just bringing the surface of the patch up to the same elevation as the adjoining surface of the road. Quite a number of patrolmen can make these patches without much trouble and get the proper amount of oil in so that the patch will be permanent and not push about, but sometimes they either get too much bituminous material in and it pushes about and makes a hump, or do not put sufficient in, and the consequence is 'raveling.' To aid them, therefore, in getting just the proper amount of bituminous material in the patch, the patrolman should be supplied with a small wire basket holding about one-fourth of a peck of stone. This basket has handles, and it is only necessary for him to dip the basket with the stone in it in the bituminous material and then raise it and allow it to drain. By the time he has the hole thoroly swept out and is ready to apply the stone, the excess bituminous material has drained off, and it is only necessary to dump the stone from the basket into the hole, tamp it and cover with stone chips."

Union county, Tennessee, county court has begun the improvement of its section of the Dixie Highway. These thru routes are responsible for much road improvement, the efforts of the private parties desiring them being effective, tho sometimes slow. The best argument for the passage of the recent law appropriating $25,000,000 a year from the United States treasury for good roads is the widespread and insistent demand for these thru routes of interstate communication, altho so far the actual work must be done and paid for as a local expense.

The desire for good roads is demonstrated by the advance of $50,000 by the Bank of Leland, Greenville, Miss., on indorsement of a number of citizens, to begin work on the good roads to be built in the county under J. S. Allen, chief highway engineer, the note to be paid when cash is available from the sale of the bond issue of $960,000 for good roads, which was recently authorized.

MISCELLANEOUS

The March of Events

September 4-8, at Lexington, Ky. Southern Appalachian Good Roads Association. Joseph Hyde Pratt, secretary, Chapel Hill, N. C.

September 6-9, at Newark, N. J. League of American Municipalities.

September 13-15, at Portland, Me. New England Water Works Association. Willard Kent, secretary, Narragansett Pier, R. I.

September 14, 15, 16, at Tacoma, Wash. Washington State Association of County Commissioners. W. H. Reed, president, Tacoma, Wash.

September 18-20, at Philadelphia, Pa. Illuminating Engineering Society. C. D. Fawcett, assistant secretary, 29 West Thirty-ninth street, New York.

September 26-28, at Clifton Forge, Va. League of Virginia Municipalities. Luther C. Bronson, secretary, Portsmouth, Virginia.

October 2-6, at Grand Rapids, Mich. Playground and Recreation Association of America. H. S. Braucher, secretary, 1 Madison avenue, New York.

October 9-11, at Providence, R. I. National Housing Association, Lawrence Veiller, secretary, 105 East Twenty-second street, New York.

October 9-13, at Robert Treat Hotel, Newark, N. J. American Society of Municipal Improvements. Charles Carroll Brown, secretary, Indianapolis, Ind.

October 9-13, at Atlantic City, N. J. American Electric Railway Association. E. B. Burritt, secretary, 8 West Fortieth street, New York.

October 11-13, at Independence, Kans. League of Kansas Municipalities. C. H. Talbot, secretary, Lawrence, Kans.

October 17-20, at Chicago, Ill. American Gas Institute. G. G. Ramsdell, secretary, New York.

October 24-27, at Cincinnati, O. American Public Health Association. Prof. Selsker M. Gunn, secretary, Boston, Mass.

November 15-16, at Philadelphia, Pa. National Conference on Universities and Public Service. Edward A. Fitzpatrick, secretary, Box 380, Madison, Wis.

November 21-23, at Springfield, Mass. City Managers' Association.

November 22-24, at Springfield, Mass. Conference on Municipal Research.

November 23-24, at Springfield, Mass. Civic Secretaries' Conference.

November 23-25, at Springfield, Mass. National Municipal League. Clinton Rogers Woodruff, secretary, 705 North American building, Philadelphia, Pa.

December 27-30, at Columbus, O. American Economic Association. A. A. Young, secretary, Ithaca, N. Y.

December 27-30, at Columbus, O. American Statistical Association. Carroll W. Doten, secretary, 491 Boylston street, Boston, Mass.

February 5-12, at Mechanics' Hall, Boston, Mass. American Road Builders' Association. E. L. Powers, secretary, 150 Nassau street, New York.

Technical Schools

New York University School of Commerce, Accounts and Finance, Washington Square, New York, issues weekly bulletins of its courses of study, covering many lines of work, such, for example, as private secretary, commercial teacher, accounting, courses of day and of evening classes being outlined. A diagram in one of the bulletins shows the increase in salaries of commerce school graduates, averages of whole classes, six to eleven years out of college, running about $300 a month.

The department of ceramic engineering in the University of Illinois has now buildings and equipment costing nearly $250,000, and a staff of four specialists in this line, in addition to the work in other departments required for the four-year course under the instructors in those departments.

Wentworth Institute, Boston, is about to add to its courses of instruction one on practical concrete work, having for its object the training of young men for the work of concrete foremen and contractors. The Institute has set aside one of its best laboratory rooms for this concrete course and is fitting it up with modern testing machinery and other necessary equipment to make possible various determinations that will illustrate the technical as well as the practical sides of the applications of concrete. The first sessions will begin Monday, September 18.

Personal Notes

Benjamin E. Briggs, for twenty-three years the city engineer of Erie, Pa., who has made a high reputation as an efficient city officer as well as an expert engineer, has resigned his position and entered private practice, which he dropped to take the office so many years ago. He will make a specialty of municipal engineering. The new track elevation, the sewage disposal plant, the Mill creek improvement, an efficient and economical street repair system, the garbage disposal plant, are some of the more prominent public improvements made or planned for and begun during his administration.

A. F. Macallum, the new commissioner of public works at Ottawa, Ont., has made his appointments of the heads of departments, which include, among others, Frank C. Askwith, assistant engineer; L. McLean Hunter, pavement engineer; William F. Brice, in charge of sewers, incinerator and gar-

bage; Norman B. McRostie, in charge of sidewalks and surveys.

M. E. Brian, city engineer of Windsor, Ont., is chairman of a board of engineers to prepare plans for joint systems of water supply and sewerage for the towns along the Detroit river from Ford City to Sandwich West, opposite Detroit, Mich.

E. G. Orbert is city engineer of West Allis, Wis.

The Pittsburg Paving Joint: A Correction

The Asbestos Protected Metal Company, of Pittsburg, Pa., are the manufacturers of the Pittsburg Paving Joint, and their eastern representative is F. Wm. Stocker, Inc., Hoboken, N. J. Ray D. Lillibridge, Inc., is advertising agent for the company.

Newark Convention of American Society of Municipal Improvements

The twenty-third annual convention of the American Society of Municipal Improvements to be held at Robert Treat Hotel, Newark, N. J., October 10 to 13, promises to be one of the largest and best conventions of its long and useful career.

As usual, the committees on standard specifications will hold their meetings on Monday, October 9, and Tuesday, and will present their reports on Thursday night.

The preliminary program shows a number of papers discussing the work of bureaus of municipal research, state leagues of municipalities, state boards of health, public improvement commissions and city managers, with their relations to municipal improvements, by men directly engaged in these lines, such as E. T. Paxton, of the Texas bureau; Paul Hansen, chief engineer of the Illinois health board; W. P. Slifer, of Philadelphia, and C. A. Bingham, city manager of Norwood, Mass.

Water works problems are to be discussed by J. Walter Ackerman, of Auburn, N. Y.; breaks in cast iron pipe, by R. D. French; the scientific cleaning of settling basins, by Alexander Potter, and the Newark water plant, by the engineering department.

In the department of sewage, George A. Carpenter will make the committee report. Progress in activated sludge treatment will be reported upon by T. Chalkley Hatton, of Milwaukee; George T. Hammond, of Brooklyn; Gustav J. Requardt, of Baltimore, and Harrison P. Eddy, of Boston, who are at work upon experimental plants which are rapidly adding to our stock of knowledge concerning the process. The Atlanta Imhoff tanks will be reported upon by C. C. Hommon, the chemist in charge. George W. Fuller and H. N. Roberts will discuss the nuisance and sanitary aspects of sewage disposal. Public comfort stations and street flushing will also be discussed by experts.

In garbage and refuse disposal, E. R. Conant will present, in the committee report, data on refuse disposal. The subject will also be discussed by L. L. Tribus and Gustav R. Tuska, and E. E. Duff will report upon the system and plant in operation in Sewickley, Pa.

The traffic and transportation committee has made a detailed study of methods of making traffic counts, and J. C. Hallock, chairman, will present a proposed standard form. E W. Stern will discuss the limitation of loads, speed and size of vehicles.

The committee on street paving has made an exhaustive study of the practice regarding treatment of cuts made in pavements and will present the results of its labors. Some special problems in street construction and maintenance and in street administration will be presented by George C. Warren, W. P. Blair and H. W. Durham. Oil for treating wooden blocks will be discussed by P. C. Reilly, and the bleeding of blocks by C. H. Teesdale; experiences with concrete paving, by K. C. Gaynor, and with vertical fiber brick and wood block, by E. A. Kingsley.

These papers will be followed by the report of the committee on standard specifications, George W. Tillson, chairman, which will present the changes proposed for the adopted standard specifications, and also the wood block specifications, which have not yet been adopted.

A. P. Folwell, chairman, will present the report of the committee on standard forms.

Street lighting will have full attention, with papers by Preston S. Miller on recent developments; by C. W. Koiner, on Pasadena's municipal plant, and by Arthur J. Sweet, on the new system in progress in Milwaukee.

Alcide Chausse will report on fire prevention and John C. McCabe on uniform boiler laws. There will be the usual committee reports on several other subjects.

Newark is the center of so much of engineering interest that the local committee has broken the society's rule by devoting two sessions and a large part of a third to an automobile ride to near-by parks and reservoirs, train and boat to the new Port Newark terminal and the harbor, besides one evening for a banquet tendered by the city.

The exhibits have become a considerable feature of the society's conventions.

The attendance will be large and reservations of accommodations should be made promptly.

Further information and copies of the program as soon as printed can be obtained of Charles Carroll Brown, secretary, 702 Wulsin Building, Indianapolis. Inquiries regarding local information of any kind should be addressed to Morris R. Sherrerd, chairman of the local committee on convention arrangements, City Hall, Newark, N. J.

Sewer Overflow in St. Louis

The Mill Creek sewer in St. Louis is one of the problems in drainage of city areas which has been prominent in engineering discussions for a number of years and has given rise to studies which have been of notable assistance to engineers in designing sewers.

This sewer was recently completed and to the surprise of everyone a heavy storm on August 12 flooded the sewer and caused considerable damage from the resulting overflow. Of course a thoro investigation of the reason for the overflow was made at once and it was discovered that the sewer was blocked by three brick bulkheads which had not been completely removed.

The daily papers have published whatever could be ascertained as fact, and it appears from a study of their reports that when the sewer was accepted by the city, the Mississippi river was so high that it covered the top of the outlet to the sewer and backed up in the sewer for a considerable distance. During the construction of the sewer bulkheads had been used to keep out the river so that construction would not be interrupted. These bulkheads had been partly demolished but one was still 9 feet high and blocked about two-thirds of the sewer. When the sewer was accepted it was understood that they were to be removed as soon as the river fell enough to permit, but the intake connections above were made before the river had so fallen. On the day of the rainfall arrangements had been made to do the work, but the rain came one day too soon.

While the rain was heavy, it did not produce a run-off equal to that for which the sewer was designed. It is evident, so far as one can gather from the inexact and inaccurate and often incorrect reports in the daily papers, that the cause of the overflow was the remains of the bulkheads, which seriously reduced its capacity.

The property owners who suffered propose now to find out who is responsible and will probably attempt to collect damages.

MACHINERY AND SUPPLIES

Kelly Trucks for Our Army on the Border

The wars in Europe have proved the worth and the vital necessity of the motor truck to the modern army. The United States army has profited by European experience in this line, as is proven by the steady increase in the number of trucks used to take care of the soldiers in Mexico and on the border.

A recent example of this progressive spirit in our army is the purchase by the United States War Department of 231 trucks from the Kelly Springfield Motor Truck Co., of Springfield, Ohio—165 3½-ton and 66 1½-ton chasses. The order is for seven motor-truck companies, all fully equipped, and each comprising 33 trucks.

The Kelly Springfield Co. has undertaken an unusual thing in connection with this order. They are not only furnishing the trucks complete, bodies and chasses, but are agreeing to recruit and train the members of the companies, and turn fully prepared and organized motor-truck units, or companies of 33 trucks each, over to the Federal Government. As each company consists of a truck master and three assistants, a chief mechanic and two assistants, forty-four drivers and two cooks, it is readily seen what a job this will be.

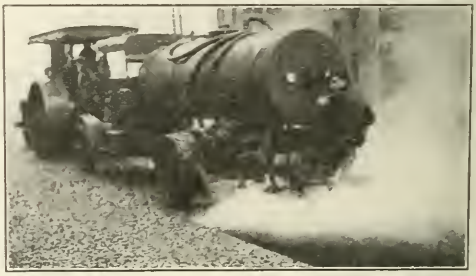
This recruiting and training has been going on for some time now. The first company left Springfield, Ohio, on July 7, on a special train for the border. Mr. F. B. Hutchinson, the sales manager of the Kelly Springfield Co., accompanied them to see that things get started right. The Government has established a permanent base for this big fleet of Kelly trucks at Nogales, Ariz. A complete service department, capable of making repairs of all kinds, has been established there.

Kinney Heater and Distributer

We are showing two views of the Kinney heater and distributer, which illustrate the side control of spray, circulating device and drop pan, spray wind shield and connection for hand-spraying hose and nozzle. The sidewise control is indicated by the hand wheel in front of operator's seat, and is so arranged as to swing the distributing pipes and nozzles two feet on either side, so as to insure perfect contact of the successive applications without overlapping or leaving bare spots on the road.

KINNEY HEATER AND DISTRIBUTER AS OPERATED BY BOSTON DEPARTMENT OF PARKS.

The circulating device is shown in part by the conducting pipe on the side of tank, receiving material from the bottom of the tank under pressure from the pump, and forcing it to the top and thence downward to the bottom of tank. This



KINNEY DISTRIBUTER AS OPERATED BY SPRINGFIELD, MASS.

constitutes an agitator, producing a reliable and uniform temperature thruout the entire contents of the tank, also greatly hastening the process of heating.

The drop pan and wind shield are shown, covering the spray pipes, and serving to protect the spray from the effects of the wind. Also, by acting automatically in connection with the opening and closing of the delivery valves, the nuisance of dripping oil on cross-walks when the machine is used for dust-laying is absolutely prevented.

An open connection is also provided for the attachment of a hose and nozzle for hand spraying or patching under pressure.

The distributer equipment, which is made by the Kinney Manufacturing Company, Boston, Mass., (and mounted on Kelly-Springfield chassis), may be demounted from the truck chassis in order that the truck may be available for other purposes when not required for road oiling.

The tank being mounted upon a separate sub-frame, it is only necessary to remove the ten bolts connecting it with the steel frame of the truck, and by means of falls lift the entire oiling outfit complete from the truck chassis, take away the truck and lower the tank equipment upon proper supports, where it may remain until again needed. The time required for demounting need not exceed one-half hour and it is accomplished without detaching any parts, disconnecting any piping, or in any way disturbing the adjustment of the tank equipment.

Wilmington-Los Angeles Roadway

We are showing herewith a modern method of freight haulage from Wilmington to Los Angeles, Cal., a distance of 21 miles. The trailers, carrying 65 tons, are hauled by a Bulkley tractor.

It is not every road which will withstand this sort of heavy traffic. Our illustration shows an almost daily scene on this road and is prophetic evidence backing up our oft-repeated statement that our roads should be built to withstand the traffic they must bear a few years hence.

A large number of Armco culverts are used for the drainage of this highway and their perfect success under this tremendous traffic is one more instance of their serviceability.

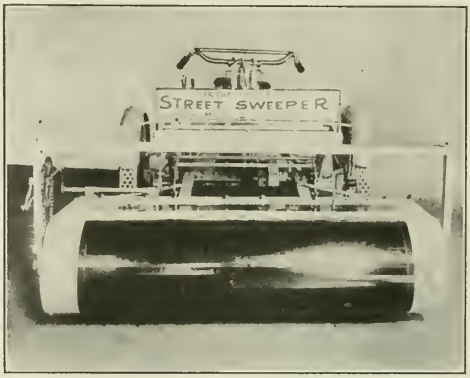
San Pedro Harbor, as it used to be called before it became the municipal harbor of Los Angeles, has been a very important commercial port of entry, practically ever since the settlement of this region by white men; and very considerable amounts of freight were hauled over the existing roadways fifty and seventy-five years ago. Phineas Banning, who in the early days owned the stage and freighting line between the seashore and Los Angeles, also owned a great deal of land in Wilmington and vicinity and was the leader of a movement which ended in the building and operating of a railroad between Wilmington and Los Angeles as early as the fall of 1869. The freight charges at that time were: Dry goods, $6.00 per ton; empty pipes, $1.00 each (whether water, steam or jimmy not stated); groceries, $5.00 per ton; passengers, $1.50 from the vessel to Wilmington and $1.00 to Los Angeles. We read without surprise that the road was profitable from the start.

Motorcycle Street Sweeper

By Albert Marple, Tropico, Cal.

Something new in the way of a street sweeper has made its appearance in Los Angeles, Cal., the motive power of which is an ordinary twin-cylinder motorcycle. Economy of operation is this machine's chief asset. Actual tests prove that it will cut the street sweeping costs of a city at least 50 per cent, and in many instances considerably more. It does as effective work as a sweeper possibly can, and may be operated at a speed of from two to twenty miles an hour, but it does its most effective work at eight miles. It was invented jointly by J. F. Smedley, F. C. Hoffer and T. C. Girton, of Los Angeles.

The street sweeping appliance is built in front of a pair of wheels, attached to the forward end of the motorcycle, and steered by its handles. The brush is 5 feet in length and is raised or lowered at will by a lever located at the side of the driver's seat. It is revolved by chains over wheels turned by the motorcycle engine. Suspended immediately in front of this brush is a cylindrical sheet-iron drum, with a capacity of four bushels, into which the dirt is swept over an apron as



the brush revolves. Thru the agency of another lever, similar also to those used on automobiles, the driver is able at any moment, without dismounting, to turn the cylinder so that its contents will be dropped in a pile upon the street. Provision is made to haul a wagon body at the rear of the machine large enough to hold ten loads of the cylinder. The use of this would

do away with piles of dirt standing along the streets and at the corners.

Primarily, like all other street sweepers, this machine is built specially for work upon streets of asphalt, macadam, concrete and similar smooth materials. It will clean the rougher streets as effectively as will any street sweeper. The cost of operation is very slight. One man operates it, and the gasoline and oil consumption is very low. The inventors claim that this device will do the work of at least twenty men. If at any time trouble should be experienced in connection with the sweeping mechanism, a simple pushing of a lever at the driver's side lifts the metal tray which covers the brush and receiving side of the cylinder, so that they are immediately opened for examination.

Nye Portable Pumping Outfit

We are illustrating a type of Nye steam pump as used by the cities of Louisville, Ky., and Cadillac, Mich., in the pumping of storm water from basements and catch basins.

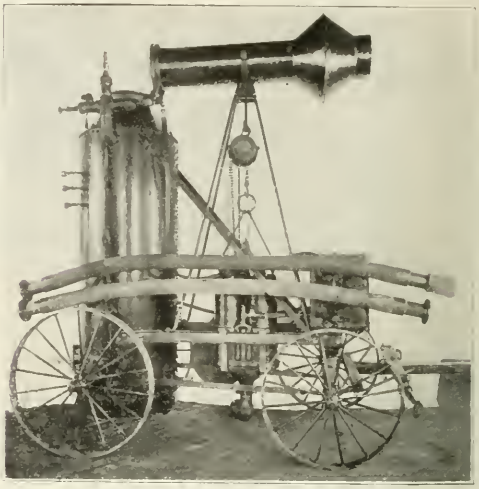
This outfit consists of boiler with all accessories, Nye pump, two 10-ft. lengths of suction hose, 50-ft. discharge hose, flexible metallic steam hose to uninterrupted steam connection within the range of the chain hoist, tank for priming, etc.

A No. 2 Nye new model pump, with 3-inch suction and 2-inch discharge, has been operated with three feet of suction and discharge one foot above pump, with only four pounds of steam indicated on a specially sensitive steam gage used for this test.

The extreme sensitiveness of the steam chest valve to the pressure, vacuum and its own gravity, which are the operating mediums, is responsible in a large degree for the high economy shown. Its function is the admission of steam to the filling cylinder in time to meet the air cushion, overcoming all shock from ram action of the rising column of water. At the beginning of the cushioning function the valve admits steam for the discharge. Filling of the alternate cylinder cuts off the supply of steam, permitting expansion of the residual charge, thereby causing discharge from both cylinders simultaneously.

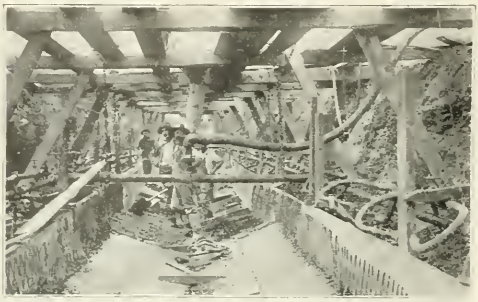
The result of this lap of discharge is a sustained momentum. An almost imperceptible increment is the only evidence of the junction of the discharge cycles. By this feature a considerable economy is effected, there being no loss of power through alternate losing and picking up of speed of the main column of discharge. This steady, positively driven discharge enables the Nye new model pumps to elevate a great percentage of solids to a considerable height.

The Nye system of jets shows, on practical tests, ability to sustain a column of mercury 29.8 inches high at sea level. This is a perfect vacuum and represents a column of water 33.9 feet high. This pump, with one steam and air-valve setting, has been in continuous service for months at a time without shut-down, giving a vacuum lift of from 20 to 25 feet.



PORTABLE NYE PUMPING OUTFIT AS OPERATED BY THE CITY OF LOUISVILLE, KY.

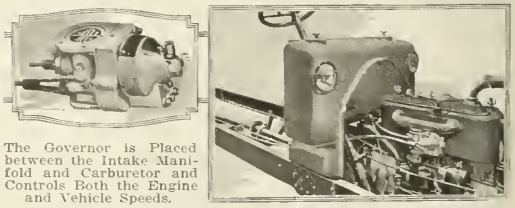
This type of pump, as manufactured by the Nye Steam Pump and Machinery Company, Chicago, may be operated to advantage at direct boiler pressure, the sensitive steam chest valve automatically taking care of variations in this pressure.



SIX NO. 2 NYE PUMPS OPERATED FROM 30-H.P. BOILER ON SEWER JOB AT LAPORTE, IND. IN PLACES THE WATER LEVEL WAS LESS THAN ONE FOOT FROM SURFACE. THIS WATER WAS SUCKED OUT OF THE SAND, AND WELL POINTS WERE KEPT IN OPERATION LONG ENOUGH TO ALLOW THE CONCRETE TO SET SUFFICIENTLY TO WITHSTAND THE GROUND WATER PRESSURE.

New Motor Truck Governor

According to "Popular Mechanics" an American-made governor, extensively employed on French military tractors, has demonstrated how the general efficiency of a motor truck may be increased, its life lengthened and the operating cost lowered. Unlike the usual instrument, this device, which is made by the Duplex Engine Governor Co., New York City, controls the maximum speed of both a car and its engine, preventing a machine from being driven at an injurious rate on high gear and safeguarding against racing the motor on intermediate ones. Separate maximum engine speeds are provided for different gears, giving increased acceleration and all of an engine's power for heavy pulls when low gear is used. The device acts automatically on a throttle valve of the grid-



The Governor is Placed between the Intake Manifold and Carburetor and Controls Both the Engine and Vehicle Speeds.

(Courtesy of "Popular Mechanics.")

GOVERNOR PROTECTS TRUCK WITHOUT CUTTING POWER.

iron type, thru which the gas passes in reaching the engine, and is attached between the carburetor and manifold. Two flexible shafts, one connected with the propulsion shaft, gear set, or jackshaft, to transmit the vehicle speed and the other extended from the camshaft, timing gears, or magneto shaft, registering the engine speed, drive the governor. These members convey their power to the governor shaft in such a way that the one revolving most rapidly drives the mechanism. When the speed of the governor is such that it exerts sufficient pressure upon a regulating rod to overcome the effect of an opposing spring the valve closes. This can be regulated by increasing or lessening the tension of the spring. The engine is under the control of the governor at all times, and when idling actuates it. The proper proportion of fuel to maintain a predetermined speed is fed to the cylinders without effort on the part of the chauffeur. If upgrade or a heavy stretch of road is encountered, the valve is opened automatically and more gas directed to the engine.

The Bates Steel Mule

The Bates steel mule, as illustrated, is so made that it can be hitched to any type of road building or maintenance machinery; the driver sitting on the machine to be hauled in the same position as when driving horses. In most cases, it is possible for the driver of the "steel mule" to also operate the machine hauled.

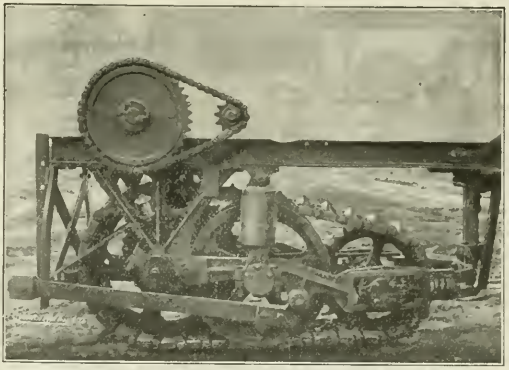
The only function the horse does is to furnish some means of pulling the machine along—that's the reason he is hitched up in front where you can watch him and guide him when you wish—while you and the implement are getting the ground or crop worked up into shape. The Bates steel mule simply goes in where the horses go—up in front, where you can watch it and guide it while you and the implement do the work.

The "crawler" consists of an endless-chain apron of metal boards, each link of which is a single piece of metal connected to the next adjoining piece by means of a connecting pin of large bearing surface. In operation the broad surface on the ground acts to the Bates steel mule as snow shoes act to a man in deep snow. It distributes the weight of the machine over so large a surface and, therefore, there are so many square inches helping to support the weight that each one does not have very much to do and, therefore, the earth does not become packed.

The control of the tractor is by means of three wheels and a lever on the end of a long column, which consists of three lengths of tubing, one inside of the other. The column being connected with the tractor thru a universal joint, can be swung at the will of the operator to any position desired. The middle wheel is the steering wheel. The wheel in front of the steering wheel operates the clutch and the smaller wheel in the rear operates the gear-shifting apparatus. The carbureter control is in the form of a lever projecting in front of the clutch wheel.

This type of tractor, as made by the Joliet Tractor Co., Joliet, Ill., does not depend on its weight to get its traction. The draw-bar is fastened to the oscillating steel side frames, making a compound lever which pulls the crawler into the ground.

DRIVING THE BATES STEEL MULE.



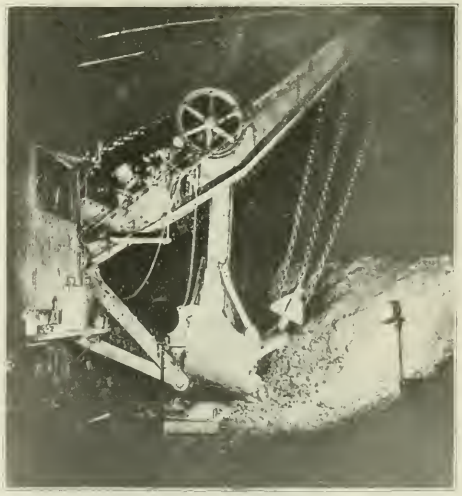
THE COMPOUND LEVER DRAW-BAR.

With a light load, where minimum traction is required, the down pull is not so great, but when a heavy pull is needed the crawler is forced into the ground as the necessity for it increases.

Under ordinary conditions of light loads, the springs give the necessary downward push to give traction to the steel mule anywhere.

Making Night Work Profitable

Good light makes all the difference between real efficiency and blundering progress on night construction work. Distinct illumination eliminates lost time and wasted motion.



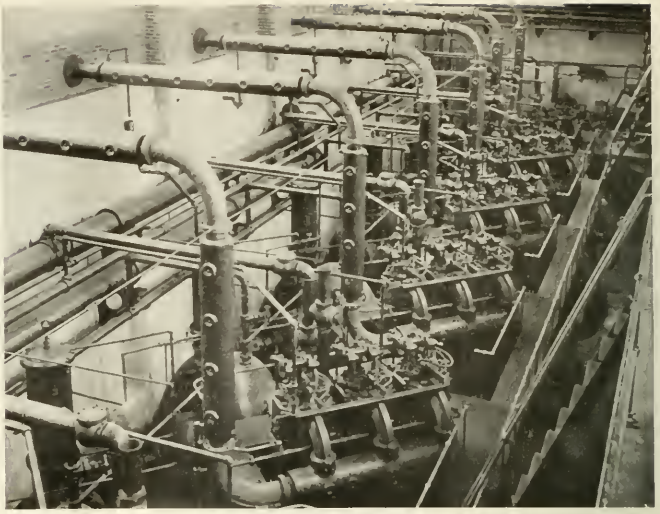
We are illustrating a type of Milburn portable light on night excavation. This type, as illustrated, burns 10 hours on a charge without attention. Still another type is designed for attachment on large mechanical equipment. The reflector is fastened to the boom, front housing or other point from which work is illuminated, while the generator is placed in the operator's cab, connection being made with a hose.

East St. Louis Pumping Station

The pumping station of the East St. Louis outlet sewer, completed in 1911, has shown no leakage thru the floor or walls of the foundation, altho the Misissippi river has at times been 15 feet higher than the lowest elevation of same.

Mr. J. A. Smith, engineer, East Side levee and sanitary district, East St. Louis, Ill., was the designing and supervising engineer for the structure, in which Medusa waterproofing powder was used in the following manner: Walls were poured in two sections, between the sections a plaster coat 1 to 2 mix of cement and sand, the cement being water-proofed with 2 pounds of Medusa water-proofing powder to each sack of cement. The floors were treated in the same manner. The foundations for this pumping station are 125x25 feet. Height from lowest elevation to top of foundation 26 feet; walls are 36 inches thick at bottom, 20 inches at top; floors, about 7 feet thick. It was necessary to have floors this heavy on account of 36-inch suction pipe for pumps imbedded in same. The sides of this foundation are reinforced by a sheet steel shell. The bottom does not contain any reinforcing material.

The foundation supports the weight of five 200-h.p. engines directly connected to 48-inch centrifugal pumps, two 190-h.p. engines directly connected to 36-inch centrifugal pumps, and all appurtenances, the total weight exceeding 200 tons.



The "A & T" Road Tractor

We are illustrating an A & T tractor pulling a large combination road machine on road maintenance work done under the supervision of Kit Carson county (Colo.) road commissioners.

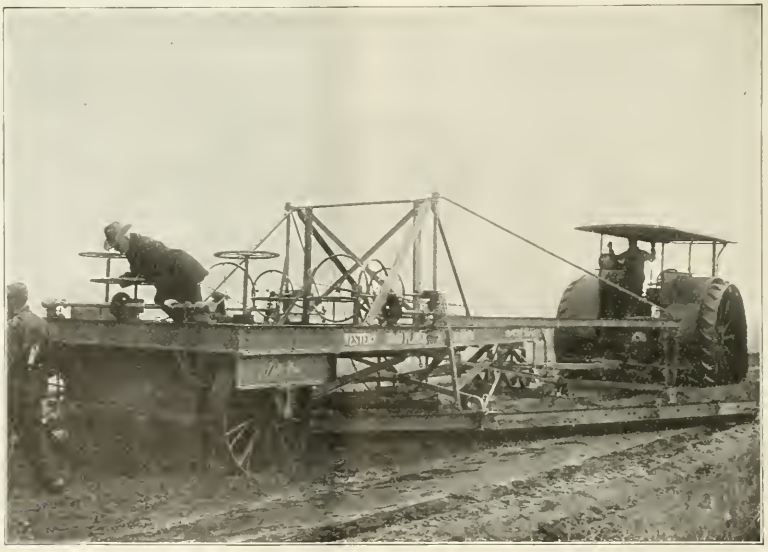
This type of tractor (gasoline-kerosene) is very extensively used for road building purposes.

The board of road commissioners, Palmer, Ill., who operate one of these types, submit their average cost for 60 days as being $8.46. The expense on a 20-mile job being:

1 tractor operator	$3.00
1 leveler operator	2.00
13 gallons gasoline	1.56
18 gallons kerosene	1.35
Oil used	.55
	$8.46

The trend in road-making machinery is toward greater capacity and the elimination of common labor, and to a con-

AULTMAN TAYLOR TRACTOR AS OPERATED BY KIT CARSON COUNTY, BURLINGTON, COLO., ON ROAD WORK.

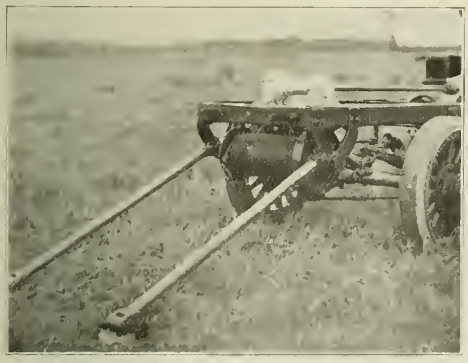


siderable extent the elimination of horse-drawn types of equipment. A study of cost records shows the reason. Formerly the item of labor constituted about 50 per cent of the cost of road construction and obviously it will for a long time be a very large factor, as it is in other kinds of engineering construction. Nevertheless, the elimination of an appreciable amount of muscular labor is often a step toward cheapening the cost of construction and therefore reducing to some extent the financial burden involved in the construction of permanent roads.

Powerful Towing Winch

We are showing a view of a towing winch designed for military chassis underneath the frame where it does not interfere with the loading space of the truck. The drum is mounted on a heavy shaft running in large bearings, and is bolted to the frame by heavy cast steel supporting arms of the I-beam type. The winch is equipped with 500 feet of cable.

The winch is driven from a power attachment on the transmission thru a propeller shaft and two universal joints to a countershaft which is geared to the winch drum. A lever mounted on the transmission cover controls the winch.



MILITARY WINCH DESIGNED BY THE RUSSIAN GOVERNMENT. USED ALSO FOR COMMERCIAL PURPOSES. VALUABLE IN ROUGH COUNTRY OR ON BAD ROADS. MAY BE USED FOR HOISTING OR PULLING TRAILERS ON ABNORMALLY STEEP GRADES, SUCH AS RIVER BANKS.

With the motor running at 1,100 revolutions per minute the cable is hauled 80 feet per minute.

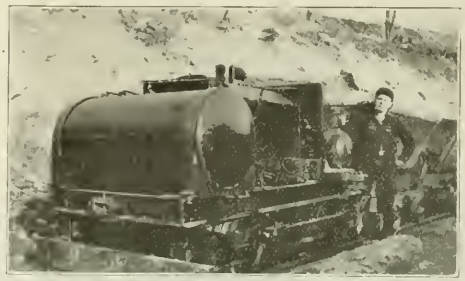
Two long braces are used to provide anchorage for heavy pulling when the weight of the car does not furnish enough resistance to hold the truck in place.

When the truck is called upon to haul a heavily loaded trailer up an abnormal grade, the truck can be run ahead of the load a distance of 500 feet. The truck can be anchored by means of the braces, and the winch can then be used to bring the load up the grade. In marshy country, in sand or other bad going, the winch may also be used to pull the truck up on to solid ground when either has become mired.

The Bell Locomotive

We are illustrating a type of locomotive as used for general haulage on tunnel and subway excavation, mucking, concreting, as well as in the construction of water, aqueduct and highway construction.

This type, which is made by the Bell Locomotive Works, Inc., New York City, ranges in sizes from 2 to 10 tons, any gage, and is equipped to burn any liquid fuel. The boiler has been approved by the United States Federal authorities after severe tests. It may be fired up in twenty minutes and contains 50 per cent greater heating surface than standard prac-



BELL LOCOMOTIVE OF 24-INCH GAGE, 6-TON WEIGHT, HAULING GRAVEL ON HIGHWAY CONSTRUCTION WORK.

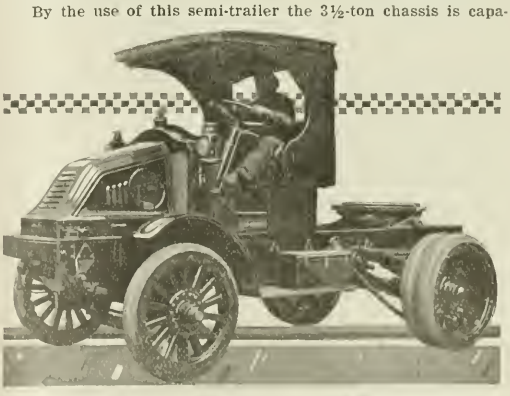
tice requires. This type is equipped with roller bearings, ground finished cylinders and pistons, drop-forged cranks, connecting rods and valve rods and oil-tight mud and dust-proof engine cases.

Power is applied radially to the front axle; that is, the crank shaft end of the engine is geared to and at the same time rides upon this axle, seated upon heavy adjustable bronze bearings. The cylinder end of the engine is hung from the main frame by a flexible steel trap. Therefore, when the locomotive runs over uneven track and the main frame rises and falls on its springs the head end of the engine swings around the front axle a distance equal to the up-and-down motion of the springs, but the driving pinion on the crank shaft remains always positively in mesh with the driven gear on the axle. The adjustable bronze bearings which seat the crank shaft end of the engine on the axle are in effect a radius link, keeping the crank shaft always properly distanced from the axle and at the same time allowing the crank shaft (and engine) to rotate about the axle like a planetarian.

A New Kelly Tractor

We are illustrating a new type of short wheel base 3½-ton Kelly tractor, built especially for use with a semi-trailer.

By the use of this semi-trailer the 3½-ton chassis is capa-



A SPECIAL 4-TON KELLY CHASSIS BUILT TO SERVE AS A TRACTOR WITH FIFTH WHEEL. THIS CHASSIS HAS A 116-INCH WHEEL BASE.

ble of carrying six or seven tons, with the majority of that weight carried on the wheels of the semi-trailer. The tractor itself carries no more weight than it would if used as a regular truck, but it is capable of hauling a much larger weight than it can carry.

Caterpillar Type of Tractor

We are illustrating the model machine of the caterpillar type of tractor now being developed by the Martin Rocking Fifth Wheel Co., Springfield, Mass.

It is not a farm tractor, but a road tractor, and is built for hauling a wagon train. There is a device on it for engaging the axle of any wagon and raising it from the ground,

throwing the weight of the front end of the wagon on the caterpillar for traction, and at the same time giving a single vertical pivot so that the wagon may be started backward. It is rubber shod so as to make for speed. This model has already been run at a speed as high as fifteen miles an hour.

Revolving Shovel Rips up Macadam

An unusually interesting job of road grading has recently been completed on Humboldt avenue in Milwaukee by Arthur Froeming of that city. The interesting features of the work from the point of view of the contractor are very well shown up in the photograph, which we publish herewith. These features may be briefly summarized as the extreme smoothness of the floor, the ease with which the hard macadam was dug and the fact that in this shallow digging the shovel was able to load a 2-yard wagon with three dipperfuls.

The contract called for the grading of Humboldt avenue for six blocks, between Locust street and North avenue, with about 7,000 cubic yards of excavation. The old macadam roadway has been dug up and the street is being transformed into a boulevard. The total width of this boulevard is 60 feet. The center portion is to be occupied by a 20-foot grass strip left at the original grade and curbed from 20-foot roadways on either side. For three blocks the center strip is occupied by street railroad tracks. The roadways are to be paved with creosote block, laid on a concrete foundation.

Shovel Operation.

The shovel used was a 14-B Bucyrus, equipped with a 2 3-yard dipper. This machine is of the traction type and was operated on platforms. The digging as stated above was unusually heavy. The material was a hard packed macadam containing a large number of big boulders, running up in many cases to 3 feet in diameter. The cut ranged from 12 to 18 inches in depth. Each 20-foot roadway, of course, was taken by the shovel in one cut.

The first thing that would strike a shovelman on visiting the job, aside from its very clean-cut appearance, was the extremely level roadway left by the shovel. This was made without the help of any hand trimming whatsoever. In fact, only two pitmen were employed. One of them spent most of his time completing the trimming at the curb on the sidewalk side and the other in keeping the near rail of the trolley car track uncovered and in clearing up on the far side.

As stated, the cut ran between 12 and 18 inches deep. The ability of the shovel to take a long horizontal direct thrust enabled it to fill the dipper very easily at this depth. As a result even in this shallow digging a 2-yard dump wagon could consistently be filled with three swings. This, of course, is a great advantage, and contributes considerably toward increasing the speed of operation.

The frequent boulders which were encountered were large enough to necessitate a good deal of cutting beneath the level of the wheels. This was done with extraordinary ease by the shovel. It was impossible to give any estimate as to the output of the shovel other than it is making very satisfactory lineal progress, in spite of the fact that over a greater part of the work street car tracks occupy the center portion of the boulevard and dump wagons have to be loaded on the tracks as shown. The street cars interrupt the operation once in every 2½ or 3 minutes.

Eight 2-yard dump wagons were used. These were hauled for an average distance of about four blocks to the dump.

Another point which was noticeable was the speed with which the shovel was able to move up. It was only a matter of a very few minutes to pick up by means of chains the rear platform, which has just been passed over, to swing it around

NOTE THE SMOOTH LEVEL FLOOR.

the front, to set it in place and then to propel forward. About 2½ tons of coal were burned per week.

Arthur Froeming had the contract only for the grading. The paving is being done by Hase & Weie, of Milwaukee. Arthur Froeming, Jr., superintended the work in person. The shovel was operated by Chas. Dean and fired by H. A. Asmussen. Herman Eick was foreman.

A 64,000 Ton Blast

A very successful blast was made in the Frazier Ballast Quarries, Frazier, W. Va., on June 27th last. Blast consisted of 24 5⅝-inch well drill holes varying from 56 feet to 121 feet in depth. Also about the center of the face at the bottom there were drilled 34 16-foot snake holes, which were loaded and fired with the main shot. Snake holes were drilled to relieve a heavy toe at that point.

Well holes were spaced 16 to 17 feet apart and had an average burden of 22 feet. Red Cross Gelatin 60 per cent. and Red Cross Extra 33 per cent. dynamite were the explosives used. Nearly all holes were double loaded with usually a 12-foot break. Cordean Bickford was used in each hole to detonate the explosives.

In all there were used in well holes 7,900 pounds of Red Cross 60 per cent. Gelatin, which was used for bottom loads, and 7,300 pounds of Red Cross Extra 33 per cent. dynamite. About 300 pounds of 33 per cent extra were used in loading the snake holes.

There were 64,000 tons of stone shot down in this blast. Stone quite well broken and distributed nicely for hand loading, the method here pursued.

The Caterpillar Tractor

The caterpillar tractor, as illustrated, is quite extensively used for grading, leveling and haulage of materials required in the construction and maintenance of roads. Its track construction enables it to negotiate soft soils and sandy places.

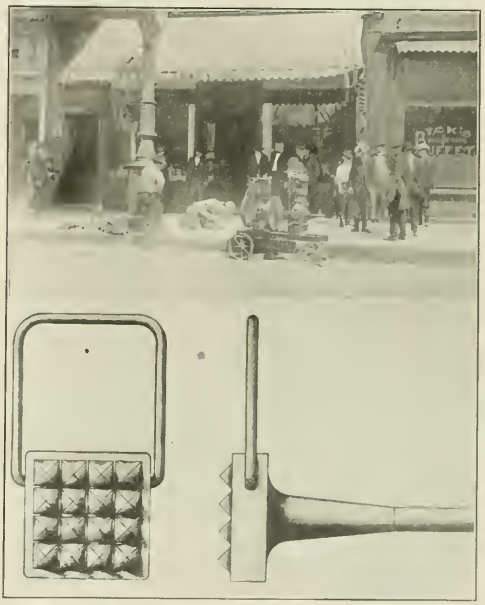
The caterpillar track, as used on this model as manufactured by the Holt Manufacturing Company, Peoria, Ill., is a flexible, endless belt composed of steel links, connected by case-hardened steel space blocks and case-hardened steel track pins. Each link combines a corrugated shoe or ground contact surface and a double rail over which the truck rollers travel. The shoes have curved ends and overlap each other, so there is no opening between them at any time. These shoes are made heavy enough to withstand the severe usage. There is no friction between the shoes and the ground, the track being simply laid down and picked up again, one section at a time. The rails each have a face 2¾ inches wide, which gives a wearing surface equal to that of the ordinary railroad rail. They are 6 inches high and have openings at the side so that any dirt falling onto the track is forced out thru the openings by the teeth of the track-driving sprocket.

The space blocks are machine finished, case-hardened and are fitted by pressure into broached holes in the links. With the special 30-inch width tracks, the total bearing surface is 4,800 square inches, and the ground pressure is 3 pounds per square inch. This pressure is much less than that of the foot of either man or horse.

All the weight of the tractor is carried on truck rollers, five on each side, these rollers having chilled faces so as to provide an excellent wearing surface.

New Stone Roughing Outfit

The Gardner Governor Company, of Quincy, Ill., offers to engineers and contractors the first outfit ever constructed for roughing stone. It has been tested by the Brinkoetter Monumental Company, of Quincy, and the first machine is said to have operated successfully in that city and vicinity.



NEW GARDNER STONE-ROUGHING OUTFIT. LOWER VIEW SHOWS ROUGHING TOOLS.

The outfit consists of an air-cooled air compressor driven by a gasoline engine mounted on a light steel truck. An air receiver is held under the truck. The compressor is a Gardner-Rix vertical, air-cooled, oil-splash-lubricated machine connected to the engine by a coupling. The compressor valves are of thin flexible sheet steel and cannot be drawn into the cylinder.

The tool is an ordinary plug drill fitted with a case-hardened steel block with 16 sharpened raised points. The block has a wire handle which helps to guide the tool. In chipping around cracks and posts set into the sidewalk a trimming tool is used. An unloading device regulates the air pressure for the most efficient work.

New Hand Book on Concrete Roads

The Kahn Road Book is principally devoted to useful information and illustrations on permanent concrete road construction. The large number of photographs of completed roads and those during construction add interest to the read-

ing pages. The book contains a general historical review of concrete pavements, with detailed information regarding particular sections. The reports of road commissioners are quoted on the satisfaction of the roads and on questions of maintenance. Tables are shown giving cost data as well as summary of yardage and mileage thruout the country. The reinforcing of concrete pavements is discussed and information on Kahn road mesh is included. The necessity and advantage of expansion joints occupy a section of the book, including in it practical information in regard to Kahn armor plates and installing device. Complete specifications for the one-course concrete highway, the one-course concrete street pavement and the two-course concrete street pavement are given in another section of the book, which is illustrated with views of concrete highways. Concrete curbs, with methods of protecting the edges, and the installation of these curb bars, also concrete culverts, bridge floors, etc., are treated. This information, together with tables giving quantities of materials for concrete and mortar, are included in the general Kahn Road Book.

The Kahn Road Book is issued primarily for engineers and contractors interested in pavement and road construction, including city engineers, contractors, county engineers, road commissioners, etc. To such persons the Kahn Road Book is sent on request by addressing the Trussed Concrete Steel Company, Youngstown, Ohio.

Value of Hydrated Lime in Cement Mortar

For years it has been known that the addition of a small amount of hydrated lime to cement mortar in brick work results in a more plastic, freer spreading material under the trowel. It has been the custom in many cities to specify a proportion of hydrated lime in cement mortar because it was recognized that it would make work easier.

The mortar being worked more easily under the trowel, permits mechanics to more firmly embed the bricks, and with less physical effort. The bricks will slide freely and the mortar will be forced into crevices where it is impossible to put the trowel. This all results in a bearing surface for each brick which cannot be gained by a hard working mortar.

The practical effect, however, of such mixtures of cement and hydrated lime has always been a debated question and it has remained for Prof. James S. Macgregor, of Columbia University, to arrive at actual facts, and in establishing these facts the question of debate has been removed.

Prof. Macgregor's investigation was conceived for the following reasons:

1. To indicate what value, from the standpoint of strength, the better bearing surface given to the bricks would possess when laid up with cement-lime mortars of varying proportions.

2. To determine the practical effect on strength when bricks absorb a portion of the moisture from the mortar and thus rob the mortar of the moisture needed to hydrate and harden the cement. This was to indicate whether the water carrying capacity of hydrated lime had a value in retaining moisture in the mortar which would be passed off to the cement and taken up in subsequent hydration, thus resulting in increased strength. The results shown in the summary of ultimate resistance prove this reasoning established beyond doubt.

The investigation as outlined consisted in laying up seven different sets of brick piers 8x8x84 inches high, each set consisting of 9 piers and being laid up in mortar of different proportions, with varying amounts of hydrated lime. Three piers of each set were tested under compression to the point of rupture at three different periods, namely, 7, 28, and 90 days, the results shown being the average of three piers at each period.

The bricks used in the 63 piers were hard burned face bricks purchased in the open market in New York City. There were also laid up seven piers 8x8x84 inches of common bricks, each with a different mortar mix, to be tested under compression at the 29-day period, the results of which were to serve as a check on the results shown by the face brick piers. Comparison of ultimate resistance of common brick with face brick shows how the general conclusions to be drawn agree and that the same underlying economic and structural value of hydrated lime applies to face and common brick alike.

The purpose of the investigation being to determine the effectiveness of hydrated lime, and also to determine to what extent Portland cement might be replaced by hydrated lime without reducing the factor of safety under practical conditions, mortars were mixed containing varying proportions of hydrate. The seven (7) mortars which were used in the investigation were mixed in the following proportions:

Mixtures Used—By Volume.

No. 1.	1.00	cu. ft. portland cement.
	3.00	cu. ft. sand
No. 2.	0.90	cu. ft. portland cement
	0.10	cu. ft. hydrated lime
	3.00	cu. ft. sand
No. 3.	0.85	cu. ft. portland cement
	0.15	cu. ft. hydrated lime
	3.00	cu. ft. sand
No. 4.	0.75	cu. ft. portland cement
	0.25	cu. ft. hydrated lime
	3.00	cu. ft. sand
No. 5.	0.50	cu. ft. portland cement
	0.50	cu. ft. hydrated lime
	3.00	cu. ft. sand
No. 6.	0.25	cu. ft. portland cement
	0.75	cu. ft. hydrated lime
	3.00	cu. ft. sand
No. 7.	1.00	cu. ft. hydrated lime
	3.00	cu. ft. sand

The proportions given are all by volume, and this method of measuring was followed because it is the general custom in writing building codes to so specify quantities.

Hydrated lime is nearly two and one-half (2½) times as bulky as portland cement (hydrate weighing approximately 40 lbs. per cubic foot, and portland cement weighing approximately 94 lbs.) and the true economic advantage of such volumetric replacements of portland cement by hydrated lime cannot be fully realized until the quantities shown have been reduced to corresponding weights, the basis upon which portland cement and hydrated lime are purchased.

On the basis of weight, the mortars previously shown are approximately equivalent to the following:

Mixtures Used By Weight.

No. 1.	100	lbs. portland cement
	300	lbs. sand
No. 2.	90	lbs. portland cement
	4	lbs. hydrated lime
	300	lbs. sand
No. 3.	85	lbs. portland cement
	6	lbs. hydrated lime
	300	lbs. sand
No. 4.	75	lbs. portland cement
	10	lbs. hydrated lime
	300	lbs. sand
No. 5.	50	lbs. portland cement
	20	lbs. hydrated lime
	300	lbs. sand
No. 6.	25	lbs. portland cement
	30	lbs. hydrated lime
	300	lbs. sand

Arthur Street, Manistee, Mich., before the use of "Tarvia-X" mixed macadam.

What Manistee did with Tarvia

MANISTEE, Mich., is a "Tarvia town"; that is to say, it has settled down to a regular policy of using Tarvia for the maintenance of its macadam roads.

It has learned, as other towns have learned, that the cheapest way to maintain macadam under modern conditions is to bond the stone with Tarvia.

As a result of this policy extending over nine years, Manistee has many miles of beautiful smooth pavements.

Notice from this record of sales how the tarviated areas have been extended year by year.

In 1907	2,500 gallons
1908	4,800 gallons
1909	3,000 gallons
1910	14,000 gallons
1911	21,000 gallons
1912	18,000 gallons
1913	9,000 gallons
1914	34,000 gallons
1915	32,000 gallons

Manistee makes use of all three kinds of Tarvia. It has used "Tarvia-B" for surface work and dust suppression, "Tarvia-A" for resurfacing operations and "Tarvia-X" for road building.

Hundreds of other towns throughout the country have found Tarvia the most satisfactory and economical answer to their road problems.

Illustrated booklet describing the treatments on request.

Special Service Department

This company has a corps of trained engineers and chemists who have given years of study to modern road problems. The advice of these men may be had for the asking by anyone interested.

If you will write to the nearest office regarding road problems and conditions in your vicinity, the matter will have prompt attention.

The Barrett Company

New York Chicago Philadelphia Boston St. Louis Cleveland Cincinnati Pittsburgh
Detroit Birmingham Kansas City Minneapolis Nashville Salt Lake City Seattle Peoria
The Paterson Manufacturing Company, Limited: Montreal Toronto Winnipeg
Vancouver St. John, N. B. Halifax, N. S. Sydney, N. S.

TRADE B MARK

No. 7. 40 lbs. hydrated lime
300 lbs. sand

It will be noticed that the mortar designated as No. 5 contained a total of 70 lbs. of cementing agent with 300 pounds of sand, or 1 to 4.3 by weight, which may be compared with mortar No. 1 which was composed of 100 lbs. of cementing agent to 300 lbs. of sand, or 1 to 3 by weight.

The economic advantage, the saving in dollars and cents, between mortar No. 1 and mortar No. 5 is therefore measured by the decreased quantity of cementing agent contained in a given volume of mortar, or approximately 30 per cent saving, provided lime and portland cement are sold at the same price per unit of measure.

Summary of Ultimate Resistances.
(Face Brick)

Figures shown are in pounds per square inch.
Each result is an average of crushing three piers.

Mortar Mix. No.. ..	1	2	3	4	5	6	7
Crushed at:							
7 Days 2630	3080	2890	3120	2760	1945	1535	
28 Days 2840	3170	3230	3470	3100	2370	1870	
3 Months 2840	4435	4300	4170	3820	2720	1950	

It will be noticed that the results, when mortar No. 5 was used, show a compressive value of 980 lbs. per square inch greater than Mortar No. 1 in 3 months. It has already been noted that mortar No. 5 contains 30 per cent less of cementing ingredients (or 43 per cent more sand carrying capacity.) Herein lies the extraordinary economic advantage, the greater strength at less expense.

Assuming the market price of portland cement and hydrated lime to be the same, pound for pound, it will readily be seen that specifications calling for a mortar to be composed of 50 lbs. of hydrated lime and 300 lbs. of sand (approximately ½ cu. ft. portland cement, ½ cu. ft. hydrated lime and 3 cubic feet of sand) will not only give a much higher structural value, but will also make a saving of 30 cents on every dollar spent for the cementing mixture in brick mortars.

To insure accurate measurements in practical work, it may be stated that an eight quart pail holds approximately 10 lbs. of hydrated lime, and for each bag of portland cement used in making mortar four (4) pailfuls of hydrated lime should be placed in the mixture to secure results equivalent to those produced in the No. 5 test.

Trade Notes

The National Transportation and Electric Service Corporation, Davenport, Iowa, are demonstrating at their office their system of automatic electric transportation on elevated tracks, requiring no operators of cars, which they propose for the use of rural districts in shipping goods and products to and from the farm at a cost less than that of the interurban railway and more flexible and adaptable to the local conditions. The inventor is also the inventor of the electric factory truck now in such common use, and most commonly seen perhaps as used by the express companies about the larger railroad stations.

Justus Roe & Sons, Patchogue, N. Y., who have for many years manufactured steel tapes for the use of engineers, are distributing a postal card, announcing reduced rates on several sizes of a new tape which they have recently patented, for the purpose of advertising and introducing it. Ask for the postal card cut-rate price list.

E. R. Marker, Wisconsin district manager for the T. L. Smith Company, manufacturers of mixers and traction pavers, has moved to new quarters at 609 Wells street, Milwaukee, Wis.

That bitulithic is popular in Rome, N. Y., is shown by the fact that 91,312 square yards have been laid on the streets of the city. The first contract, for 17,878 square yards, laid in 1902, was given six years to demonstrate itself, but since that time, beginning with 1908, increasing amounts have been laid, property owners apparently being ready to pay for pavements about every other year.

The Shawmut Paving Brick Works, of Shawmut, Pa., and the Pennsylvania Clay Company, of Pittsburgh, Pa., have become licensees of the Dunn Wire-Cut Lug Brick Company. The Shawmut company has an approximate daily capacity of 30,000 paving brick, but the company is contemplating the enlargement of the plant to a 50,000 daily capacity. The Pennsylvania Clay Company has one plant at Conway, Pa., with a capacity of 60,000; one plant at Crow's Run, Pa., with a capacity of 60,000, and one plant at Brady's Run, Pa., with a capacity of 40,000. The acquisition of these two companies gives the Dunn Wire-Cut Lug Brick Company thirty-two licensees, operating fifty-two plants.

Trade Publications

The Meridiograph for determining the true meridian in a minute or two is one of the serviceable inventions of low cost made by Louis Ross, civil engineer, 268 Market street, San Francisco, Cal.

E. I. duPont de Nemours & Co. have sent a booklet describing their various products, of which there are more than 200, classified as high explosives, low explosives, black blasting powder, sporting powders, explosives for military uses, chemicals, blasting supplies, fabrikoid, pyralin, nitre cake and a dozen or two miscellaneous and by-products. The products suitable for each of some 200 classes of customers are separately listed for their benefit. The booklet is bound in fabrikoid, which is an excellent substitute for leather for this and many other purposes.

The A. & F. Brown Co., 79 Barclay street, New York City, issue an excellent catalog of the transmission machinery they manufacture.

Fletcher cores for casting pipe are strikingly called to notice by a circular sent out from 820 Gwynne building, Cincinnati, O.

The sample book of drawing, tracing and blue-print papers of the American Blue Print Paper Co., 406 Dearborn street, Chicago, Ill., shows a full line and is a convenience for the engineer's office.

"Permanent Concrete Roads" is the subject of a booklet issued by the Trussed Concrete Steel Co., Youngstown, O., which is full of information about materials and methods of construction, specifications, cost data, areas and mileage in use, cross sections, drainage structures and other material of value in connection with the good roads propaganda.

Chain Belt traveling water screens for removing foreign matter from water used about the power plant are shown in Bulletin 64 of the Chain Belt Co., Milwaukee, Wis.

The Trus-Con Laboratories, Detroit, Mich., issue an advertising card concerning Bar-Ox, inhibitive preservative coating, which makes good use of the current thought on preparedness, plus preservation.

A booklet of Wallace & Tiernan Co., New York, entitled "Protecting the Water Supply of Greater New York," illustrates the application of liquid chlorine to various supplies of that city for sterilizing the water.

The economy of Blawforms for sidewalk, curb, curb and gutter, and road construction is shown, with full details of the forms and their use, in Bulletin 69 of the Blaw Steel Construction Co., Pittsburgh, Pa.

The Koehring Machine Co., Milwaukee, Wis., devote one of their circulars on concrete mixers to a discussion of mixer depreciation and how to reduce it to a minimum.

Vol. LI. — No. 4.

Municipal Engineering

The World's Leading Municipal Publication

October 1916.

A NOTABLE CONVENTION

The program of the Newark convention of the American Society of Municipal Improvements, October 9-13, is an evidence of the progressive character of this organization and of the high estimation in which it is held by the engineers who are doing things in the way of municipal improvements. The society has always had the reputation of being hospitable to new ideas and was the first technical or semi-technical organization to which were presented such new ideas as the bitulithic pavement, the wire-cut lug brick, the Imhoff tank, activated sludge and the like. This year most of the modern methods of sewage disposal will be discussed by nearly all those engaged in developing them and the proceedings of the meeting will contain the most complete information obtainable on the subject. The latest on such rapidly developing subjects as street lighting, brick, concrete, wood and granite block paving, garbage and refuse collection and disposal, will also be presented by the experts directly engaged in the work, thus keeping up the society's reputation for being in the forefront of progress.

One of the most important activities of the society is the formulation of standard specifications for the various kinds of pavements and for sewers, sub-committees on specifications for any class of municipal improvements being appointed upon request of the members. The progressive spirit of the organization and its independence of questions of merely business policy are shown by the adoption of standard specifications for the pavements which have demonstrated their value without reference to whether they may be proprietary or not. And at the same time the conservatism of the organization is demonstrated by the fact that it does not adopt standard specifications for any pavement until the pavement has been sufficiently developed to insure good results with such a standard specification.

These standard specifications crystallize the most modern methods of construction, but again the progressive spirit of the organization is shown by the retention of the sub-committees on all the standard forms of construction for the express purpose of reporting each year the valuable new improvements and recommending changes in the specifications, if necessary to admit them.

Our contemporary, *Engineering Record*, does not like the spirit of independence of commercialism which the society exhibits when it passes upon a pavement upon its merits alone, and tries to make the society an object of suspicion, referring to its "going counter to its own rules," leaving the reader to infer that there are rules on this subject which, as a matter of fact, do not exist.

Again, as a matter of fact, the society adds to its "power in the profession" and "its specifications have a higher standing" because of this very independence of commercialism and this exhibition of "backbone."

There is but this one yelp in public opposition to the policy of the society, which has been developed during its long, useful and really distinguished existence, so that no further attention need be paid to it.

TRAFFIC REGULATION

There are two sources of excess in the operation of vehicles on roads which may need control. One is the speed with which vehicles move and one their weight, the latter being important on the road itself rather for its concentration on the widths of wheels than for the total weight on the vehicle.

In commercial uses these excesses largely regulate themselves. Speed is a question of economy of time as balanced against economy of operation, and, except in serious emergencies, economy of operation is of greater importance than economy of time, so that for commercial uses the vehicle needs little or no regulation as to its speed. Indeed, it is seldom that vehicles in commercial use can develop more speed than that possible on gravel and macadam roads without injuring them. It is only the speed-demon in the pleasure car who needs attention. And he has the sympathy of no one when he violates the stringent regulations which are necessary to curb his propensity to assume control of the whole length as well as breadth of the road.

The motor truck is the weight carrier, and it must carry its weight on broad wheels or they will not stand the punishment, so that this matter, so far as the road is concerned, will regulate itself. The only regulation required seems to be that the tires shall in every case be proportional in width to the load carried, and that the total loads shall not be greater than the bridges of the district can carry.

Further adjustment properly belongs to the road-making authority. If the traffic is of such weight and speed as to demand pavements stronger than macadam or gravel, and the prospective amount is sufficient to warrant providing for it, then the paved road must be built and the bridges must be strengthened.

The only way to determine the necessity for improvement is to permit the traffic to develop, and the only way to develop traffic is to leave it with as little artificial restriction as possible. Traffic regulation should therefore be limited practically to the speed-hog and the designs of wheels on heavy trucks or traction engines which are suitable only for loose earth and not for pavements, and on the less thoroly improved roads to weights that they may not be dangerous to the old bridges.

The motor truck is being developed in a thoroly scientific manner and is growing on economic lines, and its features are so far, well within the limits of reasonable regulations for road pavements. And there are developments of tire attachments which make the truck available over badly rutted soft roads, if not actual improvers of them.

A BRICK PAVEMENT IN HOLLAND, CENTURIES OLD, STILL SERVICEABLE.

STREET AND ROAD PAVEMENTS

THEIR DESIGN, CONSTRUCTION AND MAINTENANCE

EDITED BY CHARLES CARROLL BROWN, M. AM. SOC. C. E.

THE CONSTRUCTION OF BRICK PAVEMENTS

Written and Compiled by the Editor

This second article of the series and the second on the subject of brick pavements is devoted to the construction of brick pavements. It is assumed that the foundation is completed ready for the placing of the wearing surface and therefore but little attention is paid to it. It is also assumed that the materials to be used have all been approved and that they are ready to haul to the street and place in position.

The handling of the materials is almost wholly a contractor's problem and the article has therefore been written from the contractor's point of view as nearly as possible, presenting methods of securing the best results possible under the standard specifications and reducing to a minimum the necessity of further attention to the pavement after completion of construction and clearing up under the specifications, at least during the guarantee period.

The methods described have been used by contractors noted for good work and are from data gathered from the editor's experience and from contractors, engineers and inspectors familiar with the best construction and expert in securing it.

Invitation is again extended to our readers to add their experience to that here recorded or to discuss any points of difference in theory or practice.

THE standard specifications of the American Society of Municipal Improvements provide that the sand cushion shall be spread to a uniform depth of 1½ inches after rolling.

Thickness of Sand Cushion.

The depth of the sand cushion depends upon the smoothness of the concrete or other base, the uniformity in depth of the bricks and the expertness with which the bricks are rolled. The cushion is intended to remove any such inequalities and should be no thicker than will accomplish this purpose. Specifications have varied from 1 to 3 inches for this thickness, but have settled to the standard given above.

If too great thickness of cushion is used, any displacement of the cushion at any one point will spread and the de-

fective spot will increase in size and rapidly affect a large area of the pavement. The sand must be uniformly dry or it will not compact uniformly under the roller, especially if no rolling is done until the bricks have been laid. The result is an unevenness of the brick surface which cannot be taken out without taking up the brick and re-shaping the sand cushion. If the sand cushion is not rolled before laying the brick, the tendency of the sand to rise between the bricks is greater when the sand is thicker and then the joints cannot be filled full of the joint filler, and disastrous consequences result as detailed below. If the rolling of the bricks is improperly done and they have not been laid closely enough together to make lugs touch blocks and the bricks tend to support each other against overturning under the tractive force of the roller, a certain amount of tipping of the bricks results, which injures the wearing surface, making it ridgy and uneven, besides making it easier for some of the bricks to sink into soft places in the cushion, exaggerating these irregularities of surface.

If the cushion is too thin, there is possibility of solid brick coming into contact with solid concrete over small areas, and then the bricks, if not properly supported by the sand cushion on each side, may break across when a heavy load strikes them right, or may rock, thus breaking the bond of the joints and producing a weak and leaky spot in the surface which will soon develop into a material defect.

Uniformity in the size of brick is now readily attainable within the limits of variation allowable in the standard specifications, ⅛ inch, and it should be economy for the contractor to insist upon the bricks reaching this standard. Under modern methods of laying concrete foundations it is possible at very little increase in cost to product a smooth concrete surface parallel to the finished surface of the street. He can, with care, insure that the bricks shall be rolled properly. When he does all these things, then he should be permitted by the engineer to reduce the thickness of his sand cushion, for the future benefit of the pavement. For a street pavement, the surface of which must reach an exact elevation, this reduction in thickness must be made in the original specifications, thus reducing the cost still further by reducing the depth of excavation by perhaps a half inch. But on a country road where the curbs are set flush with the ground surface, but perhaps slightly below the completed brick surface, the reduction can be made when the contractor has demonstrated his ability to reduce the undesirable inequalities to a minimum.

When the sand-cement cushion is used, the saving in cost of cushion is still greater and well worth the trouble of making the concrete smooth and holding close to the specification for size of brick. If it is properly placed the thickness of the cushion or bed may be reduced to 1 inch and this inch may be counted as 1 inch of the concrete foundation, so that instead of a 6-inch concrete foundation and 1½-inch sand cushion, the base would consist of a 5-inch concrete foundation and 1-inch mortar bed.

Placing the Sand Cushion.

The sand for the cushion may be hauled over the concrete if it has stood long enough to be thoroly set and the wagons or motor trucks are run straight thru, but never without boards laid for the wagons to travel on. Wheelbarrows are better to use for distributing the sand, thus avoiding the heavy wagons on the concrete. The essentials are reasonably clean and dry sand, and if the sand must be dumped anywhere but on the surface of the concrete, platforms must be used so that none of the earth surface will be mixed with it in handling. Carelessness in drying the sand for the cushion and in keeping it dry until it is spread and ready for rolling has been responsible for many rough and irregular brick pavement surfaces. The concrete must of course be swept

The forward end of a brick paving job on Middle Springfield Road, near Paris, Illinois. Note steel side forms thoroly staked in place, gravel used for concrete, concrete in sacks, men filling the loading skip of the concrete mixer, bricks piled along the roadside, and wagon delivery of materials.

clean of any loose stones or other objects of size to interfere with the compacting of the sand.

The sand cushion, according to the standard specifications, must be shaped to a true cross-section of the roadway by means of a template having a steel-faced edge, covering at least half the width of the brick work and so fitted with rollers as to be easily drawn on the curb and guide timbers or rails. If the pavement is less than about 25 feet in width, the template may extend the full width of the street, and if the curbs are set with tops in straight lines, they may serve as the guide timbers. If the street is wider, it will be better to make the template for half of the street, either using two templates or by making one reversible, to use it on either side as desired. Then a timber guide must be used along the center of the street, made of planks the thickness of the sand cushion, 4 inches wide, 16 feet long, dressed on the two sides and laid to a true surface along the center line of the street. If the curb cannot be used for the outer end of the template to run on, guide timbers of the same size must be laid along the curb. A slight excess of sand should be spread so that when the template is drawn there will be 2 or 3 inches of sand pushing along ahead of it. It will be found necessary to put considerable weight on the template to keep it down into position, commonly by men pressing down on it. Care must be taken not to spring the template in this operation, otherwise the sand will be unevenly compressed and uneven in surface. The standard specifications require that half-inch strips be laid on the guide timbers and curbs before drawing the template, thus making the layer of sand a half-inch thicker than the specifications require.

When the sand surface has been properly shaped by the template, the standard specifications require that the cushion shall be slightly moistened and then thoroly rolled over its entire surface with a hand roller of not less than 36 inches diameter, 24 inches in width and weighing not less than 10 pounds per inch of width and having a 12-foot handle. Any irregularities in surface, no matter how slight, must be taken out by the application of additional sand or smoothing off high spots, and the process of smoothing and rolling continued

Laying the brick. Note method of staking the steel channel side forms, green concrete in foreground and the double screed. The first beam levels off the green concrete as it is hauled forward by means of the chain in the foreground. Between the two bars is the dry mixture of sand and cement to form the bearing surface for the bricks. The rear bar is slightly higher than that in front, so as to spread a thin layer of this mortar on the surface. It absorbs water for setting from the green concrete below. The brick laying follows immediately after. Note delivery of bricks by pallets in piles of four; also that the carriers are not always careful to place the bricks in the same position. The inspector in the rear is marking bricks for turning or culling before the roller, still farther in the rear, is run over the surface. The photograph was taken from a point beside the concrete mixer laying the base.

until the sand cushion is all compacted to a uniform solidity. The half-inch strips having been removed from guide timbers and curbs, the template is run over the surface again and the sand smoothed off to its exact surface and elevation. If there is any disturbance of the sand or if new sand must be added to fill depressions, the rolling must be continued until the final test with the template shows the surface to be perfect. It will be found necessary to keep the cushion in preparation at least 50 feet in advance of the brick laying. The sand of this prepared cushion must not be disturbed by stepping on it or dropping bricks or anything else upon it. Any leaves, sticks, small stones or other material of any appreciable size accidentally falling upon it must be removed before the bricks are laid.

The Sand-Cement Cushion.

If the sand-cement cushion is used it must be treated in the same manner as the sand cushion, the only difference being that the sand has thoroly mixed with it, dry, and preferably in a dry concrete or grout mixer, one part of cement to about five parts of sand.

The rolling of the brick can never produce the density of the cushion which the above treatment secures, and certainly cannot approach the uniformity of condition, so that the cushion must not be neglected with the expectation that the rolling of the brick will in any degree take its place. Moreover, if the cushion is not completely compressed, rolling of the brick will force the sand up between the bricks and prevent the filling of the joints with the grout filler as already noted and to be described below.

One of the accompanying photographs shows this tendency even with a well-compacted cushion.

Delivering the Brick.

Ordinarily the bricks for a pavement are delivered along the street after the curbs are set and before the excavation is made for the foundation. They should be so delivered before the foundation is finally prepared for the laying of the brick, whatever the nature of the foundation may be. Much time and money are wasted and lost by contractors in the handling of the brick up to the time of placing in position on the street surface, a large part of which can be saved by taking proper care. Some of these instructions may seem to be too detailed or even useless, but they are all based on actual experiences and close estimates of cost of remedying defects and of extra work caused by wrong handling of materials.

Bricks loaded into cars directly from the kilns are sometimes not completely annealed and are more brittle than they are later. But in any event, they should not be thrown from car to wagon, but should be handled with tongs and clamps or gravity carrier. Careless handling results in chipped corners and edges and broken bricks, which, with any reasonable rigidity of inspection results in rejections. These rejections react upon the price of brick and the contractor loses not only the time expended in handling these uselessly defective brick, but also by paying a higher price for the brick that can remain in place. And the handling includes the unloading from cars, piling along the street, putting in place on the street, culling when laying, turning after laying, rejections again after turning, and removing the rejected brick, with the attendant handling, no small amount of time, when all added together, all of which costs money.

The motor truck or trailer with dumping body is becom-

ing the most satisfactory vehicle for delivering brick, and can dump a load with practically no damage to any of the bricks in it.

In piling, the same care as in loading should be used. And attention to the condition of the bricks in the piles will be worth the trouble of instructing the regular watchmen to look after them. Many bricks are chipped and broken while waiting for the completion of the foundation by boys and men handling them, tipping of piles which are not well made and are not re-piled, knocking by wagons and machinery when piles are not properly located; and on the latter account they sometimes become so dirty from drainage water or spattering of mud that they must be washed before they are used, or the adhesion of the joint filler to the bricks will be prevented and the pavement will always bear the marks of the carelessness in handling, its life being materially shortened on this account.

Laying of Brick.

After the cushion has been properly prepared, the bricks are laid in place. It has now been demonstrated that the most economical method of laying brick on the street, as well as that producing the best results in the completed pavement, is to place the bricks as nearly as possible in the place they will occupy in the completed pavement. This means first, that the courses of brick shall be laid straight, second, the lugs shall all be on the same side, preferably the rear, as the bricks are laid, so that, third, they can be surely set up in close contact with the brick in the preceding course, and fourth, that the brick shall be laid with the best side on top. It will not then be necessary to drive the courses together after the bricks are placed, in an attempt to correct carelessness in laying, with its displacement of the surface of the sand cushion and tendency to tip the bricks so that they will not have a full bearing. Should it be necessary to drive the courses it should be done by a sledge tapped lightly on a 4 by 4-inch timber, 3 feet long, held against the brick.

Brick surface before grout filler is applied. Note the hand roller used for rolling the brick surface; also the concrete mixer. Shoulders will be laid and compacted against the brick edges when the pavement is completed and the steel side forms are removed.

Spreading the first coat of the grout filler for joints. Note the brooms for sweeping the grout into the joints. The concrete mixer and brick-laying gang in the background show how closely the finishing follows the beginning of the pavement laying.

To produce these results easily and economically, it will be necessary to handle the bricks from pile to brick-layer with pallets or by gravity carrier. The brick-layer cannot stop to inspect every brick to see which side should go up, but the man filling the pallets is able to do so with little, if any, loss of time, especially if he is required to place the bricks in his pallet so that when dumped beside the brick-layer they will have the lugs all the same way. He should have intelligence enough to receive instructions as to which is the best side of the brick, and even as to what bricks would probably not be accepted by the inspector and so, when he dumps his pallet of bricks they should be in exactly the position to require the least handling by the brick-layer. If the bricks are handled by gravity carrier, the men or boys placing bricks on the carrier can do some of this work, but those taking the bricks off the carrier for the various brick layers will have most of the placing and selection to do. A little care in selection of those handling the brick and time spent in their instruction will save much time spent later in turning bricks marked by the inspector and again taking them out and replacing with others if they are marked a second time. If 50 per cent. of the brick are set wrong side up the first setting, without the special attention above provided for, it certainly would pay to give the special attention, even if it took time or required a few cents higher wages to those handling the brick. But really it requires only a little special care and attention on the part of the superintendent in selection of workers and supervision of them, with no extra expense. Fifty per cent. of bricks turned is exceptional, but 20 or 25 per cent. is frequently found with careless contractors or superintendents on the job.

The standard specifications provide that when there are more than 10 per cent. of culls in any section, that section shall be taken up and the cushion readjusted.

One small point which adds greatly to the appearance of a pavement and also to its water-shedding quality, is the cutting of the bats required in alternate courses at the sides of the pavement as smoothly as possible and to set the natural face next the curb or expansion joint so that the rougher end will be covered by the joint filler. The job looks better and the joint is more stable and better filled.

The wheelbarrow should never be used in delivering bricks

Applying the second coat of cement filler, which leaves the surface smooth and the joints full. Note the squeegees used in spreading this coat.

to the brick-layers, even if run on boards. The wheel displaces too many bricks, pries open too many joints and produces too much unequal compacting of cushion, both in its travel and where the bricks are dumped.

Rolling the Brick Surface.

To bring the bricks down to perfect bearing and smooth out unevenness due to irregular sizes of bricks or carelessness in placing, the brick surface must be rolled with a light tandem roller, weighing from 3 to 5 tons. If the bricks are set closely, so that the lugs of one brick bear on the surface of the next, and the roller is run slowly, the rolling can be done without displacing the bricks and moving the sand of the cushion but slightly. The roller should be run first lengthwise of the pavement, beginning at the gutter and rolling to the center, and then from the other gutter to the center, unless the crown is at one side. Then the roller should be run diagonally in each direction across the pavement until the surface is smooth and all bricks are in full bearing.

A heavy roller will cause the bricks to tilt and then the uptilted edge may spall under the roller or will project above the filler to be unfairly attacked by the traffic. The horse-drawn roller is also objectionable, mainly from the displacing action on the bricks of the horses' shoes.

An unevenness in the surface of the pavement on a Florida road, shown in one of the photographs accompanying, which is in process of rolling, may be due to the fact that the rolling has not been done strictly according to specifications, beginning at each curb and working toward the center. It may also be due in part to insufficient compacting of the base, which in this case is the natural sand, compacted by moistening and rolling with an Austin motor roller.

Any areas not reachable by the roller should be tamped with a hand tamper applied on a 2-inch plank.

Expansion Joints.

The placing of the expansion joints along the curbs is a detail which deserves much care, more than it sometimes receives. If the pre-molded expansion strips now on the market are used, such as Genasco asphalt filler, Carey's Elastite, Hydrex and the Pioneer Asphalt Company's Pioneer, there is but little difficulty in placing them, as they may be put in place of the proper width in sufficient number to produce the required thickness of joint. The standard specifications prescribe at least ¾ inch thickness for a street less than 30 feet wide, up to 1½ inches for one 50 feet wide. The brick are laid against them, and the rolling and joint filling can proceed without interruption.

If one of the bituminous joint fillers is used, the space prescribed for the joint must first be filled by two wedge-shaped strips of wood 6 inches wide and dressed on two sides. The strip next the curb is 1 inch wide on top and ½ inch at bottom and the strip next the brick is the same except that its ½-inch edge is at the top. The bricks are laid lightly against the planks to keep them in place, but not so tightly as to bind them in place when they swell from the absorption of water in the grout filler. It is a good plan to loosen up the board next the curb as soon as the filling is completed. When the filler has set the strips are removed and the joint spaces are thoroly cleaned out, so that there will be no solid material to interfere with the expansion of the pavement, and the bituminous filler is poured in until the joint is full. Too much care cannot be taken in cleaning out the joint. Occasionally the reason for a break in a pavement has been mysterious until the presence was discovered of something solid and hard in the expansion joint, which produced an excessive local strain, causing the pavement to give way in joint or brick or by lifting of crown. The practice of filling the space for the expansion joint with sand or like material is very objectionable, as the sand will get into the transverse joints of the paving and interfere with the proper grouting of the pavement, and at the same time it will run out of the

The edge of the monolithic brick pavement, showing concrete base and intimate connection of base and brick layers. A gravel and earth shoulder will be compacted against this vertical surface, which requires no curb.

expansion joint space and thus permit the grout to run into it, where it will give much trouble if not removed and it will be difficult to remove. The sand is hard enough to remove without this added difficulty. Indeed, it is seldom properly removed and a joint thus treated never does its work just right.

Filling the Joints.

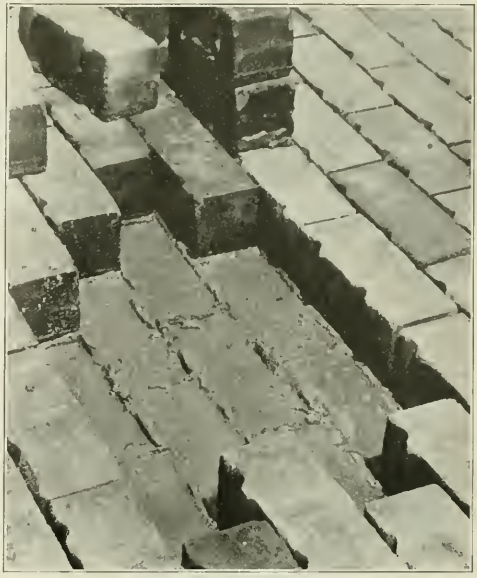
When cement grout filler is used two things are essential to good work, that the grout be kept constantly in motion until put in place, so that the cement and sand will be in contact and everywhere in the same proportions in the joints, thus making the joint filler, when set, of the same hardness and strength thruout, and the same adhesion to the brick. If either of these points is neglected, there may be trouble when expansion of the pavement takes place with rise in temperature or contraction takes place from a fall thereof. If the pavement has been laid as a plane surface, whether level or slightly sloping, with curbs at the sides, the expansion and contraction do not produce actual movement in the pavement, either lengthwise or crosswise, but the tendency to movement is taken up by strains in the brick and in the joints. There should be no bad effects upon such a pavement from changes in the temperature. But if the joints were full of sand at the bottom, as they sometimes are for one-third or more of their depth, and only the upper part of the joint is filled, and this possibly with grout that has been allowed to separate so that the filler is not all of equal strength, then all the force of the expansion must be carried by the small areas of good material. While the whole area of the joint would be able to carry this force, the small area is not. As a consequence, the cement grout filler is crushed and pinched out of the joint or the edge or top surface of the brick is spalled off, according to which is the less able to bear the strain. A break in the surface takes place and the pavement immediately begins to go to pieces. An exaggerated case of this sort, in which almost the whole pavement was involved, came under the eye of the writer a few years ago and led to the general adoption of a specification for rolling the sand cushion. Heavy rolling of the brick had caused the rather loose sand to flow up into the joints and nearly fill them for one-fourth to one-third their depth.

A half-inch of sand is spread on top of the pavement and left until the filler has thoroly set. It should be sprinkled in hot weather.

The standard mixing box of the specifications has been described so often in MUNICIPAL ENGINEERING and is now so generally included in the specifications for brick paving that it need not be described again. Its use is imperative, strictly according to the specifications, unless one of the successful modern grout mixers, such as that of the Harold L. Bond Co., or the Foote Mfg. Co., is used, in which case the best of results are easy to secure.

The pavement should be cleaned and thoroly sprinkled before and kept moist by slight sprinkling during the process of applying the grout. The first application should be swept into the joints as it is spread on the pavement by shoveling from the boxes or discharge from the grout mixers, using coarse rattan or fiber push brooms. When this first grout has settled, but before it has set, the second application should be made and the surface squeegeed with a piece of 4-ply rubber belting, or even a piece of rubber hose about 20 inches long, mounted between two boards with a handle attached. This second coat is applied by the same gang working back over the area covered with the first coat until the joints are certainly even full.

An inch of sand or fine earth should be spread over the finished pavement to remain until the whole pavement has fully set and hardened. In hot, dry weather this layer should be sprinkled at intervals to keep it from abstracting water from the cement. This layer should remain for at least 10 days and more if the weather is cold or otherwise unfavorable to the setting of the cement.



Bricks removed from rolled surface of pavement before the grout filler was applied, showing the nature of the connection between the concrete base and brick layer before the grout is applied to increase the bond between them.

Bituminous fillers for brick pavements may be of tar, or of asphalt. The standard specifications separate them strictly into the two classes, not permitting mixture of tar and asphalt fillers. The melting point of tar is required to be within 5 deg. of 135 deg. F., and it must be heated to a temperature between 300 and 350 deg. F. and poured into the joints until they are completely filled. The asphalt filler must contain at least 98 per cent. of bitumen soluble in carbon disulphide, remain pliable at all street temperatures, be proof against action of water and street liquids, and adhere firmly to the brick. Sand must be spread on top of the pavement after filling in sufficient amount to combine with the surface of the filler and whatever may be spread over the top of the bricks. It should be heated in cold weather to have its full effect. It is quite an art to pour the bituminous filler so that it will completely fill the joints and will not be spread over the entire brick surface. The latter is undesirable because it wastes material and, unless care is taken in supplying the sand, is liable to picking up by shoes and tires to the discomfort and disfigurement of persons and surrounding pavements, floors and carpets before it is worn off by the traffic.

For pouring the bituminous filler a cone-shaped can is used, having a cast iron tip with a ¼-inch hole thru which the hot liquid flows as the can is drawn along the joint with the point resting in it. A plug worked from the handle controls the rapidity of flow. A helper filling the can makes it possible to pour continuously unless the weather is so cold that the cooling of the can and the liquid makes it solidify enough to choke the opening. Multiple spouts on a carriage save time in pouring, but waste material.

One development intimately connected with the bituminous filler is the vertical fiber brick pavement, which will be described later in this series of articles. In brief, the wire-cut side of the brick is laid for the wearing surface and the bituminous filler is spread over the brick surface thick enough to form a wearing surface but not too thick to be held in place by the roughness of the brick surface.

Where the surface of a brick pavement varies from a plane surface irregularly, the design and location of expansion joints is a difficult matter and the use of a bituminous filler makes every joint an expansion joint so that little trouble may arise from expansion and the pavement require little maintenance work and expense on this account.

For the following description of the monolithic construction of brick pavements, the latest development in the continuous line of improvement of the product, we are indebted to Maurice B. Greenough, consulting engineer of the National Paving Brick Manufacturers' Association:

Monolithic Construction of Brick Pavement.

The method of constructing brick pavements whereby the brick are placed in green concrete foundation seeks to secure two results: First, a uniformly smooth surface, and second, a firm bond between the brick wearing surface and the concrete foundation.

At the present time, two methods are in vogue:

First, that whereby the surface of the concrete base is struck off and finished by means of a double template, which at once performs the cutting operation and spreads over the concrete a thin film of mixed sand and cement.

Second, the method whereby the green concrete is struck off by a single or double template, and the green mortar, wherein the brick are laid, is brought to the top by means of a slap board similar to that used in the construction of concrete pavements.

Thin Film Method.

The construction of the template used in the thin film method is of considerable importance. The most satisfactory design which has come to our attention is that in which the two cutting edges are formed by a 6-inch I-beam to the front, and a 6-inch I-beam or channel to the rear, rigidly framed 2 feet on centers, so that the two members are parallel and provided with two rollers at either end. The rear member is framed so that its bottom edge is 3/16 inch higher than the bottom edge of the forward member. The space between the two members is kept filled with a dry mixture of sand and cement in the proportions of one part cement to three of sand, which has been prepared in advance in a small batch mixture.

Operating the Template.

Concrete for the base is deposited on the sub-grade between the steel side forms, and roughly struck off with shovels to a

Constructing a brick pavement on a rolled sand bed near Tampa, Florida. Note several departures from proper procedure. The sand bed is rolled by the three-wheeled roller in the far background, which occasionally displaced the curb. The sprinkling is rather heavy and irregular, making the compaction irregular and subject to later irregular settlement. The men are standing upon and disturbing the sand surface, cause for further irregularity in the brick surface. The brick surface has not been cleaned and cleared so that the Austin 5-ton tandem roller can roll the brick properly, starting from the curb and working toward the center, first on one side and then on the other. This accounts in part for the break in the surface between the rolled and unrolled areas seen in the left foreground. Insufficient compacting of the surface of the natural sand base doubtless has its effect also.

Delivering brick to the bricklayers by Mathews gravity carrier. Note case with which the bricks can be inspected as they are put on the carrier and again as they are taken off, where they should be placed in the piles so that the bricklayer will not need to turn them to put the best side up or the lugs against the face of the preceding course. Here, too, men are disturbing the sand cushion by standing and walking on it, which will cause uneveness in the brick surface.

depth of about an inch greater than the required finished depth. At the same time it is thoroly spaded and joggled in order to compact the concrete and to bring only mortar in contact with the side forms.

The forward movement of the template performs two operations simultaneously: First, striking off the concrete base, and second, spreading over the surface the 3/16-inch film of dry sand and cement.

Upon the surface thus prepared, which should be absolutely smooth, the brick are immediately laid, observing all the precautions for laying the brick that would be observed in any other type of construction.

Grouting of the pavement is delayed until the close of each working period, when the entire force of men engaged, with the exception of a few who may be cleaning up or doing other odd jobs, is set to work for this purpose. The method of grouting which gives the most satisfactory results in other types of construction is likewise best adapted to the monolithic type of construction, namely, the box and scoop shovel method.

Discussion of Method.

One of the most important factors in securing good workmanship in this type of construction is uniformity in mixing the concrete. Unless uniformity is obtained, there may be formed depressions in the concrete base which will be reflected by a roughness in the surface of the finished pavement.

When the concrete is given its initial rough surface ahead of the template, a thoro spading serves to compact it sufficiently, and then is the time when slight irregularities in consistency across the width of the base may be best eliminated.

The film of sand and cement is applied to the top of the concrete in a dry state. Later, when the brick are laid upon it, there is sufficient weight pressing down upon the concrete to further consolidate it and to bring water enough to the surface to insure a thoro amalgamation of the thin film with the mortar in the base, and later to insure its hardening. Using this thin film of sand and cement eliminates absolutely any roughness in the surface of the concrete upon which the brick are laid.

Laboratory tests on beams of this character, conducted at the Case School of Applied Science, have indicated that sufficient bond strength is developed between the brick and the concrete to withstand horizontal shear long after the beam has failed in cross-breaking.

The brick are rolled immediately after they are laid with a hand roller weighing in the neighborhood of 400 pounds, and so smooth is the surface of the brick when laid that this is entirely heavy enough roller to put on the finishing touches.

The use of this light roller has many advantages over heavy rolling. It eliminates the danger of chipping or cracking the brick. It simply sets the brick in position, rather than forcing them in place, and, furthermore, it is a considerably cheaper operation than using a 3 to 5-ton self-propelled tandem roller.

The general details of construction which have been described here comprise the method recommended by the National Paving Brick Manufacturers' Association as being the most satisfactory plan of operation now in use.

The liability of securing a rough surface is minimized, every operation is a positive one, there is no necessity for men to go back over portions of the concrete already surfaced by the template, and when the day's work is over the pavement is completed up to that point.

Slap-Board Method.

A second method of effecting this type of construction is as follows:

The concrete for the base is deposited on the subgrade and roughly struck off by means of shovels. Either a single or double template is then drawn over it, producing the required thickness. Having been struck off, the green mortar is brought to the surface by means of a slap board, operated by one man at either end, producing a tamping effect on the concrete.

The writer has observed this method in operation during the past season, and from the results which he has seen he places less favor upon this method than on the thin-film method, for the following reasons:

First, the use of the slap board disturbs the surface of the concrete to such an extent that it is liable to produce waves or roughness, which are not eliminated in the subsequent rolling of the brick and which eventually means a rough surfaced pavement.

Second, the extreme fluidity of the green mortar, which is flushed to the surface, frequently causes it to run away from the high points of the pavement to the low points, so that as the brick are laid, there is a dearth of green mortar at the high places and a surplus at the lower places. This condition is particularly noticeable on curves where the outside edge of the pavement is elevated.

Third, the writer has observed that where this method is followed, frequently too much water has been brought to the surface of the concrete, causing separation between the sand and cement, which eventually prohibits the formation of a perfect bond between the brick and the concrete.

Fourth, by reason of the lack of uniformity in this bedding surface of green mortar, it is difficult to secure a smooth and uniform surface of the brick with a light roller. If the film is thin, the brick bear directly upon the coarse aggregate of

the concrete, whereas if the film be thicker, the rolling produces an unnecessary movement of the brick, sometimes causing the green mortar to be squeezed up in the joints so that it overflows upon the surface of the brick. This material, of course, possesses some bonding qualities, but is an inferior quality to the cement grout which should fill the joints.

Fifth, the use of the slap board does not produce a surface of uniform characteristics, but rather one having a sort of speckled appearance. Frequently it is necessary to take mortar from the concrete on one place where there is an excess and deposit it in another where there is a lack.

This patch-work manner of securing results is far less satisfactory than positive results secured by means of the double template spreading over the surface of concrete a thin film of sand and cement.

This is a period of transition in brick pavement construction. There is a tendency on the part of contractors each to make his own experiments and find a method which in his opinion possesses the individuality of his own effort. However, this association has made a very careful study of this type. We have observed the various methods of construction used; we have seen uniformly satisfactory results obtained by the use of the double template and the thin film. We have seen some satisfactory, but many other indifferent, results obtained by the use of a slap board.

We feel that if engineers and contractors were fully cognizant of the advantages in the use of the double template and the thin mortar film they would use it practically to the exclusion of other methods.

A demonstration at Paris, Ill., on the 6th of October, 1916, illustrated the association's specifications covering this type of construction.

Some Results.

On country road construction, where the edges of the pavement will be met by earth, gravel or macadam shoulders, the monolithic construction is so strong that it is believed concrete or stone curbs will not be necessary. To leave the edges in proper condition it is necessary to use substantial steel forms in which to place the concrete and the brick during construction, which must be thoroly held in place, so that the edge will be straight and vertical and give as little chance as possible for the wheels of traffic to cause any breaks.

W. T. Blackburn, the consulting engineer of the Dunn Wire-Cut Lug Brick Company, seems to be the engineer to whom should be awarded the credit of starting the development of the new method of construction.

The accompanying photographs are a few selections from a wealth of material illustrating the various steps above described and may aid in understanding what cannot be fully explained with words.

CLEVELAND STREET RAILWAY SITUATION

The Journal of The Engineers' Club of St. Louis contains a paper on the Cleveland Street Railway Situation, by F. W. Doolittle, consulting engineer, New York City, in which he takes up the events preceding the adoption of the "Tayler Ordinance," then that ordinance and the defects in its operation, as disclosed at the time of arbitration of 1913. The Tayler ordinance granted a renewal of the street railway franchise of the Cleveland Railway Co., fixing the rate of fare at 3 cents and 1 cent for transfer, but providing for a fluctuating rate of fare dependent on the cost of service. Mr. Doolittle then describes the efforts since arbitration to reduce the cost of operation in order to permit continuation of low fares and the service rendered under the Tayler ordinance, then the actual cost of service under the Tayler ordinance. From the study of costs in Cleveland and the survey of operating and traffic conditions peculiar to Cleveland, the following conclusions may be drawn:

(1) While the regulating ordinance contemplates fixing the rates of fare to conform with costs, the actual costs of service have considerably exceeded those recognized by the ordinance, due to the inadequacy of allowances for operation and maintenance, the failure to provide reserves for injuries and damages and insurance, and the failure to make due provision for depreciation.

(2) The actual value of property used for the transportation business exceeded that recognized by the ordinance, due to the arbitrary reduction of the cost new of physical property to approximately 70 per cent of such value. To reproduce identical facilities for rendering transportation service would require an investment in excess of that assumed in the ordinance.

(3) The rate of return provided in the ordinance, or 6 per cent, is not comparable with the rate of return necessary to attract money into the urban transportation business under conditions where, unlike Cleveland, such return is not guaranteed.

(4) The actual costs of operation per passenger are considerably less than those of urban transportation systems in other American cities, due to the co-operation of the public and the city of Cleveland. The skip-stop, headway as high as five minutes on heavy lines, the use of trailers and short routing, the loading and collection practice, and the regulation of vehicular traffic, are evidences of this co-operation. These innovations have had a substantial effect on costs.

(5) The scheme of ordinance regulation as provided in Cleveland retards the extensions of existing lines and will in time no doubt materially affect the distribution of population.

(6) The service rendered is found to result in a degree of crowding and a proportion of standing passengers which discloses a standard of service below that prescribed as adequate in other American cities.

(7) While the average rate of fare per revenue passenger is now generally 3 cents, with 1 cent for transfers, in conformity with ordinance costs, the increase of actual costs of operation reflected in the deficiencies of operating allowances leads to the conclusion that the car riding public of Cleveland may expect to face the alternative of higher fares or poorer service.

(8) Taking into consideration further the property abandoned, which is only now partially written off, it would appear that the present generation of car riders is receiving transportation costing in excess of fares paid, leaving future generations to pay for equipment worn out from past service. In effect, such a process of paying for the depreciation of the property results in converting physical property values into service rendered, and if continued would affect the security of the property which the ordinance is pledged to safeguard.

THE AUSTIN DAM

WATERPROOFING THE ROCK FOUNDATION

By Frank S. Taylor, Austin, Texas.

The disasters to which the dam across the Colorado River, near Austin, Texas, has been subject and the studies made to determine the reasons for the failures, make most interesting this story of the work done toward preventing the leakage of water thru the seamy limestone strata on which any dam at this location must rest. The descriptions are in detail sufficient to enable the contractor and the engineer to apply the same methods under like circumstances.

The historical portion of the article shows how the difficulties in the way of financing the construction were overcome. Starting as a purely municipal undertaking it was necessary after the great loss incident to the destruction of the first dam to grant a franchise to a company for the construction and operation of the plant under terms which would ultimately return the plant to municipal ownership.

THIS development, completed after nearly three and one-half years of work, presented several new and extraordinary features of design and construction.

The principal original and noteworthy departures from general practice are: The two sections of dam having crests at different elevations; the automatic crest gates; the arrangement of the sluice gates, and the reinforced concrete turbine chambers, all of which will be hereafter described in their proper places.

Historical.

In May, 1893, the first dam across the Colorado river near Austin, Texas, was completed, and the electrical power and pumping plant, which was driven by the water power derived from the impounded waters of the dam, was put into operation.

At that time, the development attracted world-wide attention, due to the fact that it was then the greatest dam in the world, when both height and length were considered, and the lake formed by it was one of the largest artificial bodies of water ever impounded.

The dam had a gravity section made of cyclopean concrete masonry, and overlaid on both the upstream and downstream sides with cut, red granite blocks. Its height was 60 feet above low water and the total length was 1,235 feet, of which, practically, 1,100 feet was spillway, 110 feet bulkhead on the eastern end, and 25 feet bulkhead on the western end.

The whole development was a municipal undertaking, the money being raised on bonds of the city of Austin, of which $1,400,000 were issued.

The entire river bed for many miles up and down stream, and, in fact, practically all the underlying rock of the county, is limestone, varying from the so-called "dobe," which is a disintegrated limestone, up to the hardest variety. The river bed is seamed with fissures, and there are small cavities of frequent recurrence, ranging from a few inches to several feet in the largest dimension, and these cavities are encountered sometimes as far as 20 feet below the surface of the river bed.

Shortly after the work of construction of the first dam was begun, foundation difficulties began to manifest themselves, and these were followed by other difficulties produced by the personnel of the city government. The engineers in charge could not get their instructions followed, their plans executed or specifications fulfilled. They resigned, one after the other, and their places were filled by other engineers, who also, successively, resigned. In spite of these difficulties, some 600 feet of the western end of the dam were placed on good, firm rock. The rest of the work was done more with a view to completing the dam than to finding a foundation to support it. The draft tubes from the old power station were so located that they discharged against the down-stream toe, and the waters from these draft tubes eroded the soft strata underneath the toe, so that the dam did not rest on a supporting foundation from upstream to downstream side, but merely from the upstream side down to the point where erosion had ceased. This condition continued for seven years, when the inevitable end was reached.

On April 7, 1900, under a flood of 133,000 cubic feet per second, which gave a depth of water of nearly 11 feet over the crest, a section about 200 feet long tilted backwards under the stress, sild down stream, righting itself as it moved, and finally came to rest about 100 feet below the axis of the dam. The impounded waters rushing thru the opening thus formed, eroded the remaining portions of the dam, thereby widening the gap until some 450 feet of the total length of the dam was removed. The power house was wrecked, and several people who were in it at the time were drowned.

This failure was another factor which brought the Austin dam again prominently before the engineering profession, and the peculiar conditions of its failure, together with the other features first mentioned, have made it the most widely known of any modern example of dam construction. This catastrophe deterred the municipality from undertaking the reconstruction of the dam, altho for several years it was agitated from time to time by citizens. Engineers were employed to report on the location of the dam, and several different reports appeared, the general opinion being that the character of the river bed, the limestone and arrangement of the strata made it impossible to construct a safe and water-tight dam at the point where the old structure had been built.

About seven years ago, the municipality, at a considerable expense, had a series of rock borings made, some passing thru the crest of those portions of the dam still remaining, the others made in the gap which was caused by the breaking out of that section on defective foundation, with the result that it was found that the underlying rock was good, hard, and compact below a certain depth under the river bed, and the footing of the old dam. This encouraged the citizens and municipality to undertake some means whereby the dam could be rebuilt.

After many proposals from the city to private companies, and from companies to the municipality, a franchise was granted to Wm. D. Johnson, of Hartford, Conn., on September 11, 1911, which provided that the dam and power plant would be constructed by Johnson or his assigns, and on completion, turned over to the city, Johnson to receive $100,000 in cash on completion and acceptance, and $64,800 per annum

HIGHEST FLOOD EVER RECORDED. SHOWS THE AMOUNT OF WATER WHICH MIGHT PASS OVER THE COMPLETED DAMS IF THE FLOOD OCCURRED WHEN THE RESERVOIR WAS FULL. IT IS PASSING THRU A GAP IN THE UNCOMPLETED DAM.

in semi-annual payments for 25 years, making a total payment of $1,720,000, the cash value of which is approximately $1,000,000. In order to carry out the terms of the franchise and to do the construction work, a corporation was formed called the "City Water Power Co., which issued $750,000, face value of 5 per cent., gold, sinking fund bonds, and these bonds were underwritten by Lawrence Barnum & Company, bankers, of New York.

New Plans.

The designs for the new development were begun early in 1910, and work finally began on September 22, 1911. This work was prosecuted on force account from this latter date until June, 1912, when a contract was entered into with the Wm. P. Carmichael Company, of St. Louis, to take over the work and bring it to completion. Work progressed until April, 1913, after which practically nothing was done until January 10, 1914, the entire period between these latter dates being lost by reason of an unprecedented series of heavy floods, culminating in the flood of December 3, which was the highest ever recorded in the history of the river, or memory of any person acquainted with it. It is estimated that the quantity of water passing down the river on that date was between 220,000 and 230,000 cubic feet per second.

After a considerable study of the situation, it was decided that the new development could be made best and most cheaply on the same site as the original dam. While the foundation work for the new dam was more costly than it would have been if the location were changed upstream some 800 or 900 yards, this expense was more than counterbalanced by the ability to use the existing section, which comprised 520 feet length of dam, in good condition and on satisfactory foundation, together with all the bulk-head masonry, which was thoroly good, tho not on proper foundation. Also, the larger portion of the old power house, still standing, could be utilized. The most suitable character of structure with which to fill the gap is a hollow dam, having an inclined deck, thus neutralizing the overturning moment, having buttress walls sunk well into the rock to resist sliding, and with a cut-off wall on the upstream side going down into a trench cut in the rock to such a depth that all waters would be definitely stopped from following any permeable seams.

There was, however, one difficult condition to be met, which was that in order to get the proper amount of power and lake storage, the height of the water level would have to be raised from the old elevation of 60 feet, to 65 feet above low water, which meant that with 11 feet of water over the crest, during times of flood, the maximum water level would be 76 feet above low water instead of 71 feet. That portion of the old section which had given way, failed under a 71-foot elevation of the water level, and it was imperative that that portion of the old section remaining and which would form a part of the new dam, should not be again subjected to as great stresses as it had previously withstood. This required that the maximum water level should never rise even as high as 71 feet above low water. It appeared as if these two conflicting conditions could not be reconciled. However, after considerable study, the arrangement of crest gates, later to be described, was adopted. With this arrangement, the new section of dam was built only 51 feet high from low water to crest, or 9 feet lower than the old section. Piers were built 20 feet apart on both the old and new sections, the upper levels of the piers being the same over the whole length of the structure. Crest gates were placed between the piers, the gates on the old section being 6 feet high, and those on the new section 15 feet high, so that the upper edges of the crest gates are all at the same level, which is 66 feet above low water. When the water level is at an elevation of 65 feet or less, the crest gates are tightly closed. An increase of 6 inches in the elevation of the lake level will make the crst gates automatically overturn, letting the water flow out over the crest of the dam. When the level has fallen 12 to 15 inches, or about down to the 64-foot elevation, the crest gates automatically close. During periods of flood, the crest gates are open, and the greater portion of the flood water is taken over the crest of the new section. It is estimated that with a discharge of 200,000 cubic feet per second, the depth of the water over the crest of the new section will be 18 feet, the depth of the water over the crest of the old section being 9 feet. This means that the present dam will pass 50 per cent. more water than passed over the crest of the old dam when it failed. But the elevation of the water is only 9 feet above the crest of the old dam, while it was 11 feet above the crest

THE UPPER SIDE OF THE COMPLETED DAM. THE FLOOD GATES ARE SHOWN PART RAISED AND PART LOWERED. THEY OPEN AUTOMATICALLY WHEN THE FLOOD REACHES A CERTAIN HEIGHT. THE BRIDGE BETWEEN THE PIERS SUSTAINING THE GATE IS SHOWN ABOVE EXTREME HIGH WATER.

when the weak section went out in 1900. Since the overturning moment varies as the cube of the head of water against the dam, and the sliding force varies as its square, the stresses to which the old section will be subjected can never equal those which it has already resisted. The depth of the water below the low water elevation varies from 5 to 20 feet, so that the total depth of water behind the dam varies from 70 to 85 feet.

Foundation.

As has been pointed out, the river bed and the whole surrounding country are underlaid with limestone, which has many crevices, seams and cavities in it,-and these are to be found at varying depths below the surface. About twelve years ago, two United States Government engineers made a short report for the city of Austin, in which they gave an adverse opinion concerning the character of the river bottom for supporting a dam. Of course, at that date, the only type of dam that these engineers considered was the ordinary gravity section. About six years ago the city had a number of borings made by the Sullivan Machinery Company to definitely determine the character of the river bed. The boring chart shows that there were considerable amounts of broken limestone, soft limestone, cavities, seams and fissures encountered, and the records obtained from these borings prove, conclusively, that in order to build a dam across the river at this point, the defects in the strata underlying it would have to be corrected. It was decided to fill all the underlying seams and cavities with grout, and, on the reconstructed river bed, to build a hollow dam of reinforced concrete, of such form that there could be no uplifting force from any leakage of water under it. Furthermore, as a portion of this new section, a cut-off wall would be sunk in a trench cut in the rock on the upstream side and carried to such a depth that its lower edge would be below all permeable strata.

The profiles of the old section, which was carried out in the flood of April, 1900, and of the new section as originally designed, show that the bottom of the new section goes to a depth considerably below the bottom of the old dam.

After the excavations were made it was found necessary in many places to go even deeper than indicated by the borings before a proper quality of rock could be reached. With the type of dam adopted for the new section, it is only necessary that the underlying rock be able to carry the superimposed weight, there being no uplift.

The unit pressure adopted for the wall footings was 166 pounds per square inch, with a few walls where this pressure was carried up to 200 pounds per square inch. Wherever the rock was hard and firm for a depth of 4 feet it was considered satisfactory to resist these bearing pressures. Trenches were cut in the rock to receive the footings, and in the bottoms of these trenches at intervals drill holes were made 4 feet in depth. Wherever these drill holes passed continuously thru solid rock, the trench was accepted as suitable to receive the footing. Wherever the rock was hard, but a cavity was encountered, grout was forced into the cavity and allowed to harden before the footings were built upon it. Wherever soft and defective stone was found below the bottoms of the building trenches, the excavation of these trenches was continued until some point was reached below which the thickness of the good rock was at least 4 feet. This practice applied to the trenches in which the buttress and supporting walls were built. The cut-off wall was carried down in many instances a considerable depth below the footings of the buttresses. This wall, which runs transversely across the river on the upstream side of the dam, was poured in a trench which had previously been tested by numerous drill holes made in the bottom of the trench, and, where defects were found, they were remedied by grouting. These test holes were first made 12 feet apart in the bottom of the trench. Compressed air was turned into them, one by one, to discover whether or not

WATER FLOWING OVER DAM WITH FLOOD GATES CLOSED, BEING THE NORMAL CONDITION. ONE OF THE FLOOD GATES IN THE FOREGROUND IS OPEN TO SHOW THE EFFECT UPON THE FLOW OF WATER. IF ALL WERE OPEN THE RESERVOIR WOULD SOON BE DRAWN DOWN TO THE LEVEL OF THE CREST OF THE DAM.

there was any underground connection between adjacent holes. Wherever the compressed air in entering one hole would blow out of one or more of the other holes, it was considered that all the seams or crevices between the two holes were reached by the drill holes then made. Grout would then be forced into one of the holes until it began to blow out of the others. It was then considered that the rock lying below the cut-off-wall trench and extending between the holes that the grout had entered thru, and those it had begun to blow out of had been made tight and impervious to water. Wherever no connection could be established between the holes 12 feet apart, intermediate holes were drilled, thus making the drill holes only 6 feet apart along certain portions of the cut-off-wall trench. If, after this was done, no connection could be established between adjacent holes, additional holes intermediate to those 6 feet apart were then drilled, bringing the distance apart of the holes to 3 feet.

In nearly every instance where these holes were made water flowed freely thru them, sometimes spouting up 3 or 4 feet, thus proving conclusively connection between the holes made inside the cofferdam and the surrounding body of water. As grout would be forced into the holes the velocity of water flowing out of them would gradually diminish, until it would entirely stop. In many cases, where grout was forced into a hole, the flow of water thru other grout holes, sometimes as far distant as 50 feet, would be stopped, and the grout would finally show, rising out of adjacent holes, proving that the un-

derground seams between these two holes had been thoroly filled with grout.

The grout used consisted of one part portland cement to two parts of sand, mixed with sufficient water to form practically a liquid mixture.

The apparatus used to force the grout into the holes comprises a cylinder of steel plate, 20 inches in diameter by 3 feet long, supported vertically on three legs, the bottom being conically shaped, tapering from the diameter of the cylinder down to a 2-inch discharge opening.

The upper end of the cylinder was provided with an interior cover, held tight by the air pressure from within. Entering the cylinder near its upper end is a connection for a 1-inch air pipe. The grout constituents were poured into the cylinder and compressed air admitted to the lower end of the cylinder, causing the mixture to boil and mix thoroly. This operation usually required about one minute.

After thoroly mixing, the cover was lifted into place and the air pressure turned into the cylinder near the upper end, forcing the grout out of the lower end and into the grout holes. In order to make a proper connection between the discharge end of the pressure grouting cylinder and the holes in the rock, short sections of wrought-iron pipe were sunk into each hole and cement poured around them and allowed to set, so that the upper end of the pipe provided a screw joint by which connection was made between the pressure hose leading from the grouting cylinder to the hole to be grouted. Usually a light air pressure could be applied, under which the grout would flow easily, and, as the hole began to be filled to a greater extent, the air pressure would be increased until when the hole was finally filled the pressure would be raised to 80 pounds per square inch.

By this method, and using great care in locating and filling the holes, a good foundation was secured and thru material of such a character that certain engineers had reported that it would be impossible to construct successfully the dam across the river at this locality.

Subsequent to the completion of the work a cofferdam was built on the down-stream side of the river and pumped out, and all leakage observed. There was practically no leakage thru the foundation or thru the strata below the cut-off wall, and the entire work was shown to be one of the most watertight dams that has ever been constructed.

Reciprocity of Cities Regarding Vehicle Licenses

By Andrew Linn Bostwick, Municipal Reference Librarian, St. Louis Public Library.

Investigation brings out the fact that there is considerable diversity of practice in dealing with the question of the honoring of vehicle licenses in municipalities other than those in which such licenses are issued. The data gathered here relate to fourteen cities, or more correctly, fourteen pair of cities. In six cases the replies received indicate a more or less complete degree of reciprocity. In the remaining three cases, the replies were incomplete; two of these replies, however, were to the effect that certain vehicle licenses were honored. Below will be found a more detailed statement of the practices in the municipalities under consideration.

New York—Jersey City, N. J.

In the case of public hacks a New York license is not honored in any neighboring city. In the case of the states of New York and New Jersey, however, vehicles licensed in one state are privileged to use the streets in the other for a specified time. In the reply from New York City no mention was made of vehicles used for delivery, etc.

Philadelphia—Camden, N. J.

The reply from Philadelphia covered only hucksters' licenses, and is to the effect that there is no reciprocity between Camden and Philadelphia.

Boston—Cambridge, Mass.

There is no law or practice in or about Boston which prevents the free passage of vehicles in and between the several municipalities. In brief, the information is to the effect that Boston and the neighboring cities honor each others' vehicle licenses, provided they do not cover vehicles for hire.

Detroit—Windsor, Ont.

Detroit drivers' licenses are recognized in Windsor, Ontario. The Michigan automobile license, however, is not honored in Canada, altho a bill remedying this condition is now pending in Ontario. No information was received as to the honoring of Windsor licenses in Detroit.

San Francisco—Oakland, Cal.

San Francisco and Oakland do not honor each other's vehicle licenses.

Cincinnati—Covington, Ky.

The reply from Cincinnati is to the effect that every vehicle using the city streets is required to take out a Cincinnati license, and the neighboring cities in Kentucky make the same rule regarding Cincinnati vehicles. Cincinnati derives an annual income from Kentucky vehicles of approximately $5,000.

Newark, N. J.—Jersey City, N. J.

Vehicle licenses issued in Newark are good only in that city. No information was received as to whether Jersey City licenses are good in Newark.

Washington, D. C.—Maryland, Virginia, etc.

The reply from Washington related to motor vehicles only. The District of Columbia honors all foreign automobile licenses and the same courtesy is accorded the District of Columbia licenses by all neighboring states except Maryland.

Minneapolis—St. Paul.

Minneapolis and St. Paul make it a practice to honor each other's vehicle licenses. An ordinance adopted in 1910 specifically states that vehicles duly licensed to do business in another city of the state may carry passengers, baggage and freight from said city where so licensed to any place within the City of Minneapolis without taking out a Minneapolis license.

Kansas City, Mo.—Kansas City, Kan.

Kansas City, Kan., has no vehicle license law, as the statutes of the state do not permit this. The report from Kansas City, Mo., is to the effect that most of the persons from the Kansas side who use vehicles in Kansas City, Mo. in connection with their business are glad to take out licenses for the Missouri side, as they feel that they derive a benefit from the use of the streets. The Kansas City, Mo., legal department has taken the stand that these licenses must be taken out, but as before stated, this has caused little or no resentment on the Kansas side.

Providence—Pawtucket, R. I.

Complete reciprocity exists in this matter between the cities of Providence and Pawtucket.

Omaha—Council Bluffs, Iowa.

Drivers of vehicles from Council Bluffs or other cities around Omaha are not required to take out an Omaha license unless they solicit business on Omaha's streets. A former report on this matter from Omaha gives also the information that the Omaha license is honored in Council Bluffs.

Hartford—East Hartford, Conn.

No reciprocity in licenses exists between Hartford and East Hartford.

The Municipal Supply Department V.

BUDGET — STANDARDIZATION

By Hugh M. Foster, New York City.

This last article of the series rounds it out by connecting the supply department with its superior creators and managers, thus completing the circle which began with the relations of the department with those whom it serves and continued thru the internal management of the department itself.

While the articles are based on experience in New York City, they are applicable to any city supply department and are the more valuable as an exposition of the subject because they cover more ground than would be necessary in any except the very largest cities.

INVESTIGATIONS for supply requirements for provision for annual budget appropriations should be made by the controlling fiscal department in conjunction with the operating departments and not afterward. The practice of sending examiners and investigators to take inventory, check records of quantities and distribution, after this work has all been done within a given department, is a mere duplication and waste of time. If such investigations are undertaken simultaneously and in conjunction with the operating department, time and labor may be saved and friction avoided. The usual bases for estimating budget requirements are, the consumption of last year, plus a reasonable increase for normal increment of consumption and a margin of safety for emergency needs. As far as possible the element of guess work in such investigations and estimates should be eliminated, and anticipation based upon actual past consumption for a given period.

Budget Appropriations.

Budget appropriations for supplies should be based upon actual statistics of all supplies and divided proportionately item for item. While such may be the basis for appropriations, the appropriations themselves can be lumped for supplies for a given department.

After the monetary needs of a department are determined, as far as the tax budget is concerned it is of no importance whether the money is expended for coal or for lamb chops, but the statistics in complete detail by which the totals are arrived at are important.

Emergencies.

The extent to which emergency purchases of supplies are indulged in indicates bad purchasing or bad storekeeping. The reduction of emergency purchases to the minimum indicates the efficiency of the service. In the best regulated system emergencies will occur, but in all cases of actual emergency the head of the department should personally certify, upon information furnished to him, the cause of the emergency and the justification for such purchases.

As illustrations of real emergencies, the Slocum and the Titanic disasters will be recalled. All kinds of food and clothing had to be procured within a few hours' time on those occasions. The purchasing agent of the Department of Health at the time of the Slocum disaster, Saturday afternoon, went out and hired a truck and collected food, clothing and medicines; had them loaded on the truck and had it driven up to North Brothers Island, and reached there in time to render what aid could be given to the victims on that occasion.

Responsibility to Highest Authority.

One of the most important considerations in establishing the Municipal Supply Department is the question of fixing responsibility. A purchasing agent and storekeeper for a city are in a far more vulnerable position than such officials for a private corporation. The mere fact of acting in such a capacity for a government subjects such an official to suspicion and constant criticism. Many acts are excused in private business which would not be tolerated in the public service. For such reasons it is important that both the purchasing agent and the storekeeper should be constantly subjected to the most severe scrutiny.

For this reason alone, if for no other, the power of inspection should be outside the control of both the storekeeper and the general purchasing agent, preferably in the hands of the general auditor of the city or comtroller or chief fiscal officer, as the case may be.

As the purchasing agent has to buy supplies for all operating departments, and the storekeeper has to distribute such supplies to all the departments, both these officials should be independent of all except the highest authority in the city. If the city is a commission-governed one, as is practically the City of New York, with the great powers of the Board of Estimate, the Municipal Supply Department should be directly under the commission or board.

In the government of the City of New York the Mayor is the chief executive and chairman of the Board of Estimate; the Comptroller is the chief fiscal officer and the head of the Department of Finance; the President of the Board of Aldermen is the presiding officer of that board and has three votes in the Board of Estimate and Apportionment. Besides these officials the Board of Estimate and Apportionment includes in its membership the five Boro Presidents.

It has been urged that as the chief executive the Mayor should appoint the general purchasing agent and the general store keeper. This omits any power in such selection by the Comptroller, who is the chief fiscal officer, and omits the President of the Board of Aldermen as the presiding officer of the chief legislative branch of the government. To include both these officials it was proposed to organize a board of purchase, consisting of the Mayor, the Comptroller and the President of the Board of Aldermen. The objection to this plan was that while the five boro presidents are ostensibly the heads of the boro governments and have control of public highways and buildings, buying large quantities and many kinds of supplies for such activities, they have no voice in the management of the department which buys those supplies. The legislature, therefore, made the entire Board of Estimate and Apportionment the head of the supply department as the board of purchase.

This preserves the principle of boro autonomy and precludes the danger of such a department being corrupt or ill-managed by one unworthy official. It is less likely that the whole Board of Estimate would be composed of unfit officials than that any one given office should be occupied by such an undesirable incumbent.

Standardization.

The power of standardization of supplies or the preparation of standard specifications for all supplies by the city should be in the hands of a bureau or commission, independent of the supply department. Its function should be to prepare exact and technical specifications, and while it should act independently, it should be required to prepare specifications only after conferences with all the departments using supplies and with the approval of such departments. Once adopted such specifications should be universally binding until amended.

The general procedure in the preparation of specifications should be the determination of the supplies in use, the requirements therefor, the uniformity of such supplies, the investigation of trade conditions and customs, the reference of results of such investigations to the operating departments, the conformity of departments and specifications by bringing both together to agreement, the selection of the article best suited to the need, and the description of such articles to admit of definiteness of contract and inspection of deliveries.

The basis for standardization is the record of past purchases for the supplies which are to be standardized. In preparing such specifications the encouragement of competition should always be borne in mind. The habit of exhibiting samples with the provision "or equal thereto" should be as far as possible avoided, and in all instances such usages as naming special brands or makes should be discountenanced.

The standard general classification list of the City of New York shows over 23,000 different items of supplies. The magnitude, therefore, of preparing scientific specifications for all these is apparent. The widest publicity should be given to specifications after they are once adopted. They should be distributed to all employees, stewards, storekeepers, purchasing agents, and dealers thruout the trade. Co-operation of other governmental purchasing departments and private corporations should be encouraged.

Another important element in the work of carrying on a proper supply department is adopting standard methods of sampling. It is obvious that an inspection of a barge load of coal, based on a sample which is not truly representative of the whole barge load, is unfair to the dealer and consequently in the long run deleterious to the best interest of the city.

It must also be constantly borne in mind that the best specifications are worthless in the hands of incompetent inspectors, and inferior specifications are proportionately harmful even in the hands of the best inspector, as after all specifications form the basis of inspections, and all work of preparing standard specifications is worse than useless if specifications are not uniformly, universally and rigidly enforced.

Conclusions.

The cry for a business administration of municipal government, which has been raised thruout the country and growing for more than the last decade, is worthless if it is not to be lived up to. In a recent lecture at Columbia University Comptroller Prendergast declared:

"You can get what you want no matter who is in office if you want it hard enough, because, no matter who is in office an administration cannot afford to disregard the wishes of the people if they are made sufficiently aggressive."

It is so proverbial that it is almost a trite truism that no government can rise superior to its citizenship. If you want good government it is up to you.

CHANGES IN CITY BUSINESS DISTRICTS

The change in city land values, thru changes in transportation facilities, is illustrated in the history of the boro of Manhattan, New York. It is but a comparatively few years since the business of the city was done below Fourteenth street, and certain classes of business gradually extended north, as the surface lines of travel and the elevated railways all concentrated in the comparatively small business district on the southern portion of the Island. Brooklyn fed mainly to the southern end of the Island and the railroads from the west, the Grand Central Station at Forty-second street being the terminal farthest north, as it is today. The congestion in the lower part and the land values rose to dizzy heights.

But transportation facilities have changed. Instead of one Brooklyn Bridge there are five, or soon will be. The Pennsylvania Railroad has moved its passenger terminals from Jersey City, opposite the lower Island, to Thirty-eighth street, and has subways to Long Island on the same east and west line. The other tubes across the Hudson River run to this section as well as the southern section, and soon the connection with the eastern railway lines by bridge across Hellgate and the Long Island tunnels will still further emphasize this location.

The result is a movement of the center of things up to a district roughly extending from Thirty-fourth to Fifty-ninth street, and the former southern congested district has experienced an enormous shrinkage in real estate values, except along certain special streets and certain highly specialized districts.

The causes producing this result have been developing slowly and men were slow to recognize the inevitable tendencies, nor have they had breadth of view enough to start the forces to acting which would replace the retiring classes of business with others or with manufacturing industries suitable for such locations.

A movement among the merchants to keep the factories out of the charmed district, which is the center of things, is in process, and would become more promptly successful if it were supplemented by a positive movement to locate such factories in buildings in the deserted districts. Lower rents are now available, and if modern buildings can be offered this movement should be reasonably successful, to the benefit both of the district in which tenants are wanted and of the district in which this particular class of tenants are not wanted.

Rats desert a sinking ship and strong measures will probably be necessary to turn the flow in the directions desired.

The subways seem to the outsider to be the means of salvation for the threatened districts, for they can give transportation facilities from all directions so as to make the whole of Manhattan Island, so far as this one method of transportation is concerned, practically equally accessible from outside. As the subway system is developed and transfers and thru and circular routes are devised, which will sew them all into one continuous fabric, the business and manufacturing population can select their own places of business to avail themselves of the advantages of low rents and good quarters. The subway planner and the modern building constructor can thus work hand in hand to the benefit of every one.

WORKERS IN THE FIELD

Engineering Advice by State Employes

In commenting upon the editorial on Engineering Advice in the July number of MUNICIPAL ENGINEERING, Professor G. R. Bascom, municipal and sanitary engineer in the University Extension Division of the University of Wisconsin, department of correspondence study, says:

So far as our experience has been concerned here at Wisconsin, we have had the kindest co-operation possible from the engineering profession, since the writer has been very determined in limiting out work in such a manner that he not only did not interfere with private practice, but he actually promoted work for the engineers in private practice. This is evidenced by the fact that in each case where we have promoted work to actual construction, there has been, at our suggestion, a private engineer retained to take over the work, draw the detailed plans and specifications, and superintend the construction.

Refuse Disposal by Dumping in Omaha

The Editor of MUNICIPAL ENGINEERING:

Sir:—For many years the City of Omaha has disposed of refuse and rubbish by dumping it on low ground in various parts of the city, the most extensive dumping ground being located at the south end of the west arm of Carter Lake, in the vicinity of 8th and Ohio streets.

In 1913 the City Council proposed to issue bonds for the purpose of constructing an incinerator, but when submitted to a vote of the people the proposition failed to carry.

Last summer the people residing in that portion of the city lying to the northwest of the dump at 8th and Ohio streets protested to the council against further use of that site for dumping purposes on account of the offensive odors arising from the refuse, especially during the summer season.

Mr. W. S. Jardine, Superintendent of the Department of Public Improvements then took the matter in hand and arranged to have the refuse and rubbish loaded into cars, hauled out of the city and dumped where it would not create a nuisance and at the same time could be used to fill up low ground. A site was selected for a dumping ground along what is known as Willow Creek Slough northeast of Carter Lake and about four and one-half miles from the center of the business district, partly on the ground owned by the city and partly on private property. Two parallel tracks were laid along the edge of the slough with the idea of moving them over as the filling of the slough progressed. A steam crane was purchased for the purpose of unloading the cars, and it will also be used to move the track as required.

The loading facilities have not yet been developed on account of the difficulty of securing sites of sufficient size that were accessible to railroad tracks. Sites have now been secured, however, and loading docks will be built so that loaded wagons can be hauled up an incline to a platform directly over the cars, the platform tipped and the load dumped into the cars. At the present cars are being loaded from wagons, by hand, at two stations convenient to the business district.

From 25 cents to 75 cents per load is charged for the privilege of unloading refuse, rubbish, etc., into these cars, the charge being approximately 25 cents per cubic yard. The gross earnings per car average about $12.00 and the city pays a switching charge of $3.00 per car from one station and $2.00 per car from the other.

WATSON TOWNSEND,
Engineer, Dept. of Public Improvements,
Omaha, Neb.

Who Can Help Wake Up this Town?

The Editor of MUNICIPAL ENGINEERING:

Sir—It is with regret that I return unfilled blank which you desired to be filled out giving data of improvements from this town.

I am sorry to say that I am living in a town that has no public spirit to reach out and get the necessities in the way of pavement for streets. We have some sidewalk, but it is built by contractors that are not compelled to build to a fixed grade. It is done this way for we have a bone-head mayor and a bunch of aldermen that have no interest in the future of the town.

I will add, however, that a few years ago we did have a progressive set of aldermen and they started the ball rolling in the right line by beginning at the bottom and having a survey of the entire town made. They located a proper drainage system for the town and followed this up with fixed grades for streets, curb lines and sidewalks. They met so much opposition from the mayor and his bunch that the whole outfit resigned with me thrown in. Since then I have not even opened my mouth, but expect to hunt a live town where things are done right and they do more.

This town has built cement crossings that look and act like full-fledged dams when it rains. For this they paid $10,000.00. On top of this they have recently spent $8,000.00 for fire fixtures when there was no need. If they had taken this $18,000.00 and started paving with it, we would still have the fever and be at it now. With this they have a sewer system that is worthless. They have no maps of the line or a profile for same. They don't know whether the line is above or below grade; as for instance, there was a party that wanted to build a nice home close in. The sewerage was supposed to be 9 feet under ground—it was just 2½ feet. And that is the way all our improvements here are being done.

I have been thinking some time that if I could get in communication with some of the paving people I believe I could work up some interest and get some scheme before these people, for if I can get just one block paved, I would not be afraid but that we could keep the good work going.

W.

FIRE DEPARTMENT

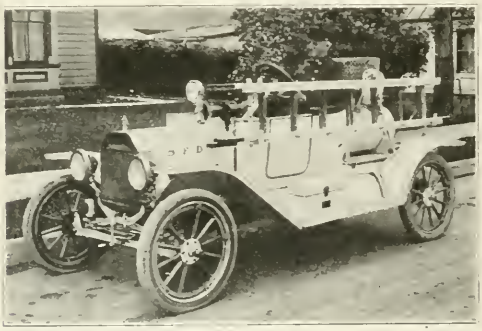
The Ford Metamorphosed

New uses of Ford automobiles are evolving as rapidly as almost-funny Ford stories.

Out in Bozeman, Mont., W. G. Alexander, city fire chief, has taken a standard Ford roadster and, for a total original cost of $900, has developed a car for both inspection and fire-fighting purposes that is satisfactory in every respect.

This outfit works alongside a 90-h.p. combination motor truck and gets to about 80 per cent. of the fires. The cost of upkeep is very small, amounting to only about $3 per month.

The car was purchased from a local garage and the members of the fire department themselves did most of the work of adapting it to the chief's requirements. The tonneau was stripped of the windshield and all unnecessary parts; then was painted white and equipped as follows:

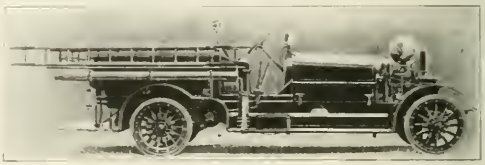


One 30-gallon tank for chemicals taken from an ordinary horse-drawn wagon and attached to the rear of the car; one 3-gallon tank attached to the right-hand running board; one-quart pyrene extinguisher; one chief's portable searchlight; 150 feet of ¾-inch chemical hose in basket; an axe and a crowbar in holders; a dashboard searchlight; one 16-foot extension ladder, fastened on the left side of the tonneau; a drawbar for towing other apparatus if necessary; all electric lights, and an electric siren horn affixed to the dashboard. The total weight is only 2,200 pounds.

Cuban Fire Department Motorizes

It is interesting to note the recent visit to this country of Leopoldo Freyre de Andrade, fire chief of the city of Havana, Cuba. Senor de Andrade made the trip of his own accord and at his own expense in order personally to inspect all different makes and the latest improvements in fire apparatus as shown at the different factories.

His report, after returning to Cuba, advised the purchase of superior apparatus irrespective of its comparative costs



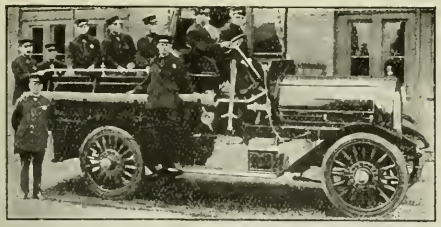
with others, and his recommendation resulted in the placement of an extraordinarily large order, amounting to $80,000.

The outfit purchased included one 1,000-gallon auto fire engine (illustrated herewith) and six 700-gallon motor engines, together with two chasses, upon which the Havana fire department will attach ladders. The order also calls for a special squad wagon, all of the machines being made by the Ahrens-Fox Fire Engine Co., of Cincinnati, O.

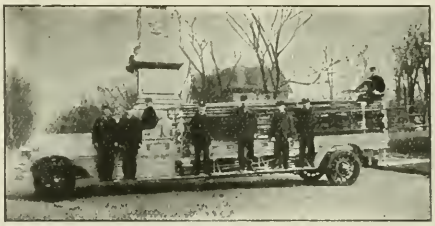
New Type Engine for Ligonier

A different type CH-40 combination chemical and hose truck has just been delivered to the city of Ligonier, Ind. The machine is one of the latest models built by the South Bend Motor Car Works, South Bend, Ind., and is equipped with a hose body capable of carrying 1,000 feet of 2½-inch standard rubber-lined fire hose, a 30-gallon chemical tank, 200 feet of chemical hose, one 12-foot roof ladder and one 24-foot extension ladder.

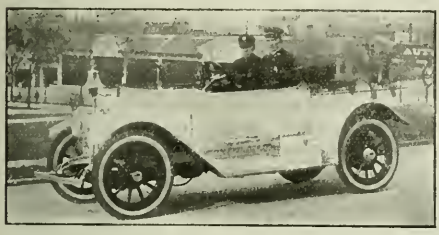
This car is capable of making from 30 to 40 miles per



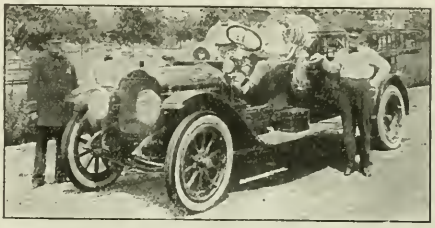
NOTT COMBINATION ENGINE HOSE, CLEVELAND, ON GOODRICH TIRES.



SEAGRAVE COMBINATION HOOK AND LADDER AND HOSE, DAVENPORT, IA.



CHIEF JOHN F. HEALEY OF DENVER ON "SAFETY TREADS."



WHITE COMBINATION ON SILVERTOWNS, TERRE HAUTE, IND.

hour under full load, it being equipped with a 40-h.p. 4-cylinder motor and mounted on 37 by 5 Goodyear pneumatic tires. It is of the worm-drive type and also carries a full quota of fire-fighting equipment.

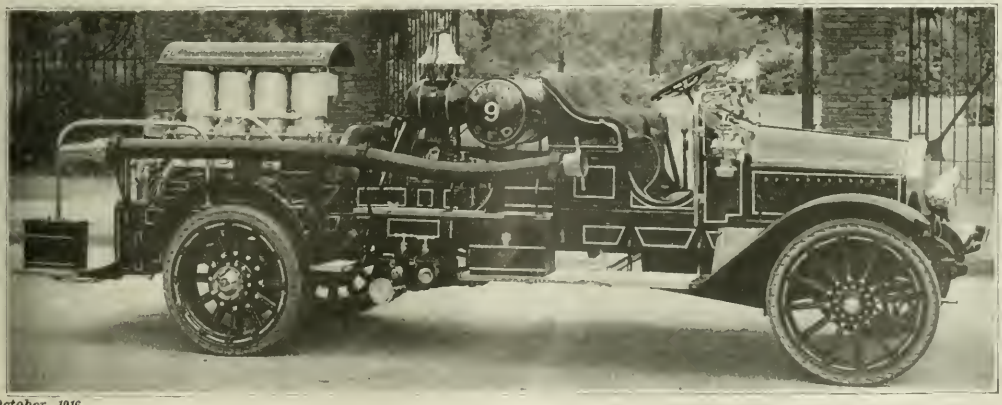
New Mack Pumping Engine

On a 1½-ton worm-drive Mack chassis, 144-inch wheelbase, the Schenectady fire department has mounted a 4-cylinder Schenectady Westinghouse 4-cycle, 6-inch bore by 7-inch stroke gasoline pumping engine in connection with a rotary pump. The engine is mounted on a sub-base which is attached to the frame. The motor is started by a Westinghouse starter. The motor developes about 60 to 65-h.p. Capacity discharge per minute is 732 gallons. With just one stream working it will throw the water 210 feet and with all three streams working it will throw the water 180 to 190 feet each. The longest distance they ever pumped was one stream 1,600 feet. Last winter, with the thermometer registering 15 to 17 below zero, the pump worked for 7½ hours without stopping, throwing two streams of water, each thru 800 feet of hose. On this particular fire the two steam engines which were working alongside of the Mack apparatus continually froze up and they had all they could do to keep one feeble stream apiece on the fire.

It took $40 worth of fuel to keep the steam engines working the 7½ hours, whereas the Mack did more than double the work on 13 gallons of gas and two quarts of oil, at a cost of a trifle over $3. The engine and equipment weighs a trifle over 4,000 pounds. The job is geared 7¾ to 1 and has attained a speed of 32 miles per hour with this ratio. It is very powerful and had very little difficulty in plowing thru the snow last winter, which was the severest they have had in that section in twenty-eight years.

The hose used is 3-inch and 2½-inch. For the first 250 feet next to the engine the 3-inch is used; from that on the 2½-inch is used.

The gasoline engine and equipment were formerly mounted on a horse-drawn apparatus and the change-over was made by the chief engineer of the Schenectady fire department.



AHRENS-FOX PUMPING ENGINE IN NEW YORK ON GOODRICH TIRES.

Motorizing Horse-Drawn Equipment

The passing of the horse in fire department work is inevitable. The quicker, surer methed of transporting fire apparatus on motor equipment has been the means of saving many lives and millions of dollars in fire losses in American cities during the past year.

"The constant care which horses require," says Geo. W. Cushing, sales manager for the Federal Motor Truck Co., "the expense of feeding, shoeing and veterinary services, together with a fast depreciation under hard service in the cities and comparatively higher cost of maintenance in the smaller towns where the alarms are less frequent, have always been large factors in the rapid changing over of this equipment to the motor, which requires very little attention and is of absolutely no expense, except when in actual operation.

"The transition from horse-drawn to motor fire equipment need not be necessarily very expensive as was demonstrated by the city of Albany, N. Y., which not long ago took an old combination hose and chemical horse-truck, made slight and inexpensive changes in the model in order to make it conform closely to several new pieces of recently purchased motor fire apparatus, added a few small accessories and had the whole adapted to a Federal motor chassis. As a result the city of Albany now has in its old truck a new, strictly modern unit which is strong, reliable, speedy and up to the minute in every respect.

"Many other cities thruout the country have motorized their fire departments in the same manner and today are enjoying all the benefit and economy of motor apparatus that otherwise possibly would have been beyond their reach financially, or at best would have cost them two or three times as much."

In many cases the cost of changing over has been even less than in Albany, because without making any changes whatever in the body equipment they have simply transferred it to a motor truck chassis, involving only a few hours' labor of some local wagonmaker and a small amount of timber for bolsters, sills, etc. The effect is wonderful not only in appearance and efficiency of the machine, but in the men whose duty it is to respond to the alarm.

One of the first cities in this country to adopt this practice was Lynn, Mass., which, like Albany, has a population of some 100,000 people, and is thoroly up-to-date in every respect. Its fire department is now completely motorized and includes six motor chassis, on which have been mounted hose-chemical and turret-truck bodies and equipment. Chief Edward E. Chase says his trucks are giving the best of satisfaction and the saving to the taxpayers has been several thousand dollars.

How different this foresight from that of other municipalities where horse-drawn equipment which, with a few small changes, could have been made the equal of any, has been discarded as junk or traded in at a very small proportion of its actual worth. We do not believe that this has been a wilful waste of money on the part of the men who have handled these matters, but due solely to the fact that they do not realize what very satisfactory and efficient motor apparatus may be made from their present horse-drawn equipment, by simply transferring it to a fire chassis.

MUNICIPAL ENGINEERING will be very glad to furnish instructions and estimates for making changes of this character to any city or fire company that is interested in obtaining the maximum fire protection at a minimum expense.

NOTE THE CHIEF'S MOST ACTIVE HELPER, STANDING TO HIS LEFT.

Unusual Record Made by Motor Fire Engines

A remarkable showing was made recently at Chicago during a competitive test of motor fire engines. An engine equipped with a double-action piston pumping unit succeeded in delivering a stream of water at the roof of the Masonic Temple (354 feet above street level), at a nozzle pressure of 230 lbs. per square inch.

The machine making this record is a distinctive design, the multiple pump being mounted at the extreme front of the chassis, directly in front of the motor. The clutches and transmission elements are separate and power is derived from both ends of the engine's crankshaft.

One of the most interesting points about the engine is the method used to cool it at the same time it is driving the pump. A series of looped tubes is attached to a bronze junction box and extended into the suction chamber. As the water from the radiator circulates thru these pipes, it is cooled by the

volume being discharged from the pump. This cooling process can be regulated by either increasing or decreasing the flow to the loops. This is both convenient and efficient.

The car, which is made by the Ahrens-Fox Fire Engine Company, of Cincinnati, O., has a wheel base of 171 inches. Its engine is capable of developing 100-h.p. and a road speed of approximately 30 miles per hour.

Alcohol a Substitute for Gasoline

By Dr. F. E. Young, Canton, O.

Only a few years ago gasoline was an outcast, a commercial waif, a foundling without a friendly doorstep to receive it; today it is King of the Road and shares public interest with "war brides" and other favorites of the commercial world. So rapid has been the increased demand for gasoline that the question of either increasing the supply or finding a suitable substitute has engaged the attention of many experts. Practical men think that the day for gasoline under 25 cents is fast passing and even higher prices may be looked for.

Ultimately there must be found a substitute, and alcohol looks most promising. That will be another necessity of life for the farmer to furnish.

Since 1910 the number of automobiles in use has been multiplied by six and now there are 2,250,000, with about a million added annually. There are about 300,000 motor boats and 700,000 gasoline engines doing farm and factory work.

The demand for gasoline is increasing by leaps and bounds, while the supply of crude oil is actually diminishing. A year ago the great Cushing oil field in Oklahoma was producing over 300,000 barrels of petroleum daily; now it is turning out less than 100,000, higher in gasoline than any other oil in the world.

Before the war we were exporting about 100,000,000 gallons and now about four times that amount annually, about 40 per cent. of the entire production. The United States produces about 65 per cent. of the petroleum and gasoline of the world.

While the production of crude oil has decreased, the supply of gasoline has been increased by new and improved methods of manufacture and by lowering the quality, so that instead of 4 per cent., a yield of from 20 to 40 per cent. is now obtained, of 58 to 60 deg. test instead of the former 72.

The earlier development of kerosene for lighting purposes and the Civil War tax on alcohol drove a colored alcohol mixture used as a lighting fluid from the market. The kerosene oil at first was so volatile that many fires and explosions occurred, and the light boiling fraction had to be taken out. At first they took off only from 2 to 4 per cent. of this gasoline, which they ran into the nearest stream, where it was not only a waste but a nuisance and a menace.

Inventors found methods of utilizing it in the gasoline lamps and stoves and other uses, but the production had to be held down until the internal combustion engine appeared, just in time to offset the introduction of natural gas for household purposes.

Shortly the automobile began to increase the demand until the infant terror of the oil industry has pushed King Kerosene from the throne and has now become the Czar of the whole empire of petroleum commerce and there are few who do not stop at the sign of the garage pump to pay him tribute.

The element of distribution is most important in any motor fuel to come into general use. Gasoline, produced in large quantities only at certain centers, must be transported long distances, to many points of distribution. The present efficiency and economy of gasoline distribution are simply marvelous. You can find a supply at nearly every cross roads, at almost every farm house and there is hardly a port into which the motor boat may chance to poke its nose, where it will not find a supply of this fuel awaiting the demand of the consumer.

A substitute, however, that can be made in any locality, from native material at small factories, will not need such an extensive and elaborate system of distribution nor extended transportation.

Alcohol can be produced wherever any form of vegetable matter can be obtained; in cities and densely populated localities the demand for motor fuel is the greatest, and fortunately the materials for making it from market, trade, and factory waste are most plentiful.

The largest alcohol producing plant in the world is now being built at Baltimore, Md., to take, at a cost of less than $4 a ton, the waste molasses from the West India sugar factories, heretofore run into the water to get rid of it, but now to be utilized, the entire output of alcohol for the coming two years being already sold to the warring nations of Europe. The cost of working will be less than $3 per ton, making the entire cost $7. The yield per ton of molasses is from 150 to 180 gallons. Alcohol is now worth about 65 cents per gallon, a profit of about $100 per ton of molasses.

Cities are destroying thousands of tons of garbage at great expense that would yield, by proper treatment, from 10 to 15 gallons of alcohol per ton, besides other valuable by-products, sufficient to pay for the reduction, leaving the alcohol as clear gain.

New Orleans being the principal port of entry for the banana trade has 2,000 tons of banana waste yearly to dispose of, which is rich alcohol material, but is now dumped into the water along with the city garbage. The sugar factory and cannery waste, the farmers' cull fruit and potatoes, the lumbermen's and pulp-mill waste should all be utilized. About 1,000,000 tons of wood pulp are made in the United States and Canada yer year. The woodsman wastes about one-half in chips, stumps, tops, and culls. The pulp mill

wastes about one-half of its receipts of wood in the removal of the bark, knots and heart wood. About half of the wood actually treated is dissolved and washed away in the waste liquors, so that 7 tons of wood are destroyed to get 1 ton of pulp.

From 15 to 20 gallons of ethyl alcohol can be made from a ton of wood waste, or over 100,000,000 gallons of alcohol, besides other valuable by-products from the total wood pulp waste. The lumber industry probably wastes as much more. Broom-corn and sugar-cane seed and cotton stalks can all be utilized. The vast kelp beds of the Pacific ocean that are to be harvested for the manufacture of potash will at the same time furnish an immense supply of alcohol.

So long as alcohol is made only from whole grain at large central distilling plants, or its manufacture from otherwise waste material, as the waste molasses, is controlled by the same interests that produce the gasoline, the production can be held down, so that the price may be held up.

The column still is continuous, has great capacity and concentrates the alcohol to the required strength at one operation, but it is in the control of the same interests, and the government requirement of 180 deg. proof or 95 per cent. pure, has heretofore required the use of that still. With the old pot still, at least three distillations are required to make 95 per cent. alcohol, so it cannot compete with the improved still.

Process and apparatus have been perfected whereby alcohol can be made of the required strength by small or medium sized plants from cheap and otherwise waste material found in every locality. The saving in cost of material, transportation of the material to the distant distilling plant, and return of the alcohol to the point of consumption, will give the advantage to the small or local alcohol distilleries. It is to such plants that we must look for the production of a sufficient supply to bring down the price of alcohol so as to compete with gasoline. This was exactly what was contemplated by the United States Congress when it passed the Industrial Distilleries and Denatured Alcohol Acts. Releasing industrial alcohol from the internal revenue tax was meant to encourage the manufacture so that it would become plentiful and therefore cheap, as is the case in some foreign countries.

That alcohol is the best substitute for gasoline as a motor fuel, is well shown by the United States Agricultural Department and Bureau of Chemistry in a number of bulletins for free distribution. Alcohol can be used in the gasoline engine without any change in the engine, but for regular use it should be given more pressure in order to secure the greatest efficiency. It can be mixed with gasoline in any proportion; it is not explosive and should it become ignited the fire can be easily extinguished with water.

The high cost of alcohol is the only thing that prevents it becoming the universal motor fuel. Each community can now make its own alcohol, which will solve the distribution problem, at the same time that it utilizes its waste materials. Industrial alcohol and other by-products afford a great opportunity for conservation and the profitable employment of capital.

Cost of Quarry Blasting

The blast made recently at the quarry of the Colorado Portland Cement Company, Portland, Col., with Monobel No. 6, shows that excellent results can be obtained with this explosive in quarry work.

The quarry face at Portland is from 39 feet to 49 feet high. The stone consists of homogeneous layers of limestone varying in thickness from 6 to 28 inches and separated by thin layers of shale varying from nothing up to 6 or 8 inches thick. The stratification is flat and the quarry floor practically level.

The blast consisted of 44 holes, arranged in four rows, each hole drilled 2 feet below the quarry floor level.

The charge of powder in the first row was figured for 2¼ cubic yards of stone per pound, there not being any burden in front at the bottom. Holes in the rear rows were loaded for 2 cubic yards per pound of explosive, to obtain a better shattering effect.

The following summary gives in detail the cost of preparing and firing the whole blast:

Number of holes	44	
Spacing average	20 ft.	
Burden average	20.6 ft.	
Depth average	45 ft.	
Tons of rock broken	61,182	
Cubic yards	30,213	
Cost of drilling (labor)		$ 261.89
Cost of drilling (power)		24.00
Total cost of drilling		$ 285.89
Total feet of hole	2,094	
Cost per ft. of hole (drilling)		$ 1317
Cost per ton of rock (drilling)		.0064
Charge of powder per hole	265 lbs. to 425 lbs.	
Amount of Mon. powder in shot	14,850 lbs.	
Amount of Giant powder in shot	100 lbs.	
Cost of 44-42 ft. fuses @ $0.1818		$ 8.13
Cost of 9-36 ft. fuses @ $0.1632		1.47
Cost of Mon. @ $0.125 including freight		1,826.25
Cost of Giant @ $0.115 including freight		11.50
Cost of shot (powder and fuse)		1,852.39
Cost of shot (drilling and loading)		325.64
Total cost of shot		$2,178.03
Cost per ton of rock (powder and fuse)		$ .0302
Cost per ton of rock (drilling)		.0046
Cost per ton of rock (loading)		.0006
Total cost per ton of rock		$ .0354
Number ft. of powder in all holes	1,294	
Number pounds of powder in shot	14,850	
Number of pounds of powder per ft. of hole from 5⅞-in. bit	12.25	
Amount of rock broken per pound of powder:	4.0 tons. 2.03 yds.	

Results:

Shot appears to have broken up very good.

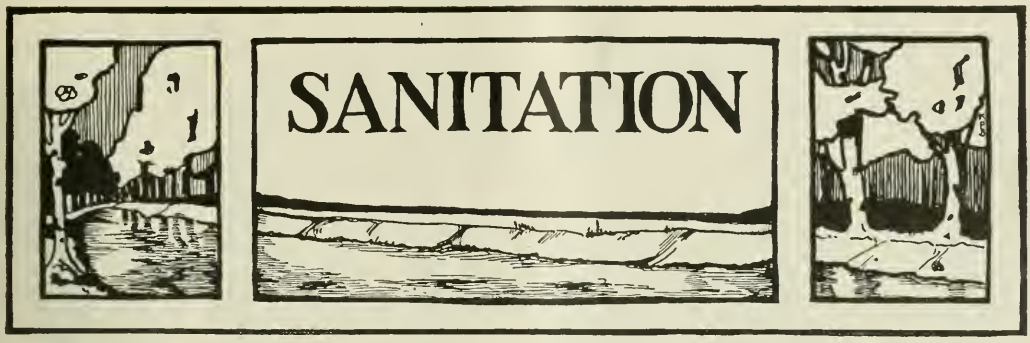
Motor Vehicles in Minneapolis

The city of Minneapolis owns 58 motor vehicles and makes monthly allowances for maintenance of 12 individually owned automobiles. They are distributed among the departments as shown in the accompanying table:

	Owned by city	Owned by individuals for which a monthly allowance is made for maintenance
City Engineer's Department	12	2
Water Works Department	6	..
Fire Department	10	..
Police Department	10	..
Street Lighting Department	..	1
Board of Education	3	6
Board of Charities and Corrections	6	2
Library Board	2	..
Park Board	9	1
Total	58	12

Fire Department Notes

J. H. Harrison, chief of the Brunswick, Ga., fire department, has been a fireman for thirty years and has been chief of the department since 1910. Since becoming chief, he has discarded the horses for motor apparatus, thus effecting considerable saving for the city. The report of the Fire and Building Permits Committee states that a feed bill of $868.86 will be replaced by a gasoline and chemical bill of $200.00.



Vacuum Street Cleaning in St. Louis

For sixty days in June, July and August the street division of the Department of Streets and Sewers experimented with a vacuum street cleaner plant, consisting of two machines, a patrol machine for cleaning the main part of the street and a gutter machine for cleaning the gutters.

C. M. Talbert, director of the department, has made a report upon the work done, from which, and a letter from the director to the editor, the following is abstracted and extracted:

Close observations made of the work of the machines warrant some conclusions and a comparison of the cost of the work with the method in use for some years past. Among the things which can be said in favor of the work of the machines, are:

First: A very complete removal from the street surface of all foreign matter and particularly what is known among those who study street refuse as "dust," this being the very fine and at times impalpable particles which lie close to the surface of the pavement and which have been found by bacteriologists to be the germ-carrying part of street refuse.

Second: By cleaning these streets every night, the department has been enabled to eliminate street sprinkling entirely. There has not been on the streets of the downtown section any sprinkling since about the first day of July. Those street sprinklers made from six to eight trips each business day over each of the downtown streets and their very slow movement and the fact that they must take the center of the street in order to properly cover the surface, complicated the traffic problem.

Third: This absence of the street sprinkler leaves a dry, clean surface for traffic and in these days when probably 75 per cent. of this traffic is automobile, it adds greatly to safety by eliminating the tendency to skid; the report of the police and others interested in traffic shows that there has been a great diminution of accidents from such causes during the past thirty days. There must also be considered the general inconvenience to pedestrians from the sprinkler sprays.

Fourth: As would naturally be expected, the use of the vacuum system has materially reduced the labor necessary to keep clean the sewer inlets and catchbasins. The superintendent of sewers reports a reduction in material removed of about 35 per cent. This proportion will be increased still further as the system becomes established and it is anticipated that the expense of cleaning sewer inlets will be reduced about 50 per cent. It has also very materially reduced the number of complaints of stopped or blocked sewers.

Fifth: From an examination of material taken from the streets, it does not appear that the asphalt surfaces are sensibly worn by the brooms.

Sixth: The more complete removal of dust and dirt from the streets reduces the work of the white wings and while they have not been reduced in number during the experimental period, it is certain that some reduction could be made. It will always be necessary in any system of street cleaning to have white wings in the congested district during the business hours.

Among the disadvantages, is the inability to use the machine under any other conditions than when the roadway and gutter are perfectly dry. During our experimental run of sixty days there have been six nights on which work could not be successfully done. It would appear to me likely that during the rainy season, that is, from the middle of March to the first of June, it would be necessary to use some form of street flushing at least twice per week. This is largely a matter of guess, as no two seasons are at all alike. There have

ELECTRIC DRIVEN STREET SWEEPER AND SPECIAL WAGON FOR RECEIVING SWEEPINGS TO TRANSPORT TO DUMP. WHEN IN OPERATION THE TWO UNITS ARE CONNECTED AND THE AIR PASSAGE, ENDS OF WHICH ARE SEEN NEAR TOP, IS CONTINUOUS.

DATA COVERING SWEEPINGS ON 140 BLOCKS, JUNE AND JULY

JUNE —1916—				JULY		
Date	Gutter Machine Cubic Yards	Center Machine Cubic Yards	Date	Gutter Machine Cubic Yards	Center Machine Cubic Yards
June 1	3.37	1.80	July 1	3.08	2.18
2	1.00	1.90	3	2.68	3.19
3	3.92	2.56	4	1.00	2.11
5	Rain		5	2.48	1.08
6	Rain		6	2.48	2.00
7	1 hour only		7	3.08	2.18
8	1.48	1.38	8	3.08	2.18
9	3.37		10	3.78	2.18
10	3.68	.22	11	3.68	3.06
12	1.58	1.58	12	3.37	3.96
13	1.36	3.18	13	2.50	3.78
14	2.92	2.18	14	3.40	3.98
15	1.18	2.18	15	3.06	2.77
16	3.08	2.18	17	3.48	2.58
17	3.38	2.18	18	3.51	2.78
19	1.18	3.38	19	3.51	2.18
20	3.68	2.18	20	3.48	3.68
21	3.37	3.37	21	3.06	2.18
22	Rain		22	2.78	2.03
23	2.18	3.92	24	3.08	2.00
24	3.18	2.18	25	3.62	2.78
26	1.99	2.18	26	3.68	2.79
27	3.51	2.18	27	2.18	1.75
28	2.98	2.98	28	2.98	2.40
29	2.62	2.18	29	2.98	2.40
30	2.18	2.00	31	3.68	3.08
	78.49	54.19		82.69	67.28

SUMMARY

June Cleaning	132.98	Cubic Yards removed, or	226,066	Pounds
July Cleaning	149.97	Cubic Yards removed, or	254,949	Pounds
Total	282.95	Cubic Yards or	181,015	Pounds
June Cleanings	22	average per cleaning	6.04	cu. yds. or 10,268 Pounds
July Cleanings	26	average per cleaning	5.77	cu. yds. or 9,809 Pounds
Total	18	average per cleaning	5.89	cu. yds 10,013 Pounds

REMARKS

On July 3rd it rained until 9 P M. Machines started cleaning at 1:30 A. M
On July 12th it rained from 4 to 6 P. M. Machines started cleaning at 8:15 P. M.
On July 19th there was a heavy rain fall of .81 inches from 2 to 3 P. M. Machines started cleaning at 7:30 P. M.

been periods wherein the vacuum cleaner could undoubtedly be used a good portion of the time, even in the month of March, which is one of our most troublesome months on account of the prevalent high winds. It must be borne in mind that the same rain that would stop the work of the vacuum cleaner would have a tendency to wash the dust into the sewer or if not heavy enough for that, to eliminate it thru a natural sprinkling.

The owners of the machines desire to contract for the street cleaning and have refused to sell or lease any of the machines, basing their refusal upon their claim that they are more interested than anything else in the success of the machine and that their men are trained especially for this work; that failures in other machines of like character that have been placed upon the market from time to time have been largely due to placing their operations under men who are not vitally interested in their success.

They propose to charge 80 cents per 10,000 square feet of street actually cleaned, with no payment for days when work cannot be done.

At the present time, we are cleaning approximately 174 great squares, which would cost $140. Assuming 120 days of work for the remainder of the fiscal year, we have $16,800, which equals the cost for cleaning the entire district six nights per week during favorable weather for the remainder of the year.

As against this payment, to clean the streets during this period by our ordinary process of flushing once each week, the cost would be 34 times $124, or $4,216, or a net increase in cost to the street division of $12,600.

To be credited in crews picking up papers, etc.	$1,800.00
Withdrawal of sprinkling taxes for eight months (reversion to Municipal Revenue)	4,000.00
Cost of water for sprinkling and flushing	1,500.00
Saving in inlet cleaning	400.00
Total	$7,700.00
Leaving a net increase of municipal expense for this cleaning of	$4,900.00

In conclusion, it may be said that during this period since the sprinkling wagons have been removed and the vacuum cleaning instituted, there have been no complaints of dust or dirt in the congested district and this department has received numerous verbal commendations upon the changed conditions as well as having on file a number of letters from merchants, stating that conditions so far as dust is concerned have been improved.

A contract on the terms given is recommended by the Director.

Since the report was made some examinations have been made of the materials collected by the gutter machine and the patrol machine and the details of the materials collected by each, which shows that approximately 60 per cent. of all street dust is found within 8 feet of the gutter and that by far the greater part of the coarse dirt is collected from the gutter. Three classes of districts are compared as follows:

First: On thorofares traveled practically exclusively by automobile, street dust passing a 200-mesh sieve amounts to 5.8 per cent. and that retained 94.2 per cent.; total, 100 per cent.

Second: With mixed automobile and horse-drawn vehicles, steel tired, dust passing a 200-mesh sieve amounts to 10.9 per cent. and that retained 89.1 per cent.; total, 100 per cent.

Third: On streets used almost exclusively by horse-drawn rubber-tired vehicles, dust passing a 200-mesh sieve, amounts to 30.6 per cent. and that retained 69.4 per cent.; total, 100 per cent.

SHOWING LAYERS OF STREET DIRT AS DEPOSITED IN BOX BY THE AIR, WHICH CARRIERS THE SWEEPINGS TO THE BOX.

It would appear from this that the very fine dust is collected on streets that are subjected to steel tire traffic and the steel shoes of horses, and that the automobile traffic tends rather to leave the dust in coarse particles.

The preliminary bacteriological examination showed that the gutter dust contained 270,000,000 germs per cubic centimeter and that the dust from the center of the street contained 249,000,000 germs per cubic centimeter. The city bacteriologist is making a further detailed study of the samples submitted.

The work will be continued for a period of at least three months and additional interesting information is expected. The Way-Cleanse Company, of Sandusky, O., own the machines and are operating them on the St. Louis streets.

The accompanying table shows the results of each day's work with each machine on the days in June and July on which it was operated.

Proportioning Waterproofing Material in Concrete

The usual specification for using a paste waterproofing states that a certain amount by volume shall be mixed with a certain number of parts of water. This mixture is then to be used in place of clear water for tempering the cement and aggregate.

Since the amount of water used for each yard varies from 25 gallons to 40 gallons, so also will the amount of waterproofing per cubic yard vary. For example, we will take a waterproofing that is used in the proportion of one part by volume to 36 parts by volume of water. If 1 gallon of waterproofing was mixed with 36 gallons of water there would be a total of 37 gallons of waterproofing mixture to be used the same as clear water for tempering the cement and aggregate. Assuming that the waterproofing weighs 8 pounds per gallon, then every gallon of mixture would contain 1/37 of 8 pounds, i. e., 0.216 pounds of waterproofing. The contractor using 25 gallons of water per cubic yard will use 25 times 0.216, or 5.4 pounds of waterproofing, in every yard, while the contractor using 35 gallons of water will use 35 times 0.216, or 7.5 pounds of waterproofing, in every yard. This would mean that one man is using too little or the other too much. It demonstrates that uniform results cannot be obtained by mixing the waterproofing as specified above. It is necessary, instead, to specify that a certain number of pounds of waterproofing shall be used per cubic yard and then introduce that number of pounds regardless of variable factors.

A method has been worked out by which this may be accomplished easily and simply, which has been used very successfully on several large operations, including the Rochester sewage disposal plant, Bevis Hill reservoir at Schenectady, New York, Omaha reservoir, and others.

One of the most interesting was the Rochester sewage disposal operation, on which Trus-Con waterproofing paste, concentrated, was used. There were several large concrete tanks which had sloping bottoms. A concrete of moderately dry consistency (28 gallons of water per cubic yard) had to be used on the bottoms, and the side walls were poured with a concrete of wet consistency (35 gallons of water per cubic yard). Mr. Poole, chief engineer, was very anxious that the concrete should be uniformly waterproofed and, of course, this could not be done by mixing one part of paste with 36 parts of water. Also, the contractors had bid a certain amount per yard for waterproofing and they had to be assured that they would not use a greater amount than that specified. It was decided that 6 pounds of paste per cubic yard was sufficient for this job, and it was introduced as follows:

The head was knocked out of a barrel of paste and half of it removed to an empty barrel. About five gallons of water was added to the half barrel of paste and the mixture was stirred thoroly. The object of this stirring with a small amount of water is to prevent the formation of lumps, which are liable to occur if all the water is added at first.

When this has been thoroly stirred to a smooth consistency, more water is gradually added while stirring until the barrel is full. This gives a thick, creamy mixture containing one part of paste and one part of water. The paste weighs 8 pounds per gallon. So every gallon of one-to-one mixture contains 4 pounds of waterproofing paste. Since 6 pounds of paste was to be used in every yard, 1½ gallons of the one-to-one mixture was necessary. The mixers used were of ¾ yard capacity, and so in every batch there was used ¾ of 1½ gallons, or 9/8 gallons, of the one-to-one mix. A measure was made which held just the correct amount for one batch, and the workman filled this and dumped it into each batch as the cement and aggregate were added. This insured that 6 pounds of paste would be introduced into every yard of concrete, regardless of the number of gallons of water used. Each night

ROCHESTER SEWAGE DISPOSAL PLANT. SHOWING SLOPING TANK BOTTOMS WHERE RATHER DRY MIXTURE HAD TO BE USED, WATERPROOFED WITH TRUSS-CON WATERPROOFING PASTE, CONCENTRATED. C. ARTHUR POOLE, SUPERVISING ENGINEER.

the number of yards of concrete and the number of pounds of paste used were accounted, giving a check on amount. This was a good safeguard. On the first day's run it was found that each batch was running a little over ¾ yard, and on the next day a slightly larger amount of the paste mixture was added.

When this specification was first advocated there was fear that the waterproofing would not uniformly distribute itself when added in such a concentrated form directly into the eye of the mixer. But the method has been used on any number of operations, both large and small, with perfect success. Even when the concrete is hand mixed this method gives perfect results. It stands to reason that if a concrete mixer will make a homogeneous mass of cement, sand, stone and water, that it will also uniformly distribute a waterproofing which in itself is mixable with water.

This method is very easy to use. All that it is necessary to know is the number of pounds to be used per yard and the capacity of the mixer.

This method has several advantages over other methods. A barrel of one-to-one mixture will last a half day on an ordinary operation, which means a saving because an extra laborer will not be required for mixing the waterproofing. The job can be figured to within a few pounds of the amount needed and the contractor can figure his waterproofing bid more closely. The architect or inspector can check the contractor at any time by recording the number of yards of concrete poured and the number of pounds of paste used.

The paste in the one-to-one mixture does not separate out very rapidly, but it should be stirred every time before taking out a measure full. Usually one stroke of the paddle is sufficient to keep a uniform mixture.

An illustrated description of the design of the Rochester sewage disposal plant will be found on page 181 of the May number of MUNICIPAL ENGINEERING, to which reference may be made for further details. We are indebted to *Structural Conservation* for the cut and data.

Motor Traffic in Seattle

In Seattle, Wash., official checks at seven points, taken at stated intervals, showed 5,160 motor vehicles in 1911 and 17,568 in 1915, an increase of 222 per cent. in motor traffic. Horse-drawn traffic decreased from 8,266 in 1911 to 3,261 in 1915, or 60.5 per cent. The total increase in traffic is 55 per cent.

The state records show that 9,540 licenses have been issued for Seattle motors, 1,329 of which are auto trucks in use by owners, and 305 are auto trucks for hire, or nearly 17 per cent. of the motor-driven vehicles owned in the city are motor trucks.

ROADS AND PAVEMENTS

Street Railway Track Laying

The Chicago surface lines are relaying their double track line on Lawrence avenue, between Kedzie and Cicero avenues, in preparation for the paving of the street. A 24-inch water pipe is being laid also as rapidly as the track construction is completed. The old roadway was almost impassable except on the street railway tracks, which had 5-inch light rails laid on sawed yellow pine ties set about 2 feet between centers. Most of these ties, when taken up, are in very fair condition. The street railway area was paved with rather small and irregularly shaped granite block on sand cushion, the upper surfaces of which had rounded off so as to make the pavement quite rough.

To remove the old roadbed the old rails are first lifted up by means of jacks inserted under them, and they bring most of the ties and paving blocks with them. The old tie rods are knocked out, the rails are pulled out one by one by a team, and the stones and ties are thrown out, requiring very little work with the pick, the lifting of the track by the jacks giving sufficient looseness to the blocks and their foundation.

The subgrade is then plowed and shoveled out into wagons. The subgrade is then trimmed flat and rolled with a 4 or 5-ton roller running in the trench. The new sawed yellow pine ties are laid on blocks 4 inches thick, 2½ feet between centers, and the new grooved 7-inch rails are spiked to the ties. Then blocks are placed under the rails, about three to each rail length, and the blocks are removed from under the ties. This leaves a full open space under the ties 4 inches high, into which concrete is filled and carried up to a level about 1 inch above the top of the ties. The blocks under the rails are left in to hold the rails up until the concrete has set, and then they cannot be removed. Universal cement, sand and broken stone form the concrete. When special temporary filling is required for cross-overs and tracks to use during construction, crushed slag of three sizes, 1½ inch, 1 inch, medium and dust, was used, tamped into place, with some sand for filler.

The north track was first constructed and put into use, and then the south track. In joining up the concrete for the second track with the older concrete, a slight valley was left about half way between the tracks. In this valley a copper wire cable for return current was laid and covered with cement mortar.

The rails of each track are connected with strap ties, with the flat side vertical, spaced about 6.5 feet apart. A sand cushion of about 1¼ inches is spread on the cured concrete and the blocks are laid on this. The blocks of dark gray granite, most of them, and about 6 by 6 by 8 inches in size, are laid on this cushion carefully to give as uniform a top surface as possible. They are carefully cut and make joints less than ½ inch in width, and are fitted in carefully between the strap ties, so that the surface of the completed pavement does not show the location of the ties.

The blocks are grouted with cement, are then thoroly tamped into bearings, and the joints are again grouted and the grout swept in until the joints are thoroly filled. Sand is then scattered thinly over the surface.

The rail joints are laid opposite, the joints being made with tie plates about 18 inches long, bolted with one bolt to each rail. The cross-ties are set about 12 inches apart at these joints so that the tie plates ordinarily extend over cross-ties at both ends. The spaces at the rail joints are left unpaved until the rail joints are welded, and then the pavement is completed. It is scarcely possible to find the junctions of the rails anywhere in the completed structure.

Most of the work is done by the Chicago Surface Lines by day labor. The Citizens' Construction Company has a contract for removing the earth to make room for the new foundation. The company uses a small concrete mixer, mounted on a car, which follows up the concrete work on the track being laid as rapidly as is necessary. Materials are brought in on small dump cars hauled by electric motors and dumped at convenient places along the line. One line is kept open for regular passenger travel, delays of traffic being but little more than those due to operating a fairly busy line on one track without turnouts for a mile or so.

Concrete Roads and Streets

Figures recently furnished by the Road Bureau of the Portland Cement Association indicate that in five states contracts have so far been awarded this year for 1,000,000 or more square yards of concrete pavement. The states and figures are as follows:

Illinois	1,412,789
Ohio	1,391,430
Indiana	1,342,095
New York	1,150,304
Iowa	1,000,291

Michigan, Wisconsin, California and Texas are making good strides toward the million mark, as indicated by the following figures, although it should be mentioned that the records of California were not complete when totals were made up.

Michigan	606,112
Wisconsin	546,203
California	448,749
Texas	530,470

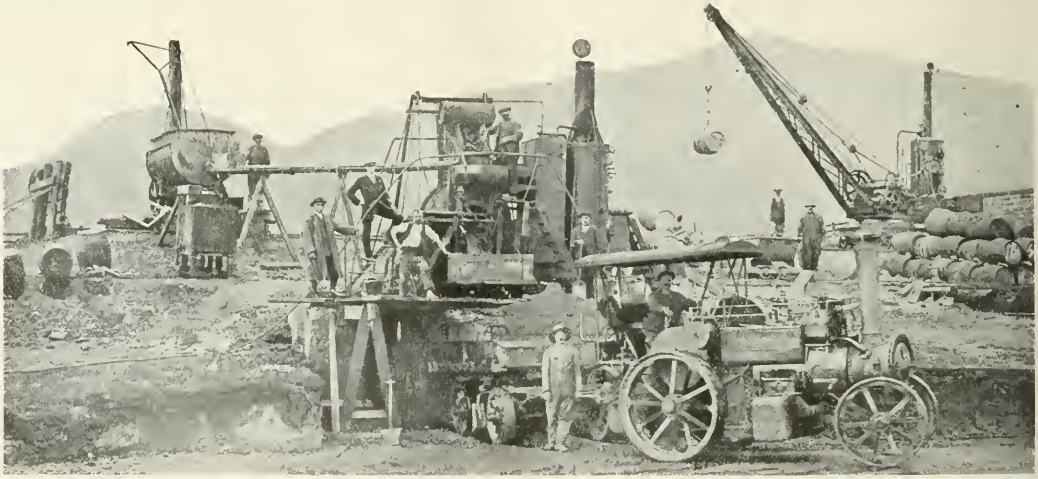
It is interesting to know that most of the yardage in Iowa is for city streets, while the greater portion of the yardage in other states is for country highways.

Tar-Macadam Paving in County of Clackmannanshire, Scotland

This article comprises a most instructive account of the manufacture of tar-macadam at the county depot of Clackmannanshire, Scotland. Mr. Jno. C. Alford, the county surveyor, furnishes some interesting figures as to costs, and we would especially draw attention to the fact that no young men are employed, the average age being fifty-seven years. This has only been possible owing to the careful way in which the plant and general arrangements have been planned by him, and the county is certainly to be congratulated on the general efficiency and low cost of production, especially in view of the natural difficulties to be contended with and the good wages paid.

The county council have recently abandoned their old quarry, which was situated at the west end of Tillicoultry, a town lying on the southern slope of the Ochil Hills, which form the northern boundary of Clackmannanshire. The isolation of this old quarry from the neighboring ones, together with the natural barriers surrounding it, which caused long detours to be made in order to reach the principal highways of the county, and the fact that the town folk passing thru the town, were responsible for the council deciding to look around for a spot more central which would be within easy access to the neighboring quarries, which supply the rubble and other metal for the road work, and which would also shorten the journeys of the tractors to reach the chief roads of the county.

Eventually the present depot, known as Bankhead stone depot, was set up, this occupying a two-acre field alongside the North British Railway, Devon Valley line, at Bankhead, about ¾ mile to the west of the old depot. There was an old, disused railway line running across this field, and owing to certain mining operations years ago the ground sloped in different directions from the embankment of the rail line, and thus offered admirable facilities for the installation of ma-



WITH THIS ARRANGEMENT AND BY THE VALUABLE ASSISTANCE OF THE CRANE IT WAS FOUND THAT ABLE-BODIED MEN COULD BE DISPENSED WITH TO A GREAT EXTENT, AND THE NUMBER OF MEN REDUCED 50 PER CENT., THESE BEING VERY ESSENTIAL POINTS JUST NOW. ONE THOUSAND TONS OF TAR-MACADAM WORK WAS DONE RECENTLY AT THE COUNCIL DEPOT BY THIS NUMBER OF MEN, WHOSE AGES WERE AS FOLLOWS: ONE, 78 YEARS; THREE, 72 YEARS; FIVE, 65 YEARS; TWO, 60 YEARS; ONE, 55 YEARS; FOUR, 50 YEARS; ONE, 35 YEARS, IN ALL, EIGHTEEN MEN—I. E., FOUR DRIVERS AND FOURTEEN LABORERS.

STEAM CRANE AT CRUSHER PLATFORM DELIVERING RUBBLE.

THE ARRANGEMENT OF KOEHRING HOT MIXER AND TAR-BOILER, AND THE HAULING OUT OF LOADED TRAILER, AND THE EMPTY TRAILER GOING INTO POSITION FOR REFILLING.

chinery and plant, owing to the various levels obtainable, which is always a desirable feature in setting up plant, and particularly of the type used in road-material manufacture. The platform of the stone crusher in use is a foot above and to the southeast end of the embankment. Below the crusher screen are fitted hoppers, which are only used when the broken metal is to be stored for future use. In addition to the hoppers there is a chute with folding doors, spaced at every 2 feet, down which the metal slides and fills at any point, the trailer standing below. When the chute is required the upper portion of the chute is formed by lifting the plate side of the hopper nearest the chute; this, when dropped, forms the side of the hopper. The metal from the crusher drops into small trucks which run along a 2-foot gage bogie line to the loading bucket of the Koehring hot mixer, into which the metal is tipped for the manufacture of tar or any sort of macadam desired.

As the manufacture of tar-macadam was not contemplated when this plant was set up, it was necessary to devise some arrangement to mix the various sizes of metal for this purpose. This was accomplished by carrying out a new hopper from the side of the existing hopper to take the three sizes to a point in the chute where the metal drops into the end of trailer and discharges the contents into a bogie on a side line. This arrangement worked very well, not interfering with the original arrangement, as a shutter in the new hopper, when thrown back, allowed the metal to drop freely into the end of trailer as before. When the treated metal from the Koehring has filled one trailer the steam tractor hauls this out of the way, and an empty trailer is placed in position, while the loaded one is hauled to the road, emptied and returned.

The North British Railway have laid a siding on the north side of the west field, with enough track to hold twelve wagons comfortably. Parallel to this siding, about 12 feet above it and 21 feet from center to center of rails, a 4-foot 8-inch gage line has been laid down, on which travels a 2-ton steam locomotive crane having a 21-foot sweep. This crane lifts all rubble out of wagons by means of iron boxes with bottoms worked on the trigger principle, and delivers it either on the bank or at the crusher when work is in progress. The whole of the unloading and delivery work is performed by the crane driver and one man. The crane is also able to run along the rails to the coal shed and deliver coal where required.

After work had been in progress some time it was found necessary to have the Koehring hot mixer set up on another level for the manufacture of tar-macadam. As stated above, the formation of the ground lends itself admirably to this purpose. The position finally decided on was the farther end of the bogie line from the crusher, the loading bucket being just below the level of the rail, so as to feed direct from the crusher by a tipping bogie. This position insures the metal from crusher being quite clean.

The hot mixer was set up on two concrete walls, and on the discharge side of mixer the soil was cut away to a depth of 6 feet to admit a trailer to be backed under the small platform, on which was a small bogie which received the tarred material from the discharge chute, and then tipped the contents into the trailer beneath, thus saving much time and labor usually expended in shoveling the material into wagons or trailers.

The tar used in the manufacture of tar-macadam was heated in a 250-gal. tar-boiler, set up on the end of the crane line and packed up high enough to allow the boiling tar to run down a 25-ft. chute, with a slope of 9 inches in this distance, into the measuring tank of the Koehring machine, and when ready the required batch of tar was run direct into the mixing drum. The crane fed the boiler with tar barrels, and

BOGIE IN POSITION AFTER TIPPING STONE INTO KOEHRING MIXER LOADING BUCKET.

THE TAR-BOILER WITH RUN FOR HOT TAR FORMED OF HOUSE RHONES AND MEASURING BOX.

THE DRIVER IN THE ACT OF RAISING THE BUCKET.

also lifted up the barrels of fuel oil for the oil furnace on the machine, and placed them alongside the engine ready to be strained before allowing the oil to enter the fuel tank.

By the thoro organization of this plant the whole process of receiving the rubble in the wagons in the siding, delivering it at the crusher, making correct-size metal, conveying it to the mixer, converting it into tar macadam, delivering into trailers for dispatch to the roadside, goes on continuously, no one part having to wait or being dependent on the other.

We believe it will be very interesting for reads to know the amount of labor required in the whole process, including the conveying, laying, spreading and rolling of the tarred stone on the road, and we give the surveyor's figures herewith:

One crusher-engine driver, who fills up his spare time helping at the jaws.

One man at the jaws of the crusher.

One man at hoppers, and one man to help him with bogie.

One man at the chute.

One engine-driver at the Koehring machine making tar-macadam.

Two men at box taking delivery of tar-macadam.

One man attending to the fires and water.

One man at the tar-boiler attending to temperature and supplying tar.

One driver at the tractor.

One roller driver and four men spreading metal.

One crane driver and man.

Nine-Hour Day.

The steam crane conveys to crusher 50 tons of rubble.

The crusher makes 40 tons of metal, 5 tons chips, and 5 tons dust.

The Koehring tar-mixer makes 40 tons of tarred stone, but is capable of manufacturing 60 tons in nine hours if fully worked. The output is limited to the supply in this case.

The tractor conveyed a distance of two miles 40 tons of tarred stone.

The cost of the day's work:

Cost of rubble, 40 tons at 3s 5d	$ 33.07
Wages of crane driver per day	1.17
Wages of loader per day	1.07
Wages of crusher engine driver per day	1.07
Wages of man at jaws	1.07
Wages of three men at hoppers and screen	3.21
Wages of Koehring driver	1.65
Wages of four men at Koehring	4.76
Wages of one tractor driver	1.70
Wages of one roller driver	1.17
Wages of three men with roller at 4s 2d each	3.13
Wages of one night watcher	.73
Cost of 336 gallons of tar	24.20
For all the engines—	
Cost of 1½ tons of coal	5.08
Cost of oils, fluid, 15 gallons	1.10
Cost of oils, paraffin, 8 gallons	1.17
Cost of cylinder	.28
Cost of oils compound	.41
Cost of oils machine	.12
Cost of oils grease	.30
Two tons of ¾-in. chips for spreading, at 4s 6d	2.18
Cost of wear of tools for spreading on road	.73
Wear and tear of all machinery	2.40

THE HOT MIXER ON THE JOB.

Gloves and overalls for men at tar	.97
Contingencies	9.14
Total cost of one day's work	$106.48

The superficial area of road, 2 miles from place of manufacture, treated with 40 tons of tar-macadam turned under the system adopted in the county, is 320 sq. yds., at a cost of $106.48, which works out at 33½ cents per square yard. This is not allowing any credit for the 5 tons of whin dust manufactured daily, which will be used as a binding material for the ordinary water bound macadam road.

Machinery.

The 2-ton steam crane (portable) with rails was supplied by Messrs. Butters Bros., Glasgow, engineers.

The crusher was supplied about twenty-eight years ago, and is still very serviceable.

The engine driving the crusher is about twenty years old, and the motor steam tractor has been in use for nine years. Both are still quite serviceable.

The Koehring hot mixer was purchased from Messrs. A. A. Byrd & Co., London, in August, 1914, and was used on the roadside last year for the manufacture of tar-macadam for the road improvement work of that year, which was done expeditiously and well. The advantage in using it in its present ideal position was the reduction on number and quality of labor that was required to work it on the roadside. The number of men employed on the roadside was thirteen, while four men—and not necessarily able-bodied men—can do the same work in its present condition.

The county surveyor speaks very highly of the mixer, as it does its work most efficiently, and he stated that he did not see how the manufacture of tar-macadam as done by it could be improved upon. With the present arrangement of having the tar-boiler in an elevated position the process is as clean as it is possible to make it; in fact, there is no visible sign that tar-macadam is being manufactured till the stone is ejected from the drum into the bogie, which passes over and delivers it into wagon. Mr. Alford further stated that he was more than satisfied with the hot mixer, and that his expectations have been fully realized.

We have no doubt that our readers, and particularly road engineers, will be interested in this record of work done in a very difficult district, and with such success as regards cost and the type of labor used.

Georgia Has a State Highway Commission

On September 19, under the provisions of the law recently passed by the legislature, the Georgia State Highway Board was organized, with the State Prison Commission as a nucleus. Judge T. E. Patterson was selected as chairman of the highway department and Capt. Goodloe Yancey as secretary. The other members of the prison commission are R. E. Davison and E. L. Rainey. These four, with S. W. McCallie, state geologist, Prof. C. M. Strahan, head of the engineering department, University of Georgia, and Prof. R. D. Kneale, head of the engineering department of the Georgia Technical School, form the highway board.

The legislature gave the board very little power and no appropriations, so that it cannot yet take advantage of the National appropriations. The National law gives the state three years, however, in which to comply with its conditions, and the first work of the State Highway Board will be to work out a system of state work and of co-operation with the counties of the state, so that when the legislature makes the necessary appropriations and gives the board the necessary authority, it can start the work at once.

E. W. James, chief of maintenance in the U. S. Office of Public Roads, was present at the organization meeting and showed what would be necessary for Georgia to do to comply with the federal act and receive its share of the National appropriations.

Meeting and Paving Demonstration of National Paving Brick Manufacturers Association

The National Paving Brick Manufacturers' Association holds its annual meeting at Terre Haute, Ind., at the Deming Hotel, October 5, at 10 o'clock a. m. On October 6 a demonstration of the method of constructing monolithic brick pavement will be made, to which engineers and state, city and county officials have been invited and are expected in large numbers.

The company will leave the Deming Hotel at 9 a. m., October 6, for a short inspection of old brick streets in Terre Haute, especially that on South Sixth street, which is still in very excellent condition and now some twenty-five years old.

At 10 o'clock the party will take the interurban railroad to Paris, Ill., where the older streets will be inspected and a demonstration of the methods of construction of monolithic brick pavement will be given from start to finish.

On return to Terre Haute a banquet will be served.

Paving in Manhattan Boro

The chief engineer in charge of highways of the boro of Manhattan, New York City, Eugene W. Stern, has made his report for 1915, the first year of his incumbency. It shows the improvements made in the organization of the department and the work done by it in interesting form.

The boro has but 479 miles of streets in its 22 square miles of area, of which 248.92 miles are paved with sheet asphalt, 115.33 with stone block, 55.58 with block asphalt, 34.50 with wood block, 4.5 miles with macadam, and but 20 are unpaved. There are also 0.63 mile of viaducts. Of the paved streets, 335.25 miles are old enough to be under the maintenance charge of the boro, the remainder being still under contractors' construction guaranties. But 10.60 miles of street were paved in 1915, three-fourths of which were asphalt.

The congestion on some streets is excessive. Over Fifth avenue at Forty-second street 1,149 vehicles have been counted in one hour bound south, as compared with a maximum of 900 for the Strand, London, and 600 on the Boulevard des Capucines, Paris. On 49 miles of New York streets traffic is over 10,000 vehicles a day, and on 75 more it is from 7,000 to 10,000. The openings made in the streets in the year numbered 22,000, requiring replacement of 132,000 square yards of pavements.

The report recommends the replacement of about 40 miles of old pavements with new each year for the next ten years, at a cost of about $3,000,000 a year, a less amount being required thereafter as compared with an appropriation of $1,000,000 in 1914 and one of $600,000 in 1915.

Maintenance of 335.25 miles or 6,875,870 square yards of pavements by the boro cost $440,666. The cost per square yard was 8.1 cents for stone blocks, 6.9 cents for asphalt, 5.3 cents for macadam and 4.4 cents for wood block. These figures indicate that in general the kinds of pavement have been selected with very reasonable success for the service required of them.

Fall of Quebec Bridge Span

The new bridge across the St. Lawrence river at Quebec is apparently doomed to bad luck. The fall of the suspended span before its arrival on its permanent supports on the ends of the two cantilevers, while serious in its consequences in loss of life and property and a source of heavy expense and loss of time in replacing the span, is no such indictment of the bridge engineering profession as was the former failure of one of the great cantilevers while under construction. That failure involved a complete re-design and reconstruction of much of the bridge.

The reconstruction on the new design has progressed to the point of closing the opening between the projecting ends of the cantilevers with an ordinary truss bridge supported on those ends. This truss had been completed, floated out on barges under its proposed final position, hung from the suspender links from the cantilever ends above, and lifted a few feet on its way up to its place in the bridge.

It is supposed that one of the cast blocks which were bearings for pin connections of the ends of trusses at right angles to each other broke and thus threw the weight of the structure upon two diagonally opposite points of support, there being four such points in all. The motion accompanying threw one or more of the truss ends out of the stirrups in which they rested. The unequal stresses, for which no provision had been made, caused the collapse of one or more of the panels of the trusses, and the whole span fell into the river, carrying with it the men at work upon it.

While the loss is by no means as serious as that in the first accident, it is said that it will cost some $600,000 and a year's time to replace the truss and mount it in position.

A Correction

In an article on Granite Paving in Brooklyn, published on page 92 of the September number of MUNICIPAL ENGINEERING, a typographical error in the report, which was followed in the article, caused the statement that the Koehring mixer employed in the work had a capacity of 100 square yards a day. Apparently this should read 100 square yards an hour. The error is of course self-evident to any one acquainted with the capacity of the mixers used in laying concrete base for pavements.

Street Improvements in Minneapolis

Minneapolis, Minn., is contemplating a large amount of paving of arterial streets under the Elwell law, under which two-thirds the cost is assessed against benefited property. Of the present gross bonded debt of the city, $24,127,200, the sum of $2,679,027.49 is for street improvements under that law, two-thirds of which is to be paid by the property owners. Of this sum, $935,550.45 is for improvements on the arterial lines of streets, nearly all of it on property in the south and east districts. Some probable new arteries, due to expected suburban developments, are included in the list.

MISCELLANEOUS

Association Meetings

Oct. 9-13, at Robert Treat Hotel, Newark, N. J.—American Society of Municipal Improvements. Charles Carroll Brown, secretary, 702 Wulsin Bldg., Indianapolis, Ind.

Oct. 10, 11, at the Hollenden Hotel, Cleveland, O.—Central States division of American Water Works Association. R. P. Bricker, secretary, Shelby, O.

Oct. 10-15, at Visalia, Cal.—League of California Municipalities. H. A. Mason, secretary, Pacific Bldg., San Francisco, Cal.

Oct. 11, at Vernon, B. C.—Union of British Columbia Municipalities. H. Bose, secretary, Surrey Center, B. C.

Oct. 11-13, at Independence, Kans.—League of Kansas Municipalities. C. H. Talbot, secretary, Univ. of Kan., Lawrence, Kansas.

Oct. 12-14, at Everett, Wash.—League of Washington Municipalities. H. A. Brauer, secretary, Univ. of Wash., Seattle, Wash.

Oct. 13, 14, at Street Cleaning Department Bldg., New York City—Society for Street Cleaning and Refuse Disposal. J. R. Buchanan, secretary, Municipal Bldg., New York City.

Oct. 16-21, at Detroit, Mich.—National Safety Council. W. H. Cameron, secretary, Cont. & Coml. Bank Bldg., Chicago, Ill.

Oct. 18, 19, at Red Wing, Minn.—League of Minnesota Municipalities. R. R. Price, secretary, Univ. of Minn., Minneapolis, Minn.

Oct. 23, at Cincinnati, O.—National Highway Exposition.

Oct. 24-27, at Cincinnati, O.—American Public Health Association. S. M. Gunn, secretary, Boston, Mass.

Oct. 26-28, at Hillsboro, Tex.—League of Texas Municipalities. H. G. James, secretary, Univ. of Tex., Austin, Tex.

Nov. 15, at Urbana, Ill.—Illinois Municipal League. J. A. Fairlee, secretary, Univ. of Ill., Urbana, Ill.

Nov. 16-18, at Nashville, Tenn.—Fire Marshals' Association of North America.

Nov. 20-22, at Lewiston, Mont.—Montana Municipal League. E. S. Judd, secretary, city clerk, Billings, Mont.

Nov. 20-23, at Springfield, Mass.—City Managers' Association. O. E. Carr, secretary, Niagara Falls, N. Y.

Nov. 21, at Springfield, Mass.—Massachusetts Civic League. E. T. Hartman, secretary, 3 Joy St., Boston, Mass.

Nov. 22, 23, at Springfield, Mass.—Municipal Research Workers. L. D. Upson, program committee, Detroit, Mich.

Nov. 22, 23, at Springfield, Mass.—Training School for Public Service. Charles A. Beard, supervisor, 2161 Broadway, New York.

Nov. 23, 24, at Springfield, Mass.—Civic Secretaries' Conference. Howell Hart, secretary, Milwaukee, Wis.

Nov. 23, 24, at Springfield, Mass.—Massachusetts Federation of Planning Boards. A. C. Corney, secretary, Cambridge, Mass.

Nov. 23-25, at Springfield, Mass.—National Municipal League. C. R. Woodruff, secretary, 705 N. A. Bldg., Philadelphia, Pa.

Dec. 27-30, at Columbus, O.—American Statistical Association. C. W. Doten, secretary, 491 Boylston St., Boston, Mass.

Dec. 26-31, at New York.—American Association for the Advancement of Science. L. O. Howard, secretary, Smithsonian Inst., Washington, D. C.

Jan. 20, 1917, at Kansas City, Mo.—Western Paving Brick Manufacturers' Association. G. W. Thurston, secretary, 416 Dwight Bldg., Kansas City, Mo.

Jan. 23-25, 1917, at New York.—American Wood Preservers' Association. F. J. Angier, secretary, Mt. Royal Sta., B. & O. R. R., Baltimore, Md.

Feb. 5-12, 1917, at Mechanics' Hall, Boston, Mass.—American Road Builders' Association. E. L. Powers, secretary, 150 Nassau St., New York.

Prizes for Engineering Papers

The Hydrated Lime Bureau of the National Lime Manufacturers' Association, Arrote building, Pittsburg, Pa., will pay $100 for the best letter of not more than 500 words on the use of hydrated lime in concrete, the letters to be received on or before 9 a. m., December 6, 1916. The terms of the contest are given in a circular issued by the bureau, which can be had on application. Other prizes for $50 and $25 are also offered, and $5 will be paid for each other paper retained for publication.

The engineers' subdivision of the Chicago Association of Commerce offers three prizes for $50, $30 and $20 for the three best papers not exceeding 3,000 words in length on any one of the subjects, "Engineering and Civic Progress," "The Engineer of the Future," and "The Business Relation of the Engineer to the Commercial World," papers to be received at its office, 10 South LaSalle street, Chicago, Ill., on or before November 1, 1916. Details will be given by the secretary of the association.

Car Shortage Becoming Serious

Last year, with the crop shipments to shipping ports for foreign countries, cars were hard to find, but this year, with the added increases in demand for cars for transporting materials for manufacture, building and engineering construction and for machinery for all purposes, as well as general merchandise, the shortage in cars is becoming very acute, and many manufacturers are now notifying their customers that they must order in advance of their requirements to insure delivery on time, even tho their own facilities are sufficient for any reasonable calls. They emphasize four points, which are thus expressed in a circular letter from the Universal Portland Cement Company:

"Keep shipments coming. Order shipments well in advance of future needs. When possible place orders for carloads 'any size.' Unload cars immediately upon receipt." In other words, keep things moving so that the cars will waste no time standing still or acting as storage.

The Newark Convention of the American Society of Municipal Improvements

The twenty-third convention of the American Society of Municipal Improvements bids fair to be the largest convention the society has ever held, tho the last three conventions have each broken the record for attendance. The program sustains the reputation of the society for keeping its discussions fully up to date, being specially timely on activated sludge and Imhoff tank sewage treatment, street lighting, garbage and refuse collection and disposal, wood block, granite block and concrete paving, all these subjects being treated by those directly engaged and prominent in making history in these lines.

Newark has an exceptional situation among interesting examples of municipal and other public improvements, and the local committee has made ample provision for showing them t odelegates in large and small parties under competent guidance.

While this number is issued immediately before the convention, it may not be too late to recommend our readers in municipal employment to attend. The society has had an addition of new members during the year of over 20 per cent., and there will be a considerable number of names to be passed by the board at the convention, which have come in during September.

Why the A. S. M. I. Goes to Newark

The man from Newark was in Chicago trying in stentorian tones to convince a friend that Newark, N. J., was a quick-rising sort of town not mentioned in the baking powder ads, when a stranger butted in and offered a few favorable remarks to sustain our citizen's contention.

"Thanks," said the Newarker, "you seem to know our town. When were you there last?"

"Only three weeks ago," replied the stranger assuringly.

"—," ejaculated the man from Newark, "you ought to see it NOW!"

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places, as follows:

Oct. 11, 12: Engineer, Indian service, at Canton Asylum, S. D., and Kiowa Agency, Okla., at $720 a year.

Technical Association Notes

The Northwestern Association of members of the American Society of Civil Engineers, the Minnesota sections of the American Society of Mechanical Engineers and the American Institute of Electrical Engineers; the Minnesota Surveyors' and Engineers' Society; the Engineers' Club of Minneapolis, and the Civil Engineers' Society of St. Paul have formed the Minnesota Joint Engineering Board, with representatives from each of the six societies, to bring about closer co-operation. Geo. W. Rathjens, of St. Paul, is the secretary of the board.

Personal Notes

S. H. Bothwell has been promoted to the office of city engineer of Webster Grove, Mo., a suburb of St. Louis.

Elwood G. Ladd, Florida Life building, Jacksonville, Fla., is in charge of the office of the Chicago Bridge and Iron Works, which covers the states of Florida, Georgia and Alabama.

Arthur J. Sweet has opened offices in the Palace Theater building, Milwaukee, for consulting practice in steam, electrical and illuminating engineering, and makes street lighting problems a specialty.

George A. Taber, consulting engineer, recently with Nicholas S. Hill, has associated himself with Clarence D. Pollock, and they will practice under the firm name of Pollock & Taber, with offices in Park Row building, New York City. Their specialty is municipal engineering, including pavements, water supply, sewerage and sewage disposal.

Publications Received

Second annual report of Country Roads Board of Victoria, Australia. W. Calder, chairman, Melbourne, Aust.

Annual report of North Yakima, Wash., for 1915. N. A. Gilman, city engineer.

Electrolysis and its Mitigation, by E. B. Rosa, chief physicist, and Burton McCollum, electrical engineers, is No. 52 of The Technologic Papers of the U. S. Bureau of Standards, Department of Commerce, Washington, D. C. Earth resistance and its relation to electrolysis of underground structures, by Burton McCollum and K. H. Logan is No. 26 of the same series. Protection of Life and Property against Lightning, by O. S. Peters, Assistant Physicist, is No. 56 of the same series.

A Good Roads Bulletin for Illinois Public Schools, issued by F. G. Blair, State Superintendent of Public Instruction, gives much valuable information on how to keep earth roads in the best condition possible, with some statement of the advantages of macadam road surfaces.

Bulletin 347 of the U. S. Department of Agriculture is a description of "Methods for the Determination of the Physical Properties of Road-Building Rock," by Frank H. Jackson, Jr., assistant testing engineer in the Office of Public Roads and Rural Engineering.

Report No. 111 of the State Bureau of Municipal Information of the New York State Conference of Mayors and Other City Officials is on Municipal Clean-up Campaigns, various methods and plans adopted by American cities, organizations, samples of literature used, and programs. Denver, Philadelphia, Cincinnati, Jersey City, Toledo, Cleveland, Chicago, Kewanee, Ill., Muskogee, Okla., Brooklyn, Spokane, Paterson, Salt Lake City, Dallas, Pensacola, Bay City, Ore., Antlers, Okla., Denison, Tex., Rochester, Cornwall, N. Y., Galveston, Akron, O., Wichita Falls, Tex., Charleston, S. C., Utica, N. Y., Larned, Kan., Saratoga, Chattanooga, Covington, Ky., New York, Reading, Pa., Richmond, Va., St. Louis, St. Paul, Tyler, Tex., Minneapolis, Tifton, Ga., Ft. Worth, Lockport, N. Y., Boston, Mass., are cities contributing to the report, and there are others which have not responded to requests for information.

The report of Oliver McClintock, delegate of the Pittsburg Chamber of Commerce to the Dayton meeting of the National Municipal League, on the subjects of municipal home rule and the commission-manager form of city government, with special refernce to Dayton itself, has been published in pamphlet form by the Chamber.

Reports of the chief engineer of the Miami Conservancy District; vol. I, synopsis of proposed plan of improvement and process followed in its development; vol. II, real estate descriptions; vol. III, forms of contracts and specifications and detailed estimates of costs, 25 cents each. Arthur E. Morgan, chief engineer, Dayton, O.

Report of division of Sewage Disposal of Columbus, O., for 1915. C. B. Hoover, chemist in charge.

Report of Commissioner of Public Roads of New Jersey for 1915. E. A. Stevens, commissioner, Trenton.

MACHINERY AND SUPPLIES

New Motor Combination Flusher

The Moreland Motor Truck Manufacturing Co., Los Angeles, Cal., has recently delivered a new type of combination sprinkler and flusher to the city of Los Angeles.

In general appearance the unit is not materially different from others in common service. The flushing nozzles, however, of which there are five, each separately adjustable, are mounted at the front of the chassis. Each is controlled by an individual valve, and all of them by a master valve operated from the driver's seat. While traveling at a speed of about eight miles an hour the apparatus is capable of flushing a 60-foot pavement. The sprinkling nozzles are provided at the rear, and at a speed of 10 miles a street 80 feet in width can be sprayed from curb to curb. The tank has a capacity of 1,200 gallons and can be filled in about two minutes. A pump mounted on the chassis delivers the water to the nozzles at high pressure. The truck's propulsion shaft passes thru that driving the pump, for which there is a special clutch and two-speed transmission set, so that both narrow and wide pavements can be cared for properly. At night the machines are used for flushing the streets and in the daytime for spraying them.

Evolution in Armor Plate

We are illustrating three different steps in the evolution of Baker armor plate for joints in concrete pavements.

View (1) shows standard angles having sheared members extending into the concrete on the under side. This was used in the first rural concrete road built by the R. D. Baker Co. for the Wayne County Road Commission in 1909. These joints, four in number, are still wearing very well with a possible exception that the concrete has worn away faster than the steel. The objection to this joint is the high price, owing to the amount of steel used.

View (2) shows the first Baker armor plate having sheared members every foot, anchoring it to the concrete. This plate was 3/16 inch by 21 inches. The manufacture of this plate was discontinued. The experiment showed, as well as observation, that the plates will not wear down as fast as the concrete. Also, being a straight plate, the action of the steel tire in passing over the joint tends to vibrate the concrete back of the steel.

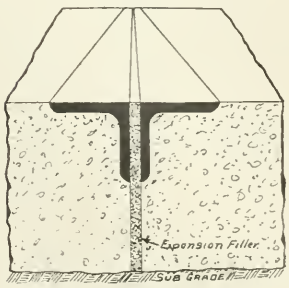
View (3) shows Baker bevel-edged plate employing a minimum quantity of steel. The tendency of traffic is to drive this steel down upon the concrete. This plate, which is ⅛ by 2½ inches, will wear down evenly with the concrete, as roads having it installed have demonstrated. The beveled or turned-over edge reinforces it as the shock of the steel tires comes against it.

Measuring Device for Concrete Mixtures

A method of changing readily the proportion of cement in concrete has been used in Los Angeles, which is very simple in theory. As usual, the various mixtures for the concrete used at different places on the job called for twice as much gravel as sand, and the only variable quantity was the proportion of cement to sand. Measuring boxes of size to suit the mixer used were made, into which the material was discharged thru holes governed by sliding plates, the gravel box being the size of the sand box.

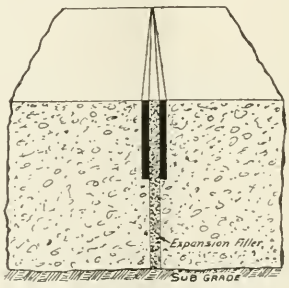
These boxes can be discharged at will into the hopper of the concrete mixer. A third box for measuring the cement was divided into two parts by a permanent vertical partition and sliding plates in each part so that by cutting off portions of the box the amount of cement measured could be varied according to the proportions required. The design of the cement box was not perfect and caused the plant to be very dusty. The ease with which the volume of the cement meas-

(View 1)



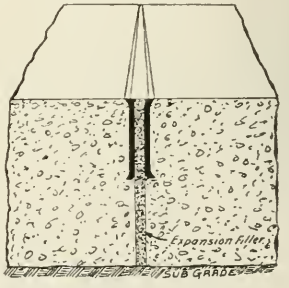
Angle Iron
The first steel protection for expansion joints in a Concrete Road used in 1909.

(View 2)



Straight Baker Armor Plate.
The next step in Expansion Joint Protection.

(View 3)



Baker Bevel Edged Armor Plate.
The last step in Expansion Joint Protection.
Maximum efficiency with minimum steel.

uring box could be changed made changes from one mixture to another possible on short notice, and as frequently as necessary.

An Unusual Structure

The accompanying photograph illustrates a large elevated water storage tank built for the Campbell Flour Mills Co., Limited, of Toronto, Ontaria. Their flouring mills, which rank among the most progressive in Ontario, were recently equipped with an automatic sprinkler system to provide fire protection and reduce their insurance rates. The tank is used for the storage of water necessary to operate the sprinkler system to provide fire protection and reduce their insurance rates. The tank is used for the storage of water necessary to operate the sprinkler equipment satisfactorily. Altho the installation was made for a private concern, its unusual features make it noteworthy to municipal waterworks engineegs, who readily can see its adaptability to their own civic uses.

The prominent position and great height of the structure renders it peculiarly effective for advertising purposes, and the company has taken advantage of this fact in having the tank built in replica of a bag of flour. The work is built entirely of steel, which material may be readily formed to the shape desired and at the same time insures great strength and unusually long life. The tank was painted and lettered to represent exactly the sack in which the company's product is marketed.

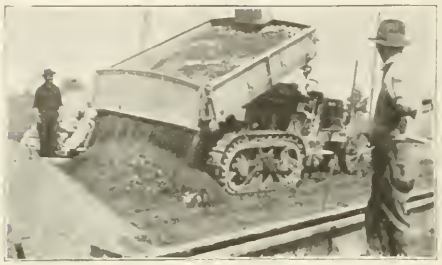
Some idea of the size of this water tower may be gathered from the following data: The tank holds 40,000 gallons of water. The total height of the structure is 152 feet above foundations. The tank itself is 37 feet deep and 18 feet wide, being built oval in cross-section to correspond truly to the shape of a flour sack. The weight supported is over 200 tons.

The work was designed and executed by the Canadian Chicago Bridge & Iron Company, of Bridgeburg, Ontario, which makes a specialty of this class of construction. They have also recently constructed in the city of Toronto for the City Dairy Company a similar structure having a tank in the shape of a milk bottle.

Hauling Hot Asphalt

We are illustrating a loaded train of all-steel, Western 5-yard cars, owned by the San Francisco-Oakland Terminal Railway. They are operated on the streets of Oakland, Berkeley and Alameda, Cal., and used for hauling hot asphalt. These cars are equipped with air brakes and special swivel automatic couplers for taking curves of 30-foot radius. They are built so that they do not leak and have given excellent satisfaction.

TRAIN OF WESTERN 5-YARD CARS USED BY SAN FRANCISCO-OAKLAND TERMINAL FOR HAULING HOT ASPHALT.



ALLIS-CHALMERS TRACTOR TRUCK DUMPING SEVEN TONS OF GRAVEL ON ROADBED OF CONCRETE ROAD. NOTE THE DRIVER OPERATING THE DUMP BODY FROM SEAT.

The Tractor Truck

Generally speaking, the Allis-Chalmers tractor truck combines in a practical way the speed of the auto truck with the essentials required in haulage work where an auto truck is used, viz., traction effort and drawbar power.

The traction effort is produced by a special type of all-steel wheels. The drawbar or pulling power is produced by a high-power auto-truck-type motor. This combination produces a tractor truck of great efficiency in haulage work.

This type of truck carries a body load of seven tons. The body equipment is furnished to meet the requirements of the purchaser's haulage problem.

The large amount of drawbar power developed by the high-powered engine and special type wheels enables hauling of one to four trailers of one to five tons capacity, thereby cutting auto trucking costs 50 per cent. and upwards, according to the number of trailers it is practical to use.

For gravel, sand, crushed stone and brick hauling, a special type of end dump power hoist body is recommended. This body is made of heavy sheet steel, with a device for spreading to desired depth, from 2 to 15 inches. This body is constructed to allow the end gate lowering free of bars or other obstructions, to level with bottom of body, to permit hauling of contractors' equipment, lumber, etc. The capacity of the end-dump body is 5 yards.

The dump mechanism is operated from driver's seat for either spread or pile dumping, and is simple and fast in operation. The spreader device can be set for permanent depth spread, which is a vital feature in road construction work, as in no cases provision for permanent spreading device is made on dump bodies.

An Improved Centrifugal Pump

The development of the steam turbine and the high-efficiency multi-stage centrifugal pump have gone hand in hand, but up to the present, it has not been entirely practicable to reconcile the speeds of the two machines so that each would work at its best efficiency. Heretofore it has been necessary either to reduce the speed of the turbine and sacrifice much of its efficiency, or, else speed up the pump with similar results. To overcome this difficulty, the Cameron Pump Works, of New York, have designed a multi-stage centrifugal pump, known as the "BT" type.

An accompanying photograph clearly shows the construction of one of these three-stage pumps. The high-speed feature is a virtue of impeller design. With the ordinary impeller the diameter cannot be reduced sufficiently to get high speed without sacrificing vane length, and consequently, efficiency for a certain vane length is very necessary in order that the impeller perform its function without excessive loss. Small external diameter and adequate vane length are obtained in this pump by bringing the vanes well down into the impeller hub, at the same time so turning them that the incoming water is guided smoothly and with little loss into the outer portion of the vane, where the velocity is generated that is finally converted into useful pressure by means of the external diffusion vane. Additional advantages in the small impeller are light weight and low fiber stresses in the material.

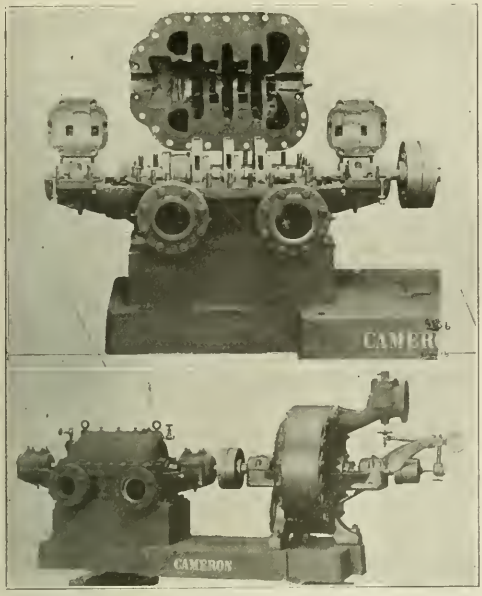
Detailed Construction.

The casing is divided along the horizontal outer line. Both the suction and discharge connections are in the lower half of the casing. The upper half is readily removable, giving full access to the revolving element. There are suitable openings for draining the pump and for displacing the air when starting. Inlet and outlet nozzles can be arranged either on the same or opposite sides—an advantage where pumps are installed in limited space.

The shaft is made of high-grade forged steel, accurately machined and ground, and wherever it comes in contact with the fluid being pumped, it is thoroly protected by bronze sleeves, which prevent the stuffing-box packing from scoring the surface of the shaft.

Each impeller is cast solid in one piece and is of the enclosed type. Surrounding each impeller hub is a pair of rings—one stationary, attached to the casing, and one revolving, attached to the impeller. By the use of double rings instead of a single ring, it is possible to restore the initial tightness of the joint between the low and high pressure sides of each stage without any fitting whatever, whereas a new sin-

ALLIS-CHALMERS TRACTOR TRUCK DRAWING THREE TRAILERS CARRYING THREE YARDS OF PIT-RUN GRAVEL, WEIGHING 3,200 POUNDS TO THE YARD, AND FIVE YARDS IN THE DUMP BODY, MAKING A TOTAL OF FOURTEEN YARDS. NOTE THE ROUGH, RUTTY AND SANDY CONDITION OF ROADBED.



ABOVE: THREE-STAGE BOILER-FEED PUMP, SHOWING INTERNAL CONSTRUCTION AND ACCESSIBILITY OF PARTS.

BELOW: THREE-STAGE BOILER-FEED PUMP DIRECT CONNECTED TO G. E. TURBINE. CAPACITY, 550 G.P.M., 200 LB. PRESSURE, 31,000 R.P.M.

gle ring would have to be of special diameter, and then fitted to the impeller hub or the casing in order to make a tight joint.

The diffusion ring surrounds the impeller at its periphery, altho it is not in contact with it. It contains a series of openings, which receive the water from the impellers at high velocity and by means of gradually increasing area toward the periphery, reduce the velocity into pressure and enable it to advance to the entrance of the next impeller with much less loss of energy than would be the case if the high velocity of ejection were maintained.

Taking Care of the Thrust.

To take care of thrust, which manifests itself in all multistage pumps, this pump is equipped with a simple internal hydraulic balancing device. This device consists of a revolving disc attached to the shaft at the inboard or high pressure end. Opposite this disc is a stationary drum of the same diameter. Water at high pressure connects with the space between the disc and the drum, causing the disc to react against the opposing thrust, neutralizing it and holding the rotor in proper relation to the casing. The slight leakage involved in this process is piped back to the suction.

On this pump there are two ring-oiled bearings, self-aligning, one located on each side of the casing. The bearing bodies are horizontally split, with removable caps, and the bushings are also split and lined with high-grade bearing metal. Bushings and bearing bodies have a spherical fit, automatically maintaining the alinement of the shaft. The bearings are of ample proportions to prevent heating, and the oil chamber is of liberal capacity. The bearings are supported by strongly ribbed brackets, cast integral with the lower casing, thus counteracting any possible tendency towards even slight vibration. These brackets are located sufficiently distant from the stuffing boxes to permit of adjustment of the glands. Felt washers are provided to prevent oil escaping from the bearings.

Functions of Component Parts.

The stuffing boxes are deep and provided with water seals, consisting of a lantern gland in each box, connected to the water from the discharge side of the pump, thru a concealed passage, so arranged that it can be readily cleaned. The stuffing-box gland is fitted with swing bolts to give quick and easy access to the stuffing box.

When the pump is direct-connected, it is supplied with a shaft-coupling of the flexible type to compensate for slight variation in alinement.

The bed-plate under the pump is of one-piece box construction heavy enough to give a rigid support, and with cross ribs to prevent distortion.

The second photograph shows this pump entirely assembled, and it is claimed by the manufacturers that it occupies less space than the ordinary boiler feed pump of this general type, and that it will give a higher degree of efficiency. Several are now being built for use by the U. S. government.

Texas Using Auto Truck Train

Probably the most modern innovation in "prairie schooners" is now being operated thru the sparsely settled section of Texas by a telephone-construction and repair gang whose work enforces long overland trips where living accommodations are uncertain.

The motor train comprises a tractor and five enclosed cars, two of which are used for sleeping purposes, one for a kitchen, one for a diner, and the car at the rear as a general baggage car in which all the workmens' equipment, except poles, is carried.

Berths in the sleepers are arranged in double, cross-wise tiers so as to accommodate twelve men to each car, and small stoves heat each car during cold weather. All openings are screened, and the sides are fitted with heavy drop curtains which effectually keep out rain.

The kitchen car is equipped with stoves, a regular sink, shelving for dishes and supplies. In the diner there is a single long table and a butler's pantry with warming ovens in which the food can be kept piping hot until served. Even a telephone is installed at one end of the car.

The complete train idea is that of the Southwestern Telegraph & Telephone Co., of Houston, Texas, and the truck used is made by the Wichita Falls (Texas) Motor Company.

Courtesy of Popular Mechanics.

New Hand Hoist for Truck Loading

The vastly increased adaptation of the motor truck to the varied uses of the general contractor is leading to the invention of numerous innovations in the way of accessory loading and unloading devices. These always are worth the serious consideration of the contractor.

One of the latest devices designed especially for increasing motor truck efficiency by reducing the time of loading and unloading is a new type of hand-operated hoist at the plant of the Toronto, Ont., Canada, hydro-electric system. It is there used for loading and unloading 5-ton rolls of cable.

The hoist, which is of the differential block-and-fall type, is mounted on a small carriage running above a horizontal I-beam, supported on two steel uprights, about 20 feet above ground. This makes it possible for the truck to drive underneath it.

The salient feature of the crane, however, is a patented, automatic lowering device, making it possible for even a 5-ton load to lower itself under gravity. This lowering of the load is accomplished by means of a light hand chain, which is itself made impervious to tampering by an automatic centrifugal governor brake which forestalls a too-rapid descent of the load. This brake is so designed as to permit of the empty hook being pulled down rapidly by hand, a fact which eliminates the time usually necessitated on this operation in the ordinary sort of chain-block.

A special steel bail attends to the lifting of the load. The vertical arms of the bail are perforated near the bottom in which the bar thru the center of the roll is inserted. The arms themselves are bolted to the horizontal top member of the bail, in which three sets of bolt holes are provided, making the arms quickly adjustable for any width of cable drum.

The use of this new hoist, which is made by the Herbert Morris Crane & Hoist Co., Ltd., of Toronto, enables one man to attend to all loading and unloading operations at the plant. Prior to the installation six or seven men were required for exactly the same work.

A Contractor's Street Blockader

C. C. Fouts Co., Middletown, O., have devised a metal blockade for contractors' use on street contracts which is quite convenient and complete. It consists of two or more tripod stands of gas pipe which carry frames made of small channel bars braced 8 inches apart with rods. These frames are 10 ft. long and are hinged to flat bars attached to the upright part of the tripod stands. Two or more stands can be used according to the width of the space to be shut off from travel. By dropping the channel bars down over the supporting bars and dropping in the pin connections, the barricade is kept in a continuous straight line. By lifting the channel bars slightly they can be rotated on the pins and the barricade can be made to surround any space with its straight sides each 10 feet long.

In the center of each 10-foot frame is a plate with the word "Closed" on it in prominent letters, and above this is a bracket in which the red night lantern is set. On top of each of the tripod stands can be set a "stop" or "safety first" sign.

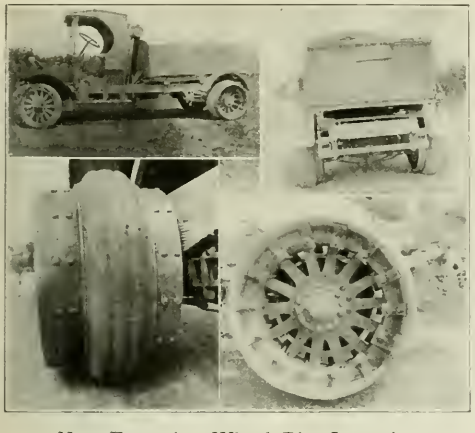
Domestic Special Hoisting Outfit

The Presbrey-Coykendall Co., of New York City, have for some time past been handling building stone and similarly heavy materials by the use of hand-operated double-purchase guy derricks combined with the Domestic special hoisting outfits, which are illustrated herewith.

The power equipment operates the single or double-purchase winch in connection with single or part lines just the same as by hand, the difference being that the power rig will operate continuously all day long without getting tired and at less expense than for labor to wind the winch. One man takes the place of the usual four or six winding by hand, and the load is always under full control.

The engine, the jack shaft with clutch, the two winch heads, and a platform that can be attached to the mast as a mounting for the hoist, form a self-contained unit. The sprockets, steel roller chain and several extra sprockets for power shaft to winch, so that the power unit can be coupled without difficulty to secure desired rope speed in connection with single or part lines, according to the load, also are accessory parts of the equipment.

The outfits, which are made by the Domestic Engine & Pump Co. of Shippensburg, Pa., are made with three sizes of engines: 3½, 5 and 7 h.p., all having variable speed control thru a speed-changing lever on the engine governor, and provision for further speed change by substitution of different sized sprockets. The engines are fitted with both dry battery and magneto ignition and hit-and-miss governor acting directly on the fuel consumption in exact ratio with power delivered to the load. The smallest outfit is intended for use with 12-in. or 14-in. derricks and the two larger with 14-in. or 16-in. masts.



New Extension Wheel Rim Invention

Mr. Albert E. Gray, who does a general contracting business in Goodland, Ind., has just secured a patent covering a new type of special extension rims for the rear wheels of his motor truck.

Mr. Gray's device overcomes the common trouble of having a heavily-loaded truck cut down into soft ground, sand or loose clay roads over which it may be traveling. The particularly noteworthy feature of the rims is that they accomplish the above and still do not interfere with operation under ordinary conditions. It is further understood that there is no particular objection to using these bands on a hard, solid or smooth road. Insofar as experiments yet have demonstrated, there is no detrimental effect on the truck, aside from the possibility that in running on the bands over a hard solid road, contact with the metal rims might occasion undue vibration.

Mr. Gray himself says: "The roads over which I have to travel are rutted so deeply that the very axle of my truck used to drag the ground and absolutely prohibit turning out whenever I wanted to. All that was at once nullified in effect after I had put the extension rims on my wheels. I then was able to make at least 50 per cent. better time with my truck. Whereas I formerly could get only 3 miles per gallon of gasoline on the rutted dirt roads, I now get 4½ miles per gallon. The truck runs faster and more smoothly. We now are making ten and eleven trips per day as contrasted with only seven trips on the same amount of gasoline and oil before I put on my rims.

"It is further interesting to know that there are twelve distinct ways of attaching the extension rims to truck wheels, and practically any kind of a wheel can be used."

The Service truck upon which Mr. Gray is using his invention carries 36 by 10-in. Firestone tires. The rim on the inside of the wheel is 31 by 4 in. wide, and on the outside 31 by 6 in. wide. The rims, which are made of 3/8 in. steel, are 98 in. in outside circumference and have 14 clips 1/2 in. thick, held secure by 14 bolts.

Load Test of Corrugated Iron Culvert

Prof. A. N. Talbot, who is in charge of the Materials Testing Laboratory of the University of Illinois, recently made an interesting test of the strength of the American ingot iron corrugated culverts in order to afford an impartial and authoritative statement for the Middletown, O., manufacturers.

He selected from the regular stock a culvert pipe 8 ft. in length and 36 inches in diameter, which was put in a hydraulic press and loaded as shown per the accompanying table report.

OFFICIAL REPORT OF TEST

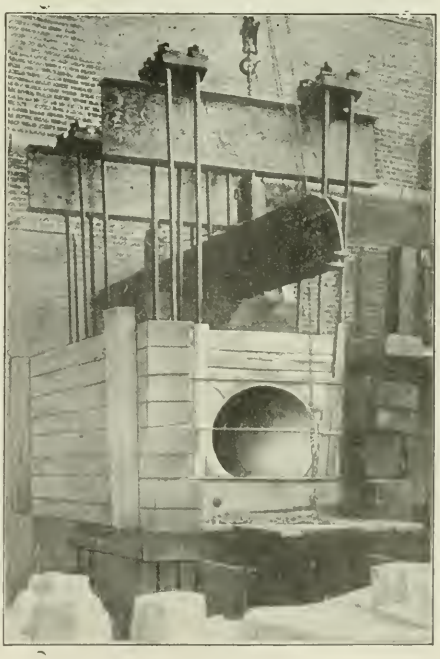
DISTRIBUTED LOAD TEST OF CORRUGATED CULVERT PIPE

AMERICAN INGOT IRON 99.84% PURE.

Total Load on Pipe in Pounds	Load Per Lineal Foot in Pounds	CHANGE IN DIAMETER IN INCHES					
		LEFT END		RIGHT END		MIDDLE	
		Horizontal	Vertical	Horizontal	Vertical	Horizontal	Vertical
15000	1820	0.0	0 0	0.0	0.0	0.0	0.0
28000	3400	0.01	0.01	0.0	0.02	0.0	0.01
40000	4850	0.07	0.09	0.10	0.12	0.13	0.13
48000	5830	.22	.22	.24	.28	.32	.35
56000	6780	.31	.32	.40	.42	.47	.49
64000	7760	.37	.39	.48	.49	.57	.60
72000	8730	.45	.50	.61	.64	.72	.77
80000	9700	.54	.60	.72	.75	.83	.90
88000	10650	.69	.83	.83	.90	.98	1.05
96000	11600	.87	.91	1.03	1.10	1.32	1.30
104000	12600	.96	1.03	1.11	1.20	1.43	1.45
112000	13560	1 10	1.19	1.30	1.39	1.56	1.64
120000	14550	1 27	1.40	1.42	1.48	1.72	1.83
128000	15500	1.45	1.59	1.63	1.72	1.95	1.05
136000	16500	1.75	1.89	1.73	1.92	2.20	2.28
144000	17500	1.87	2 04	1.93	2.12	2.37	2.52
152000	18400	2.02	2 20	2.03	2.25	2.50	2.58
160000	19400	2 2	2 4	2.2	2.4	...	.....
168000	20400	2 5	2 9	2.6	2.9	...	.....
176000	21300	2 9	3.1	2.7	3.2	...	.....
184000	22300	3.1	3 5	2.9	3.4	3.8	4.0
184000	22300	3.4	3 9	3.1	3.7	....	4.3
*15000	1820	2.4	3 2	2.6	3.0	..	...

* { Test Discontinued / Load Released

It will be noted that total load carried amounted to 184,000 lbs., or 92 tons, and that the total load per linear foot was 22,300 lbs., or over 11 tons. Despite this extraordinarily heavy fill Prof. Talbot states that the pipe still was in good condition at the conclusion of the test and no fracture was found in the metal.



"CROWN" PICKS BEING USED TO TEAR UP ASPHALT AT 12TH STREET, BROOKLYN, N. Y.

Crown Pick for Asphalt Cutting

We illustrate herewith Crown picks, such as recently were used to tear up asphalt on Twelfth street, Brooklyn, N. Y.

The Crown pick, type 56-H, is a pneumatic hammer especially adapted to tearing up asphalt pavements and loosening and wedging out bricks and stones when demolishing old structures. The valve is of a special spool type. The cylinder is made of special steel and the handle is drop forged.

The handle, which is of the closed type, is provided with an inside throttle trigger. This is really a safety device, as it removes the possibility of kicking the throttle open while the machine is lying on the ground with consequent chance of accident. In addition to the inside trigger a simple spring tool retainer is provided, which makes it impossible to shoot the pick out accidentally.

The use of Crown pneumatic picks for cutting asphalt when digging up streets for drain repairing, laying gas or water mains, repairing street car tracks, etc., results in a large saving. It is at its best when working in bitulithic topping and the different grades of asphalt.

The style of tools used and the manner in which they should be applied vary with different conditions according to the Ingersoll-Rand Co. of New York City.

Asphalt Paving with a Road Asphalt Plant

The portable asphalt plant is each day more thoroly demonstrating its value in the asphalt paving field. One of the latest demonstrations is that made at Joliet, Ill., by the R. F. Conway Co., of Chicago, of the capabilities of an 1800-yard road asphalt plant, built by the F. D. Cummer & Son Company of Cleveland, O.

This plant is designed to be transported in several units so as to reduce the weight on the wheels and to make it easy to set the various parts in the most convenient fashion on the ground where it is to be operated.

The accompanying photographs show the two sides of the plant as set up early in the present season, alongside the Rock Island Railroad, a side track of which is seen with tank cars on it in front of the boiler and dryer.

In the view showing the loading of the motor truck with asphalt mixture, the boiler will be seen on the right. This

particular boiler and the engine behind it were the property of the company and set up to operate the plant and are not those furnished regularly with the Cummer plant.

Behind the boiler is the dryer for sand or broken stone, which is shown to better advantage in the other photograph, where the pile of aggregate is seen with men shoveling it onto the bucket elevator near the smoke stack, which delivers it to the revolving drum of the dryer.

W. T. Damewood, superintendent for the R. F. Conway Co., in charge of the plant, states that the dryer is of ample capacity for the plant and will handle regularly all the material which the men can supply to the elevator.

The dryer and its furnace are transported on wheels, set low, and the front wheels are on a frame hinged to the base frame of the dryer so that the whole machine can

be lifted to the height it stands in the picture. Part of this frame can be seen immediately under the smoke stack. The rear end of the dryer can be lifted likewise by attaching to the bottom of the fire-box the uprights to which the rear wheels are joined. But Mr. Damewood preferred to make the small concrete piers shown, on which to rest the rear wheels, without resetting them.

The housing of the hot elevator and of the bins for holding the hot aggregates is seen in the middle of each photograph.

Back of the mixer are three tanks for heating asphalt, two next the machine and one farther to the rear. These tanks are supplied with fire boxes and the hot liquid asphalt is pumped by a Kinney rotary pump from the tanks to the elevation of the mixer, where it is drawn off as needed into the weighing bucket. Bermudez asphalt is used on these contracts.

It will be seen from one picture that the reason for lifting the dryer is to make it possible for wagons to back under the mixer to receive their loads. A little more space is required for the Garford and Peerless trucks used for hauling, and so the earth was excavated about a foot to give the additional room.

Mr. Damewood reports that the plant has laid 20,000 square yards of pavement this season, the work having been done in about three weeks, and that 50,000 yards are yet to be laid, which he thinks he can do in 60 days. The capacity of the plant is shown by his statement that in 8 hours it has filled 34 truck loads of 14,000 pounds each, enough asphalt mixture to lay practically 2,300 square yards of pavement. He is very enthusiastic in his praise of the efficiency of the plant and his confidence seems to be well placed.

ROAD-OIL HEATING AND PUMPING OUTFIT.

New Road-Oil Heating and Pumping Outfit

Experience caused Road Commissioner Emil Schmechel, of Thiensville—who is in charge of road work in Ozaukee County, Wis.—to devise plans for a new type of roal oil heating and pumping outfit, which really would economize on the time and trouble hitherto confronting his road crew. Mr. Schmechel's suggestions were submitted to and developed by the Gilson Mfg. Co., of Port Washington, Wis., and the result, illustrated herewith, has proven eminently satisfactory according to Road Commissioner Schmechel.

This outfit consists of a 30-h. p. steam boiler, a 4½-h. p. Gilson engine, together with a rotary pump. The steam boiler is used for heating the heavy road oil, which, after having become sufficiently fluid, is pumped into the tank wagons by means of the engine and rotary pump. It requires only 8½ minutes to fill a 600-gal. tank.

Air Drills Restore Tank

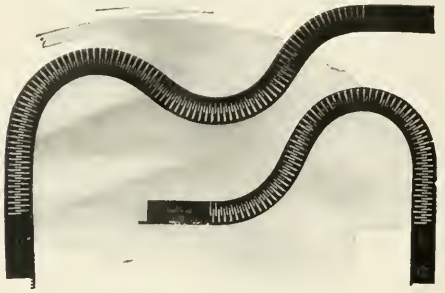
Another triumph was added recently to the many already credited to the mechanical engineering profession when the Johnson & Barry Steel Company, North Birmingham, Ala., accomplished the almost impossible task of restoring twelve large oil tanks, thirty feet long and ten feet in diameter, belonging to the Texas Oil Company, to their former career of usefulness. These tanks were a mass of burned and melted iron, full of great holes, bursted by various explosions during a recently fire. With a Chicago pneumatic boxer hammer the tanks were completely cut apart and straightened out. All rivets were removed by Boyer rivet busters

"BEFORE" AND "AFTER" PHOTOS OF TEXAS OIL COMPANY TANKS RESTORED TO USE WITH BOXER HAMMERS.

and the plates were riveted with Boyer riveting hammers. New iron was, of course, used to mend the spots where the iron was bursted out. Little Giant air drills were also used on this job and a Chicago pneumatic compressor supplied all the air used. The accompanying "before" and "after" photographs illustrate what a difficult task it was and how successfully it was completed.

A New Curve Rule

A new departure in flexible curve rules has been invented by the Keuffel & Esser Co., Hoboken, N. J. All of the flexibility of older rules is retained, together with an unusually light weight. The material is black xylonite, notched from



NEW FLEXIBLE CURVE RULE.

opposite edges, thus making the rule very flexible. On one edge is a ruling strip of black xylonite, and on the other a metal wire for retaining the rule in any curve into which it may be bent. Each extremity ends in a tangent.

Corduroy Trench Backfiller

A new back filler for sewer trenches has been put on the market by Pawling & Harnischfeger, Milwaukee, Wis., which is making a record for economy and rapidity of operation in filling pipe sewer trenches in Chicago. The accompanying photograph shows the machine ready for work and will make a brief description more clear. The machine is mounted with its rear wheels of the caterpillar tractor style, and it is mover forward or backward by its own power applied to these wheels. Steering is done by the engineer by means of the forward truck. The form of all the wheels is such that the machine can travel over very rough ground with ease, and so it can follow a trench readily thru the debris which is incident to sewer construction.

A jib boom is mounted on the frame of the machine, which is counterbalanced by the gasoline engine mounted on the other side of the machine, hidden by the driver in the photograph. This boom is a braced I-beam 22 feet long, which can be changed in length by adding an 8-foot extension.

The outer end of the boom is raised or lowered by the wire cable and the winch shown. The scraper is operated by the hoisting engine, which also moves the machine. It is of the drag-line excavator type and is of a special design, which does not require the services of a man to place it in position to be filled with dirt. By means of the two lines attached to it, which may be worked in opposition with each other, or either or both of them slackened up, the scraper can be dropped in position to take hold of the dirt at any point under the boom, and can be thrown to a distance of ten or fifteen feet beyond the end of the boom and catch the earth just as well. This makes the width of the space the machine can cover at least 40 feet. The scraper is 4 feet wide and built of steel plate, steel angles and oak planks, and is very ingeniously designed and mounted to make it self-acting.

The 12-h. p. 2-cylinder vertical hopper, cooled engine runs at 400 r. p. m. and is provided with a friction clutch of the internal-expansion-ring type, and is connected to the machinery by a high-speed roller chain. It has an efficient governor to regulate its speed, and the fuel is fed by pump from tank located in the base of the engine.

This backfiller has the corduroy traction, or caterpillar addition to the back-filler which the P. & H. company have had on the market for some time, and it weighs about 7 tons, as compared with 5 tons for the older machine.

The back-filler is a one-man machine, there being no necessity on straight work for but one man, and this one man, according to his own story on the job, can fill 100 feet of pipe-sewer trench in an hour or 900 feet in a 9-hour day. The cost of operating the machine is therefore very much less than that of filling the same amount of trench by hand. The standard price for backfilling on sub-contracts is about 8 cents per linear foot in Chicago, so that the 900 feet of backfilling, which is the machine's daily capacity, would cost $72 by hand. It is evident that with the machine the contractor can shade the standard price somewhat and still make a handsome profit on his investment.

The backfiller has been used successfully in cutting off the top of an old graded street, hardened by the travel down its center, making it easier for the trench machine to work, and it should be possible to use it for a number of similar purposes, thus making it a valuable piece of apparatus at all times for the contractor, and not alone for finishing up the job.

The writer has seen the machine operated successfully, tho, of course, more slowly, when the trench-filling material was piled in a row of trees. The engineer was able by throwing his scraper skillfully and running the machine forward and backward short distances to handle practically all of the dirt and scrape it into the trench and the side trenches for catch-basin and house connections. The ease with which the machine moved and the way in which the corduroy tractor followed the ground and bridged small breaks in the surface was remarkable, only less so than the certainty with which the bucket was dropped in the place for moving just the bit of dirt wanted.

Pawling & Harnischfeger will send any desired detail of information about the machine, which has now demonstrated its utility and its economy, and its ability to make good money for its owner and operator.

Enlargement of Gramm-Bernstein Company

The Gramm-Bernstein Company, of Lima, Ohio, makers of the well-known motor truck of that name, have done such an enormous business that in order to finance the concern properly a considerable increase in capitalization has been made, the method being to form the Gramm-Bernstein Motor Truck Company, with a capitalization of $3,000,000 common stock

and $1,000,000 preferred stock, to take over the business and operate it on the larger scale made necessary by the phenomenal development of the use of the truck.

M. Bernstein is president and treasurer of the new corporation and B. A. Gramm is vice president and general manager. Mr. Gramm is called the father of the motor truck industry, being one of the pioneers in their manufacture.

Mr. Gramm's inventions, including his transmission and transmission control, auxiliary drive off the transmission for driving hoists, pumps and the like, are among the important assets of the company.

The company's line includes trucks ranging in capacity from one to six tons, and they are successful in meeting any of the demands made by contractors or other truck buyers, as well as the foreign users of trucks for war purposes.

Fuel from Municipal Waste

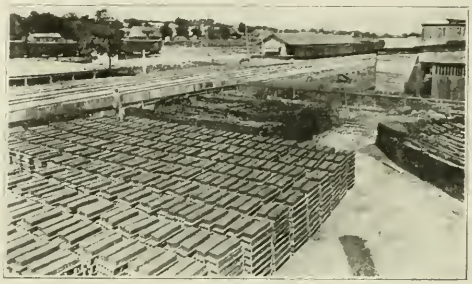
By T. J. Lacy, Austin, Texas.

The factory of the Austin Oakoal Manufacturing Company is now complete and in operation after having burned down once and after many setbacks, due to the necessity of originating the machinery required for producing the new fuel bricks in a profitable manner. The factory, which is at East Fourth and Brushy streets, has now been in operation several weeks.

The company is composed of about forty leading Austin men, who believe that they see a great future for this process of converting city garbage and refuse into a high grade fuel, and they are now planning the erection of a second plant. They say the trash and garbage collected by the carts of the city sanitary department is sufficient to keep two plants going.

From the standpoint of the city the new enterprise is regarded as a most fortunate development, for already the city government has experienced the greatest difficulty in finding places in which to dispose of the waste without arousing the active resentment of the residents of the neighborhood. The erection of a garbage disposal plant at a cost of $75,000 or more was seen as a necessary step in the near future had the Oakoal plant proved unsuccessful. The city's contract with the Oakoal Company is that the company shall dispose of all of the city's refuse and garbage in a sanitary manner at a cost to the city equal to about half the cost of incineration.

The manufacture of the fuel is quite interesting, inasmuch as it is made up entirely of waste material handled by common labor. The waste, which the city had to burn formerly in the incinerator, and the garbage is taken by carts to the factory and dumped. It is then sorted and the non-combustible materials, such as iron, bottles, tin-cans, etc., are segregated and sold. That which is left is placed upon a large belt and carried to a grinder, which reduces it to even sizes. It is then conveyed by elevator to a storage bin at the top of the building. Coal slack, another waste product, is shipped



MUNICIPAL WASTE AFTER TREATMENT, DRYING IN THE PLANT YARD.

in car loads and passed thru another grinder and placed in a bin alongside the first one. The two products now come together in a mix machine or pulper, where steam, hot water and creosote or water gas tar are injected, reducing the mass to a pulp.

The water gas tar is another waste product which the gas works usually run into the river or sewer. It contains a powerful disinfectant and its presence makes the finished product impervious to moisture. The hot steam thoroly sterilizes the material.

The product is now conveyed to a brick molding press, which presses the material into the shape of building brick at the rate of forty each minute. Each brick weighs two pounds. The fuel is then placed on wooden pallets and set aside to mature and dry. In a few days it is ready for market.

The plant gives employment to twenty men, including draymen, and is capable of making fifteen to twenty tons daily. The price for 1,000 bricks or one ton is $6.50 to the customer. The chemical analysis of the University of Texas shows over 12,000 B. t. u. per pound, as much as the best Oklahoma bituminous coal. Oak wood has 8,000 heat units and consequently Oakoal is one and one-half times as strong as oak wood in heat.

One of the best business men, a merchant in the city, has stated that he burned one ton of Oakoal in his cooking stove and it gave better results and lasted longer than two cords of oak wood. It is very good in heaters, fire-place grates, base burners, small boilers and ranges. It is burned successfully in bakery ovens. This fuel will be most appreciated by poor people in the cold season, when they can buy it at one cent a brick or less in quantities.

This new method of garbage disposal is creating considerable interest among municipalities, as the disposal of municipal waste in a sanitary manner has been both a troublesome and an expensive problem. The Mutual Film Company of New York have secured pictures of the plant in operation, which will be shown thruout the country.

The perfection of the system is due to several years' experiments of E. L. Culver, formerly of Austin, Tex., now located in the Conway Building at Chicago. Mr. Culver states that as a result of this plant several cities in the United States and Canada have adopted this system, and a plant of the most modern and up-to-date construction is being erected at St. Joseph, Missouri.

MUNICIPAL WASTE, GARBAGE AND TRASH, IN PLANT STORAGE BEFORE TREATMENT.

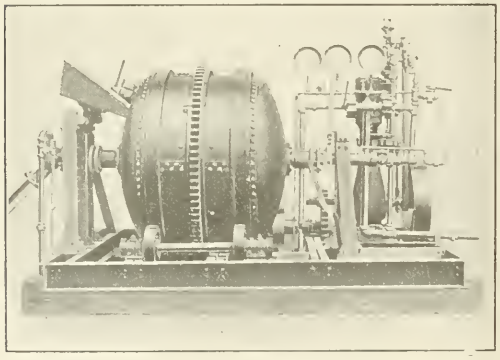
Radical Departure in Mixers and Conveyors

The hopper-type mixer and conveyor has proven to be a generally economical means of placing concrete in tunnels and certain types of mass concrete work, but a new and novel device recently has been perfected.

This machine combines mechanical mixing with pneumatic conveying and placing and is suitable for all types of concrete work of both large and small yardage, in light walls or in mass, re-inforced or unre-inforced concrete.

The device comprises a cylindrical drum set on a horizontal axis driven by an independent motor or engine. Within the drum are mechanical mixing apparatus and special contrivances for delivering the mixed concrete to the outlet thru which it is ejected by pneumatic pressure without any suspension of the machine's rotation. Following the ejection of one batch of mixed concrete the machine is stopped, recharged thru the hopper and the process is continued with unusual rapidity.

A pipe from 2 to 8 inches in diameter may be connected with the hollow trunnion outlet, and thru it this concrete is discharged in a continuous stream with a velocity of approximately 50 ft. per second, despite so low an air pressure as from 15 to 20-lb. per square inch. Most of the ordinary types of pneumatic distributing machinery have been characterized by air pressure fluctuations of from 5 to 40 lbs., but in this new device the pressure is maintained steadily and uniformly. The consistent output of mixed concrete nearly doubles the capacity of the machine and reduces the necessary amount of compressed air by half for every cubic yard of concrete placed. One of the prominent features of the machine is that concrete made with 1-inch stone may be



discharged thru a 2-inch pipe; 1½-inch stone concrete thru a 3-inch pipe; 2-inch stone concrete thru a 4-inch pipe, and, furthermore, concrete made with the run of ordinary crusher stone thru a 6-inch pipe.

Machines of this type fitted with 2 or 3-inch discharge pipes distribute the concrete to a total horizontal distance of nearly 500 ft. and a vertical height of 90 ft. The larger sizes, with 4 to 8-inch discharge pipes, can place it horizontally 300 ft. distant and 100 ft. high.

One man, beside those supplying material, is sufficient to operate the machines, which, up to even the 4-inch discharge pipes, have a capacity of between 20 and 50 yds. of concrete mixed and placed in 8 hrs. All labor from the mixer to and into the forms is eliminated, except for the two men who handle the delivery hose to place concrete directly into the forms. This two-man crew is sufficient for placing a small or large yardage.

Operating under favorable conditions the large new machine has an 8-hr. capacity of about 500 yds. of concrete. A 2-bag machine, with a 3-inch outlet, weighs in all about 8,000 lbs. and is run by an 8-h. p. engine or motor. It is said that a speed of about 16 r. p. m. produces the best results and any degree of consistency can be adequately handled with it.

The inventor and developer of the machines, James H. Graham, is placing it on the market thru the Pneumatic Placing Co., Inc., of New York City.

Trade Notes

Two of the three new motor pumps ordered by the Hartford, Conn., fire department have been delivered. They are American-LaFrance, of 750 gallons a minute capacity, with a chemical tank and hose and capacity for 1,000 feet of regulation fire hose. One of the machines replaces four horses and the other five heretofore in use. The third machine will be delivered shortly.

The Clydesdale Brick and Clay Company, of Pittsburgh, Pa., with a new plant at Elwood, Pa., has become a licensee of the Dunn Wire-Cut Lug Brick Company, of Conneaut, O. H. J. Orth is president of the Clydesdale company and W. W. Cunningham vice president and general manager. The Clydesdale plant at Elwood will have a daily capacity of 100,000 paving brick. It is the intention of the company to double the plant's capacity in the near future.

The Sewell Cushion Wheel Company, of Detroit, have opened a branch in Pittsburgh, at 711 First National Bank building, under the management of Mr. E. G. Burley. This makes the thirteenth branch which has been opened by this company, the others being located in New York, Chicago, Philadelphia, Buffalo, St. Louis, Boston, Cleveland, Minneapolis, Rochester, Baltimore, Seattle and Los Angeles.

For more than five years patent infringement suits have been fought in the federal courts between the Sanitary Street Flushing Machine Company, owners of the Ottofy patents, and various infringers. The Ottofy patent, No. 795,059, covers "any flushing machine made or that can be changed or adjusted to deliver a flat stream of water under pressure, forward and latterly, at an angle of 20 degrees or less." This claim having been sustained in the courts, Studebakers concluded to acquire the patent. The Studebaker Municipal Utilities Company was organized for that purpose, and is now the owner of the Ottofy and various other patents covering the modern art of street flushing. Flushers manufactured under these patents will in the future be marketed through the vehicle division of the Studebaker organization.

A. N. Moore, vice president and treasurer of the Oregon Portland Cement Company, of Oswego, Ore., on August 29 filed with the United States Court in Portland a suit charging fourteen cement companies of the United States and Canada with illegally combining in violation of the Sherman and Clayton anti-trust acts, alleging that they sought to restrict the production in his plant to one-sixth its capacity and to dictate the exact territory in which he may do business, and that the prices maintained cause the coast states to pay more than a million dollars annually in excess of what they should pay.

Trade Publications

Studebaker Corporation, South Bend, Ind., in their serial No. A 892, entitled "Analyze Your Bid," show their dump wagons and the details that are of special interest.

Dust-proof refuse collection is the subject of a booklet of H. Kastor, Hotel Netherlands, New York, descriptive of the Ochsner sanitary system of refuse and garbage collection.

The Barber Asphalt Paving Company, Philadelphia, Pa., puts it up to the reader of a recent circular to make the decision of the proper asphalt, and explains the reasons for the claims of superiority for natural asphalts.

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The World's Leading Municipal Publication

NOVEMBER, 1916.

A NOTABLE CONVENTION

The promise of the program for the Newark Convention of the American Society of Municipal Improvements, outlined under the same title in this department last month, was fulfilled completely, and practically every one left with words of commendation for the wealth of valuable papers and interesting discussions and the good care taken of the delegates by the local committees. The discussion of the valuable papers on sewage disposal was cut short by an eleventh hour demand for the convention hall for other purposes, but the papers themselves were most of them printed in the advance papers and covered all the work done during the past year and the answering of questions was the only necessary omission. Much of this was done in smaller group meetings later in the day.

Unexpected contests over proposed changes in specifications took time from presentation of routine papers on paving, but every one seemed pleased with the result and after lively discussions the Association reasserted its unvarying position regarding the manner of adopting changes in specifications and the revisions will be found as usual only those in details necessary to keep the specifications in close accord with the latest tested and approved methods of construction.

There was but one real exception to these general expressions of satisfaction with the convention, for the as yet unexplained habit of the *Engineering Record* of objecting to the methods and results of the modes of procedure of the Society led it into some criticisms of the Society's actions, which became so hysterical that they actually condemn the Society for doing just what the *Record* has demanded it should do, losing sight of the fact that its criticisms are applicable to the things the Society was asked to do and that the refusal of the Society to accede to these requests should be commended if the *Record* is to gain a reputation for consistency.

The Society is certainly alive and growing in importance and influence and attacks so obviously ill-informed and worse conceived seem to have the effect of making the value and high standing of the Society better known and the desire for membership in it more extended.

STATE HIGHWAY CONDITIONS.

Recent travel over representative sections of the highways of four states with highway commissions, with less detailed observation of roads in three other states, gives material sustaining the positions taken by MUNICIPAL ENGINEERING relative to the character of design and construction required for the most economical administration of the public highways.

The travel included bituminous and other pavements in the states early in the highway construction field, such as New Jersey and New York, where such road surfaces are becoming unbearably expensive to maintain, after some years of use, because the traffic has changed so in character and amount that pavements sufficient at the time of construction are now wholly inadequate except as foundations for more durable wearing surfaces. The fact that they are built with the proceeds of 20 or 50-year bonds makes no difference, but only demonstrates the folly of making bond terms longer than the estimated length of life of the roads, and the bad judgment of the designers in estimating the effect of road improvement upon the amount and weight of traffic over such improved roads. If the New Jersey estimates, that the tonnage capacity of motor trucks running on country roads is equal to the railroad tonnage capacity, are discounted even fifty per cent, the absolute necessity of providing for such enormous traffic in designing and constructing a new road is fully demonstrated. No traffic regulations should be permitted to dwarf such a development, tho such details as excessive weights, narrow tires, kind of tires and speeds in proper relations to each other are necessary to the permanence of even the most durable pavements.

The travel in Michigan showed that the small amount of state aid granted in that state has the effect of improving gradients, widths of roads and drainage facilities, and to a certain extent the quality of materials on the roads, but is not sufficient to develop the use of modern road surfaces. The result is good as far as it goes, but the main traveled roads are frequently impassable, because the traffic now running over them wears them out annually or biennally, and the state must reconstruct road surfaces on such roads before it can be said to have a real highway system. A few wealthy counties are doing their full duty in this regard, but the state at large is with reasonable speed putting itself into the condition of Indiana. In that state the local roads are excellent and in the main sufficient for the traffic over them, but the main traveled roads, built of the same gravel or light macadam, are either impassable at a reasonable speed most of the time or are practically reconstructed every year.

Travel in Illinois, Ohio and Pennsylvania showed the effects of designing the main traveled roads for the travel expected over them, and in these states most of the roads now building need not be reconstructed for many years and will require only incidental repairs if very reasonable regulations of trailers and of relation of speed to load are enforced, such as are now proposed in New Jersey.

State supervision of main highway construction and maintenance and state and national aid in liberal amounts on the trunk lines are fully demonstrated by the facts gathered on these trips to be necessities of modern traffic conditions.

STREET AND ROAD PAVEMENTS

THEIR DESIGN, CONSTRUCTION AND MAINTENANCE

EDITED BY CHARLES CARROLL BROWN, M. AM. SOC. C. E.

THE MAINTENANCE OF BRICK PAVEMENTS

Written and Compiled by the Editor

Maintenance of pavements is a subject which has never received the attention it deserves and there is practically nothing in print upon the subject. There has been no attempt at standardization of methods, determination of economics of repair or of neglect of repair nor of keeping cost data. The repair of streets is generally assigned to one of the less technical departments of the municipal administration and one which is subject to frequent changes in personnel on account of the demands of city politics. This doubtless accounts in large part for the unsatisfactory state of enlightenment of the average city government upon this important problem of municipal housekeeping. Fortunately, there are a few of the large cities in which, at least occasionally, the maintenance of streets is in competent hands and there is a little foundation on which to base an article such as this.

As to actual methods used in the repair of streets it is only possible in a single article to describe one or two of those producing the best results. The absence of any written discussions of the economics of street maintenance makes it necessary to devote much of the article to this subject, making it of as much practical benefit to the street superintendent as possible.

Resurfacing being one method of maintaining an old brick street, one or two methods of performing this work are given.

Undoubtedly some of our readers have devised special methods for brick street repair, others have figures of actual cost, and others have studied the question of when to repair a brick street in order to keep it in good condition for the least expense, and we hope to hear from all of them with additional information and in criticism of this article. City administrations need more help on the problems of street repair than in any other branch of construction and city officials are invited to contribute from their own stores of information for the benefit of the officials in other cities.

A BRICK pavement properly designed and constructed for the traffic to which it will be subjected is practically indestructible, and for such a pavement there is no maintenance required. Such a pavement is an ideal, however, which is seldom realized, so that every brick pavement will require at least slight repairs from time to time. Whether defects appearing shall be repaired or not, and if repaired, when, are questions which this article will discuss to some extent, giving experiences of those expert in their answer.

Soft Bricks.

The simplest defect appearing in a brick pavement is the soft brick. When such a brick is subjected to traffic it will wear faster than the surrounding bricks, and soon a depression is formed which brings the wear upon the surrounding bricks so that they receive greater punishment from the blows of the traffic dropping ever so slightly into the depression and therefore wear more rapidly than their fellows, and the hole rapidly increases in size and depth. When such a soft brick shows itself it should be cut out and replaced promptly with a new one. Every day's delay causes greater wear of the bricks surrounding it and makes more necessary the replacing of such bricks in order to make the repaired surface uniform with the pavement surface surrounding it. If the bricks in the pavement, all of them, have a high loss in the abrasion test, the repair must be made more promptly than if the bricks in general are hard. If traffic is light, a week or a month of delay may not count for more than a day on a heavy-traffic street.

To make such a repair the brick must be cut out, meaning its entire destruction, with chisel and hammer; the joints surrounding it must be cleaned out, the sand cushion must be carefully removed, renewed and compacted. The sand must be adjusted so that the top surface of the brick will be exactly even with the pavement surface surrounding it, and the brick must be removed and replaced as often as necessary to bring this result. No sand should be permitted to work up into the joints. Then the joints surrounding the brick must be completely filled until the surface is brought to its original smooth condition.

Monolithic brick pavements are yet too new to have required repairs, but it would seem that it might be necessary, in replacing a soft brick, to cut out the foundation somewhat to allow for the adjustment of the surface to perfect alinement. Sand-cement mortar would be used as the material in which to bed the brick.

Equal care must be taken, whatever the filler, and when cement filler is used the traffic should be kept off the spot repaired for at least 24 hours, and 48 hours or longer is much better.

Such repairs should be inspected at frequent intervals until it is certain that they are again integral parts of the pavement, equal to the areas surrounding them.

That such repairs are possible, even by those not particularly expert, in such manner that they are scarcely recognizable as repairs, is shown by the photograph accompanying of two rows of brick replaced across the street, where they had been removed to insert a street-light wire.

Displacement of Sand Cushion.

Should the adjustment or the compacting of the sand cushion be improperly done, or should it be possible for water to displace it, there will be irregular settlements of the brick surfaces. When cement filler is used these settlements result in cracked and pinched joints and spalled bricks, either at once or later, and with any filler the irregularities in the surface of the pavement produce excessive wear and increasing roughness of the pavement.

Here again the repair of a light-traffic street can be delayed, but that of a heavy-traffic street should be made as soon as the defect is noticed and the weather permits.

The proper maintenance of a street requires that defects in the original construction should be corrected when the repairs are made which they have made necessary. The cause for the defect should be ascertained, if possible, and enough of the pavement should be taken up and relaid to bring up the quality of the disturbed section to that of the street in general. It is not economical to carry this relaying any farther than this or to make the relaid section materially better than the rest of the pavement.

Relaying Defective Surface.

One of the accompanying photographs shows dimly the success possible in relaying a defective section of pavement so that the surface of the street is restored and the location of the relaid section is difficult to recognize. In this particular case some cement-filled street surface disturbed for excavations had been replaced by an area relaid with bituminous filler. This combination of two kinds of filler in the same area was causing the deterioration of the whole pavement, and so the whole affected area was taken out and relaid with cement filler.

The bricks were taken up and cleaned, the edges of the area being toothed so that the patch would join closely with the undisturbed pavement. Whatever old bricks could be used were used where they would fit best, quite a number of new bricks being required. The sand cushion was gone over carefully, and new clean material supplied as necessary. It was then carefully smoothed off to the required surface and compacted to some extent. The bricks were then laid in place. Lines of brick were laid across the open area where they would serve as guides and closing lines, and the courses of brick between these guide lines were carefully laid so as to close up as nearly as possible with only the widths of joint required by the lugs on the bricks. Very little trimming of bricks was required to make a neat and close-fitting job. The bricks were then thoroly tamped into place and adjusted until they formed a smooth surface, uniform with the surrounding undisturbed pavement. The grout filler was then carefully applied until all joints were thoroly filled, and traffic was kept off the area for 48 hours. The result is a patch, the edge of which must be hunted for, and a complete return to the original monolithic condition of the surface before the first excavation was made in the street.

These repairs were made by E. H. Christ, consulting engineer, in Grand Rapids, Mich., to whom we are indebted for the data for this description. Mr. Christ states that some of the patches made under the same contract as the above were protected from traffic for 24 hours and some for 48 hours, and he can see no difference in the results.

Cracks.

The subject of cracks in brick pavements is one on which there are so many differences of opinion that this article can only state a few of the problems and give such information concerning them as may be at hand, at the same time requesting contributions to the data available and criticisms of the opinions and results here offered. The discussion of cracks and their causes is applicable to any pavement, but the details concerning repair of them are here made applicable only to brick pavements.

TWO ROWS OF BRICK REPLACED OVER ELECTRIC LIGHT WIRE TO STREET LAMP.

Longitudinal cracks are attributed mainly to three causes: Insufficient allowance for transverse expansion, causing an elevation of the crown of the pavement sufficient to open a crack along the crown or at the weakest line of joints in its vicinity; heaving of the pavement, ordinarily attributed to absorption of water by the subgrade, freezing of water reaching subgrade or cushion producing an exaggeration of the heaving; settlement of a portion of the base, most likely along the edge, especially on a country highway.

Expansion and Contraction.

Many pavements, particularly on country roads where steel-tire traffic is not very extensive, go for many years with such cracks without serious deterioration of the pavement. Others are repaired by filling the cracks with a bituminous filler, which aids in keeping the surface water-proof and to some extent in protecting the edges of the crack from disintegration. Cement grout filling does not seem to be uniformly successful, as the next considerable increase in temperature produces the same rise in the crown and again opens the cracks. If the cracks are due to heaving or settlement, the grout filler may be more successful.

A complete cure for the longitudinal cracks due to temperature change would require the cure of the cause, which is probably either insufficient allowance for expansion or improper construction, causing obstructions in the expansion joint to the proper expansion of the brick or concrete surface. Flow of grout filler into the expansion joint, or leaving sand, bits of brick or concrete or other debris in the joint space cause longitudinal cracks in the pavement, and they are so

LARGE IRREGULAR PATCH IN GROUT FILLED BRICK PAVEMENT. SURFACE PRACTICALLY RESTORED TO ORIGINAL SMOOTHNESS AND CONTINUITY.

concealed that their effect cannot be exactly shown. It is seldom that the expensive reconstruction of the expansion joints along the curb is considered justifiable, and the filling of the cracks from time to time with a compressible filler is accepted as the best method available. In a heavy-traffic city street the life of the pavement is cut down, but the ultimate expense, including the earlier resurfacing required, probably justifies the course adopted.

If the cracks are due to heaving, drainage of the pavement is the only permanent cure, and this may mean a complete reconstruction, so the decision to fill the cracks with a grout or soft filler probably produces the most economical result.

In both cases the extra expense of keeping up the pavement and of the shortening of its life should be charged to defective design or construction.

With bituminous fillers no such difficulties arise.

Expansion Joints.

Expansion joints at intervals across the pavement were long considered necessary unless bituminous fillers were used, but the later years of experience have shown that so long as the pavement runs without material break in its surface, it is capable of carrying the strains from expansion by heat without injury, the only requirement being that there shall be no opportunity for movement. When a street surface has a straight line, or very nearly so, for surface cross-section, the longitudinal expansion joints along the curb are not necessary.

When an intersecting street is reached, if its crown is carried thru the intersection, it makes a break in the continuity of the pavement of the main street, and there is a probability of an arching of this cross-street crown and even an explosion of the intersection. On account of these frequent intersections of city streets, construction without cross-expansion joints is more satisfactory in country roads than in city streets.

Either the arching of the intersection described or the compression of a cross-expansion joint, if one is used at the intersection, allows a movement of the brick pavement in the vicinity. When contraction follows, the strength of the adhesion of joint filler with brick is not sufficient to draw the pavement back and there is a tendency to hair cracks in the joints, which later increase until the grout filler near the surface becomes disintegrated and the tops of the joints are left open and the edges of the bricks unprotected. This condition spreads until considerable areas of the pavement are affected. When these areas shall be repaired and how, is a question which no two street superintendents will answer alike, tho most of them will practically answer by letting the pavement go until the depreciation has become so great that holes are actually forming. This neglect greatly reduces the life of the pavement, but no one as yet has data enough to say what is the economical method of procedure.

One of the accompanying photographs shows a method of preventing the movement of the pavement at its end by putting in a heavy sandstone header, backed up so as to give weight and bearing enough to withstand the expansive force of the pavement. It will be noted that some tendency is shown to crowd the bricks up along the beader at the ends of the short rows made because the railroad track runs diagonally across the street. This looks as tho the pavement were being shoved uphill (to the left), but is probably due to the lifting of the ends of these short rows on account of the transverse expansion. This displacement has not as yet become sufficient to warrant relaying, altho the pavement was laid in 1910. When the joints have been pinched and opened again often enough to show serious disintegration, the relaying should be done and the tendency of the bricks to rise near the header be restricted, if possible.

Iron Covers as Anchors.

The fourth photograph illustrates two or three difficulties met with in connecting brick pavements and iron covers.

At the right side is a defect which is found also in pavements where part of the pavement rises for any reason and has a tendency to fold back over the immovable pavement behind. The joints are pinched at the top and the edges and tops of the bricks are spalled by the concentration of the force on the upper edges of the joints, and the surface is left rough and jagged and ready for the destructive action of the traffic

HEAVY STONE HEADER AND BACKING AT DIAGONAL END OF BRICK PAVEMENT ALONG RAILROAD TRACK, NECESSARY TO PREVENT MOVEMENT FROM EXPANSION.

passing over it. Unquestionably such places as this should be taken out and replaced as promptly as possible. Whatever is the cause of the lifting of the pavement to produce the difficulty should be discovered and removed, if possible, and then the repaired pavement will keep its place. This may be the shoving of the brick against an immovable manhole top, as in the photograph, or the pushing of the casting into the pavement, or the partial sliding of a section of the pavement up on a header or an inlet or some other anchor which is not quite square with the pavement. Loosening up the anchor so that it can move with the pavement, if it is surrounded on all sides by the pavement, will prevent the same occurrence in the repaired pavement. Dressing the header so that the force will act at right angles to the bearing of the brick on the face of the header will hold the pavement in place. Each place has its own particular variation of the problem of keeping the pavement from moving.

The longitudinal crack running to the right from the manhole has been observed many times in well-designed and constructed brick pavements with manhole or other covers set solid on their bases so that they cannot move. They have been seen with both sand and mortar cushions under the bricks. They are likely to run in but one direction, but sometimes a smaller crack runs out in the opposite direction from the larger one. Again, when the pavement is weak, as it is near an intersection laid with diagonal courses, the cracks may run out in other directions and sometimes for considerable distances, following joints rather than breaking bricks, when the line of force is diagonal to the direction of the courses.

The crack is apparently caused by a lifting of the brick, but why the brick should lift at this particular spot (which may or may not be on the crown of the street), and not elsewhere in sufficient amount to cause or continue the crack, is not so evident.

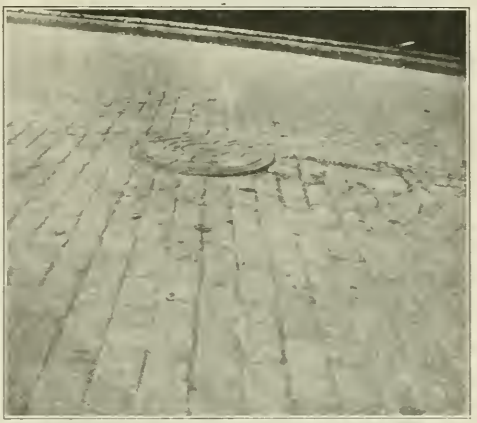
The photograph was taken on a street in Greenville, Mich., laid in 1910, by E. H. Christ, of Grand Rapids, consulting engineer, which has shown but one such defect prior to the excessive hot weather of 1916, and now shows two or three. The pavement was laid under the specifications adopted by the A. S. P. S. in 1911 and had the closest of inspection under Mr. Christ and Charles H. Gibson, mayor of Greenville at the time, who were able in this way to obtain an exceptionally good street with remarkably few defects, the worst of which is shown in this photograph. Mr. Christ contends that if the manhole cover had been set free of the manhole and the concrete foundation so that it could move on the top of the concrete foundation of the brick pavement, back and forth as the expansion and contraction of the pavement might affect it, there would be no rock against which the wave in the pavement could break and therefore no defect in the pavement. He goes so far as to set lamphole covers over valve boxes, large enough so that the motion likely to occur in any direction will not be great enough to prevent the operation of the valves.

Most of the defects observed in brick pavements will arrange themselves in one or another of the classes above described.

Resurfacing.

Resurfacing is one method of maintaining a brick pavement, and is something to which every pavement is subject at some time.

The resurfacing may be done by taking up the brick surface, repairing breaks in the foundation, cleaning it up and laying a new brick surface according to standard methods. Before taking up the old pavement its defects should be studied carefully by an expert and the new construction should be designed to overcome the difficulties shown by the former pavement, the reason for which is usually not difficult to find.



DEFECT IN BRICK PAVEMENT DUE TO MANHOLE SET SOLID IN CONCRETE FOUNDATION AND INTERFERING WITH EXPANSION OF PAVEMENT.

When the brick pavement is rough and uneven, largely on account of rough and uneven tho thoroly compacted foundations, it may be advisable to resurface with some other material laid on top of the brick. This can be done readily if the brick surface has been worn down so that the thickness of the new surface material will not interfere with the proper drainage of the street. The only place where adjustment of the new and old surfaces is difficult is ordinarily in the gutters, where the old surface has not been worn down as much as the main traveled parts of the street, and along street-car rails. The latter adjustment is so difficult that it is seldom attempted.

Resurfacing with Asphalt.

Columbus, O., has resurfaced many old brick streets with asphalt, and the following description of methods and results is taken from a paper before the American Society of Municipal Improvements by Thomas H. Brannan, superintendent of asphalt:

One of the first questions to be considered in resurfacing brick with asphalt is that of surface drainage. All of our old streets were laid with a 6-inch gutter. After a 3-inch coat of binder and top has been put over the old brick, it therefore leaves a very shallow gutter. On streets having a lateral grade of 0.6 per cent. or over this is not so serious, but for grades less than 0.6 per cent. a 3-inch gutter may not be deep enough to carry the water. On these streets one of two things can be done, viz.:

The first method is to take up the old brick in the gutters for a width of 3 to 4 feet from the curb and lay a concrete base to such a grade that when the gutter is paved with new brick these brick will be high enough at the outer edge to form a shoulder for the edge of the asphalt and be 6 inches below the curb at the gutter line.

The second method is to take up the old brick for a distance of 3 to 4 feet from the curb, then concrete this space, leaving it low enough along the curb to lay asphalt and still maintain a desired depth of gutter. The outer edge of the concrete can be brought to the level of the old brick and an asphalt roadway can then be laid from curb to curb. This will increase the transverse grade or crown of the street near the curb, but not enough to be seriously objectionable.

Before any asphalt is laid on old brick it is essential that the old brick pavement be cleaned and all of the dirt removed

RESURFACING OLD BRICK PAVEMENT WITH ASPHALT USING BINDER COAT AND WEARING SURFACE COAT. ASPHALT LAID FROM CURB TO CURB.

from the joints to a depth of at least ½ inch. This is done most effectively by flushing with a fire hose. It can also be done by raking out the joints with sharp pointed picks, or hooks, and then sweeping. If flushed, it is necessary to give the street some time to dry out, and for this reason the sweeping is preferable during the late fall months.

In case the old brick are worn thru at any point or are more than 3 inches below the general grade, these holes or depressions are cleaned out and concreted. At intersecting streets it is necessary either to go back of the properly line a few feet and relay the brick, bringing them up enough to form a shoulder for the asphalt at the lot line, or to take up the brick in the wing and let the new asphalt pavement down enough to meet the existing pavement on the cross-street.

A closed binder, containing from 20 to 25 per cent. of material passing a 10-mesh sieve, is preferable to a paint coat. A paint coat of asphalt must be cut back with naphtha in order to apply it, and unless this naphtha entirely evaporates before the top is laid it is likely to work up thru the top and be detrimental to the pavement. The large variation in the thickness of the top, however, would be the greatest objection to the paint coat. The wide-tread roller bearing on the different depths of top, will compress the thinnest portion the most and leave the deep spots only partially compressed. Trucks going over the pavement after it is completed will further compress the deep spots and form depressions in the pavement. The depressions thus formed will likely produce shoving and destroy the pavement.

We use 1½-inch top and 1½-inch binder on these streets. The 1½-inch binder is figured on the basis of 1 cu. yd., box measurement, laying 20 sq. yds. Whatever excess there is over this amount is paid for by the cu. yd. as extra binder.

Where the brick foundation is very irregular the binder is laid in two courses. The depressions are first filled and rolled and then the 1½-inch binder is laid. An examination of the under side of a slab of binder taken from a cut on a resurface job of this character showed the print of all the brick, and also showed the binder driven in between the brick sufficiently to give a good bond.

The average amount of binder required on all the streets that have been laid was .022 of a cu. yd. per sq. yd. of top. This, at $7 a cu. yd., would be an item of about 15 cents a sq. yd. for extra binder. This amount, plus 5 cents a sq. yd. for cleaning, deducted from the cost of excavation and new concrete, represents the saving that can be made on this kind of construction.

In our city, with concrete figured at 70 cents a sq. yd. and excavation at 95 cents a cu. yd., this saving would amount to

Brick Streets Resurfaced with Asphalt—Columbus, Ohio.

Streets	Width	Completed	Thickness	Sq. Yds. Asphalt	Price per Sq. Yd.	Extra Binder per Sq. Yd. Top Cu. Yds.	Cost of Extra Binder per Sq. Yd. Top	Total Cost per Sq. Yd. Incl. Extra Binder
Gay St., High St. to 5th St.	46.5	11-1912	2 in.—1 in.	7,218	$0.92	$0.043	$0.05	$0.97
Fifth St., Long to Broad St.	24	11-1912	1½ in.—1½ in.	2,577	1.22	.005	.03	1.25
Sixth St., Broad to Town St.	30	11-1912	1½ in.—1½ in.	3,979	1.25	.0127	.09	1.34
Wilson Ave., Broad to Bryden	30	7-1914	1½ in.—1½ in.	5,037	1.37	.0313	.22	1.59
Monroe Ave., Broad to Oak	30	9-1913	1½ in.—1½ in.	1,274	1.40	.0301	.21	1.61
Grant Ave., Broad to Naghten	32	9-1915	1½ in.—1½ in.	4,793	1.36	.0261	.18	1.54
18th St., Long to Mt. Vernon	30	8-1915	1½ in.—1½ in.	3,264	1.35	.0207	.13	1.48
20th St., Broad to P. C. C. & St. L.	30	8-1915	1½ in.—1½ in.	10,716	1.36	.0366	.25	1.61
Bryden Rd., Ohio to Miller	40	7-1915	1½ in.—1½ in.	10,066	1.36	.0201	.13	1.49
10th Ave., High to Neil	30	8-1915	1½ in.—1½ in.	7,289	1.34	.0118	.08	1.42
15th Ave., High to Indianola	30	8-1915	1½ in.—1½ in.	3,943	1.36	.0154	.11	1.47
Dennison Ave., Buttles to Fifth	30	1916	1½ in.—1½ in.	13,720	1.39	.0371	.26	1.65
				73,876				

75 cents a sq. yd. of finished pavement. This saving, compounded annually at 4 per cent., would amount to $1.35 a sq. yd. at the end of fifteen years, or enough to almost renew the pavement.

Another advantage of this form of construction lies in the fact that it is not necessary to have a street torn up nearly so long for repair, and, if required, it need not be closed to traffic at all except on the day that asphalt is being laid on a certain portion of the street.

As a general proposition I would not advise attempting to surface over the old brick on a street having a car track. The only way that this can be done, if the brick are left in, is to raise the track, and this causes a bad condition with regard to the grade of the tracks at all intersecting car lines.

Bituminous Resurfacing.

The laying of a less expensive and apparently less durable resurfacing on a brick street is described by Herbert W. Hatton, consulting engineer, Wilmington, Del., in a letter to the editor, from which the following is taken:

In 1911 the writer was supervising the laying of 16,000 sq. yds. of brick pavements at Cambridge, Md. Part of this work was thru the business section and part thru the residence section. It was desirable to lay the one as durable as possible, while the object of the second section was to obtain durability, but at the same time to reduce the noise of such pavement to a minimum. To accomplish this result cement grout was used to tie the brick together in the business section and Pioneer Asphalt filler was used on the work in the residence section.

Strict supervision was maintained on all the work to see that the joints were filled from the bottom up and not poured cold just in the top of the joint. The asphalt was maintained so hot that it ran like water, and because of a 6-inch crown used in a 30-foot street, the asphalt ran from the joints on the side, flooding the brick. As the appearance was bad, instructions were given to use coarse sand in the top of the joint as soon as it was filled, and also to use the sand as dams to prevent the asphalt running out of the joint.

The result was that this entire section of pavement was covered with an asphalt coat and sand. Thus accidentally this pliable top was given to the pavement, which effectually deadened the noise, and at the same time gave two years of actual wear before the brick were exposed to traffic.

The city of Wilmington, Del., for many years laid brick and vitrified block pavements, and, using poor judgment, failed to place any but coarse sand foundations. In the early spring and during continuous rainy seasons the water would go thru the sand joints used and cause a floating or saturated sand foundation, with the result that the blocks became uneven and the edges badly spalled. Other vitrified block pavements which had been in service a number of years, laid on a concrete foundation, were also in need of repairs, so that, following the results obtained at Cambridge, the suggestion was made to use a tar or asphalt water-proofing cover on these brick pavements, and follow by using ¼ to ½-inch screenings, with dust out, to be ironed into the tar under traffic. Accordingly the street department undertook the work by force account to try it out thoroly, believing better results would be obtained when the work was not done for the greatest profit to be obtained therefrom.

The street was thoroly washed under a pressure sprinkling wagon and roped off from travel. All depressions of an inch or more depth were carefully cleaned when the street had dried and the sand or grouted joints were hand-broom swept after being scraped, and the dust and dirt removed. A day was selected when the pavement was thoroly dry; ¾ to 1-inch stone was placed in all depressions after the bottom surface had been tar-swabbed, using tarvia. The entire surface was then flooded with a ⅛-inch coat of tarvia A, being swept from joint to joint and carefully brushed and rubbed in with wire brooms. Immediately following the rubbing-in process ½ inch of dustless screenings was spread over the street to completely cover the tarvia, with the result that under traffic a street presenting a surface similar to bitulithic was obtained.

This surface still adheres after more than two years, showing that brick pavements can be repaired at little expense for many years of additional service when they appear worn out.

Ninth street, in the same city, was almost impassable, the brick being worn into deep depressions. It was decided to make more permanent work in making repairs. Accordingly the street foundation was carefully prepared in the same manner, but the stone pockets were omitted. Before placing the

RESURFACING OLD BRICK PAVEMENT WITH ASPHALT, USING BINDER COAT AND WEARING SURFACE COAT. NEW BRICK GUTTERS AND ASPHALT LAID BETWEEN THEM.

ABOVE: AN OLD BRICK PAVEMENT IN ST. JOSEPH, MO.

BELOW: THE SAME PAVEMENT RESURFACED WITH LUTZ SURFACE HEATER IN 1908 USING A TWO-INCH ASPHALT COVERING, AS IT APPEARED IN 1916 AFTER EIGHT YEARS OF WEAR.

tar coat, wrought iron nails 3 inches long were driven down between the brick joints about every four rows, a foot to two feet apart, staggered. The tar coat was then applied, and immediately thereafter a covering of bitulithic to a depth of 3 inches was placed. This was carefully rolled and a seal coat was applied. After five years of heavy traffic this street surface has remained in as good condition as when it was first placed.

A factor of vital importance in the selection of a type of pavement is the per cent. of grade and the crown given the street.

The secret of the durability of the pavement on Ninth street is its grade, which varies between 3 and 7 feet to the 100.

After making an extensive tour inspecting street pavements, thru the New England States south to Washington, D. C., careful observation permits the statement that all stone-mixed bituminous pavements must have a grade not less than 2 feet to the 100 to wear well, and if the fall is greater the life of the pavement is not hurt thereby.

In Waterbury, Conn., a bitulithic pavement on a .5 per cent. grade went to pieces in a year. In Wilmington, on Delaware avenue, where the grade is .5 to 1 per cent., the same results obtain, except that the life is probably one to two years.

Asphalts will not adhere as well nor the results of coal tar coats for resurfacing, and all pavement covers are inclined to peel and loosen unless the work has been done when the surface has been dry, with little or no moisture in the foundation. Any sweating of the foundation is sure to cause the surfacing to loosen and it provides a means for frost to get in its deadly work.

It is not possible to obtain good results unless the tar first coat is scrubbed in, as it were, with wire or very stiff brooms. This scrubbing cuts any dirt or dust coating held on the surface and gives the tar a chance to grab hold.

Standard Method of Making Repairs.

The city of Buffalo, N. Y., has the reputation of looking after its street repairs with the most minute care of any city, and its annual reports give in detail the cost of repairs in actual amounts spent, in cents per square yard actually covered by repairs, in cents per square yard of total area of each street repaired. With knowledge of the method of construction of each street, taken from the city's records, any desired study of methods and results can be made. For the purposes of this article the following statement of the methods of repair followed is sufficient. We are indebted to George H. Norton, city engineer, and J. A. Vandewater, assistant engineer, for it:

An inspection of all pavements is made each spring, as soon as the weather permits, and defects are noted. A list of the pavements in need of repair is then made and the streets are taken up in their order as nearly as possible, those in bad condition being repaired first.

Depressions exceeding ½ inch in depth under a 4-foot straight-edge, holes, disintegrated brick and cracks over ½ inch in width are taken up and repaired. The joints of the patch in the good pavement are carefully chiseled out, the old brick that are not broken or badly worn are thoroly cleaned and turned over when relaid. The brick are laid to fit the old courses and the joints properly broken. The sand cushion is raked up and enough new sand added to bring the brick up to about ¼ of an inch higher than adjoining pavement after ramming. This is done to allow for compression of the sand cushion. Joints are grouted in the usual manner with a mixture of one part each of portland cement and clean, sharp sand.

We have a few old pavements laid with a pitch filler, but we usually grout the joints. After repairs are made the patches are covered with a layer of sand to protect them from traffic, and they are also barricaded for about 48 hours, and longer if possible. Repairs are made with uniformity as to color of brick.

Where it has been impossible to obtain the same size brick as originally laid, a strip is taken up for full width of the pavement, relaid with new brick and the old brick used for patching. This frequently happens on some of the old streets which were laid with a small block.

Cracks under ½ inch in width are cleaned out and filled with a cement or bituminous filler.

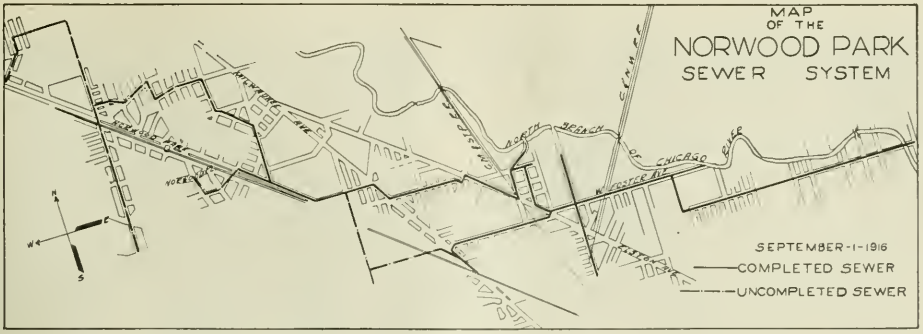
The repair gang consists of 3 pavers, 2 pounders and 10 to 12 laborers, and 1 or 2 teams, as required. Pavers are paid at the rate of 60 cents per hour, pounders 31.25 cents, laborers 25 cents and teams 75 cents. One of the pavers acts as foreman and locates the patches and size of same, keeps a record of the material used and the time of the men and teams.

The cost of repairs per square yard during the past five years was as follows:

1910-11	77.10c
1911-12	90.50c
1912-13	83.80c
1913-14	69.50c
1914-15	99.10c

This is the actual cost of work done on the street and does not include yard and office expense and supervision.

The cost of repairs on yardage maintained by city on streets repaired only during the past nine years varied from $0.0151 to $0.0716 per sq. yd. each year.



CHICAGO'S NORWOOD PARK SEWER

METHODS OF CONSTRUCTION

This brief article on a large subject touches points of value to the contractor and constructing engineer. The data are collected from various sources, including visits to the work in progress. The two contracts and the contracts for pipe-sewer branches to the main sewers are notable for the great variety of machinery in use on them, in sewer excavation, sewer laying, trench filling, etc. Not all of them could be covered in this article, but there will be others.

THE Norwood Park sewer system, in the northwestern part of Chicago, Ill., is a large one draining territory southwest of the north branch of the Chicago River and north of Wilson avenue to the western city limits at Maynard street, south of Bryn Mawr avenue, and the west boundary of Norwood Park and Edison Park north of that street. The accompanying map shows the extent of the two systems, the full black lines showing the brick sewers completed between July, 1915, and September 1, 1916, and the broken lines the sewers still to construct, which the contractor expects to complete in 1916, about a year ahead of the time set in his contract.

The system includes 14 miles of circular brick sewer, 2½ to 10 feet in diameter and 16 to 22 feet deep, and many miles of smaller vitrified pipe sewer.

Brick Sewer Contracts.

The brick sewer was let in two sections, No. 1, the Argyle street system, and No. 2, the Forest Glen system, both contracts being taken by the H. J. McNichols Company, of Chicago. The total amount of the two sections is about $750,000.

In each section the sewer increases in size up to 9 feet in diameter and has an overflow outlet into the North branch, the dry weather flow of sewage running farther down in a smaller sized sewer to a discharge into the intercepting sewer system of the city whence it is carried or lifted into the Chicago river on its way to the great drainage canal. Thus the sewer in West Foster avenue increases from 5 feet diameter at Milwaukee avenue to 9 feet near its overflow into the North Branch, but it divides there, the storm water excess flowing into the North Branch thru a 6.5-foot sewer and the sewage flowing in a 5-foot sewer to Argyle street and thence east, increasing to 6 feet at the lower end near North Francisco avenue.

The plans call for 3-ring brick work on all the sewer 6 or more feet in diameter and 2-ring on smaller sizes. Over 26,000,000 brick are used in the sewer. In Section 1 are included 121 manholes, 286 standard catch basins, 2 concrete bulkheads and a special brick overflow. In Section 2 are 184 manholes, 342 standard catch basins, 8 large catch basins, 1 bulkhead and a special brick overflow.

There are 4 street car crossings, 8 steam road crossings, 5 of which were tunneled and 3 timbered; one 24-inch and four 12-inch water-main crossings. Pavements on 15 streets and 7 intersections were taken up and will be replaced. Six old sewers were taken up and many connections were made with old sewers and drains.

The entire area is flat and much of it was low and swampy and will be greatly improved by the drainage afforded by the sewer. Most of the excavation has been in clay.

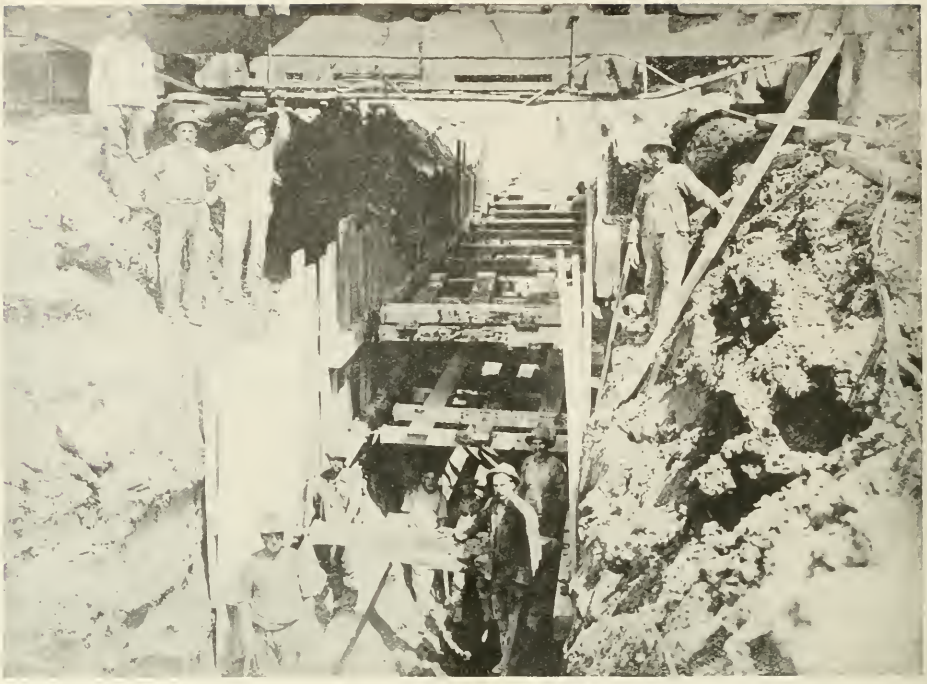
Trench Excavation.

The excavation of the trenches for the sewers over 4 feet in diameter, is done with steam shovels, Bucyrus 45-C shovel being used on Section 1 and a 60-C shovel on Section 2. The smaller shovel has a 30-foot boom, 40-foot dipper handle and 1-cu.yd. dipper, and the large one a 36-foot boom, 52-foot dipper handle and 1½-cu.yd. dipper.

The frames on which the shovels are mounted straddle the trench and are supported on wooden rollers, running on timbers laid along the trench. A cable attached to a convenient tree or to a deadman ahead is handled by an extra drum on the machine and hauls the machine ahead at each move.

The dipper of the 60-C machine has a heavy cutting lip instead of teeth and the bail is inside the lip so that it does not interfere with cutting the sides of the trench. The grade of the bottom of the sewer can be maintained within a fraction of an inch if the operator is expert, and it requires very little trimming to fit the bottom of the trench to the shape of the sewer brick work, whether it is circular, as in good material, or is flat or any other shape required for a foundation in poor material.

The shovel excavates from 12 to 16 linear feet of trench at each setting, the distance depending on the depth of the trench and the length of the boom. The sides of the trench require very little trimming to make them smooth enough to set the trench sheeting and bracing, and this is done as soon as the section of the trench is excavated and before the machine is moved forward. The wait is very short, and the machine is quickly moved forward to begin work on the next



SHEETING AND BRACING GANG AT WORK UNDER STEAM SHOVEL WHICH IS READY TO MOVE UP.

section. One large photograph shows the trench excavated, the sheeting and bracing placed and the machine ready to move forward. The frame, the rollers and the timbers on which they travel are clearly shown. One of the small photographs is a view on the surface, showing men laying planks for the rollers getting ready to move the machine forward.

The last photograph, looking back from the machine, shows the bricklaying.

There are 3 men required to operate the steam shovel, 2 men smooth off the bottom, 4 men do the sheeting and bracing, who are served by 4 men passing the sheeting down and 4 men pulling the sheeting in the completed section. This is the average force on a 9-foot sewer.

Brick work is kept up close to the rear end of the shovel, invert being laid first and followed by arch on wooden forms in the usual way. For 9-foot sewer, 10 brick layers are required, with 5 tenders.

These men constructed about 150 linear feet of completed 9-foot sewer in an 8-hour day. On 6-foot sewer the average is 200 feet a day.

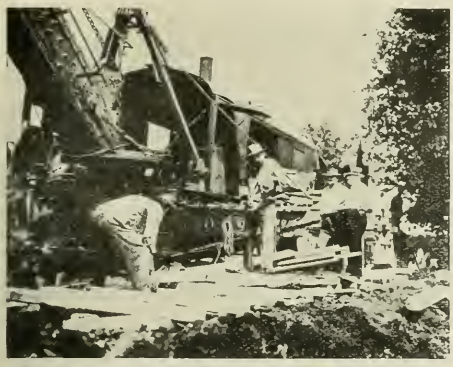
On Section 1 there was considerable sewer 4 feet or less in diameter. On this work a steam Parsons trench excavator was used. It cuts a trench 78 inches wide and up to 20 feet in depth.

Trench Filling.

The process of filling the trench over the completed brick sewer included two stages. Immediately behind the brick laying and as soon as the cement mortar had set, earth was shoveled in and tamped in place along the haunches and over the arch so as to well cover the sewer. The black surface soil is more easily handled and if convenient was used first, followed by the clay of the lower part of the excavation.

Much of the sewer is located in areas as yet undeveloped and so the immediate consolidation of the earth in the trench is not everywhere insisted upon. At a convenient time the second stage of the trench filling is completed with a backfilling machine. After the steam shovel on Section 1 followed a steam tractor on the front of which was mounted a swinging boom which can be raised and lowered. This is operated by a hoisting engine, which also operates an ordinary drag scraper of about a half-yard capacity. On the tractor are an engineer and fireman. Two men handle the scraper, to guide it to fill under the pull from the engine. As observed by the writer, an average of 5 scoops a minute seems easy to maintain. The earth is hauled thus into the trench and is heaped up over the trench to a height of 2½ feet above the tops of the manholes, making the total depth of fill at that place 12½ feet, the width of trench at bottom being that for a 5-foot brick sewer, or about 6½ feet, since it was not necessary to carry the trench bracing below the springing line of the sewer arch. The boiler requires 1,000 to 1,100 pounds of coal per 9-hour day. The contract price for filling this trench was 35 cents a linear foot. The boom of the machine is 52 feet long and the scraper can be thrown by the engineer some 10 or 15 feet beyond its end. The tractor wheel rims are widened by the use of wooden slats and it runs along the open side of the sewer, and draws the earth from the bank on the opposite side, so that a considerable width must be covered by the boom and the scraper. The machine observed was put together by Sol McKeen and he holds patents on some of its details. He expects to make some improvements which will reduce the number of men required to handle the machine. When the machine is used to fill pipe sewer trenches, 24-inch tile or less, the machine will fill 1,600 feet of trench per 9-hour day.

Behind the Parsons excavator a smaller machine of like



LAYING PLANK TRACK FOR ROLLERS UNDER MACHINE IN PREPARATION FOR MOVING UP.

nature with gasoline engine is used. Surplus earth is used for filling low areas in the vicinity.

On some parts of the work the earth as excavated was dumped into cars and hauled back and dumped on the completed sewer behind.

On Section 2 the backfilling was done with a Marion revolving steam shovel equipped with an orange-peel bucket. This machine was moved forward on wooden platforms, which were picked up in the rear by the revolving boom and set in place in front by it. The crew of this machine consisted of the operator and 4 men. Excess material was used for leveling streets.

Many branch pipe sewers are being laid to connect with the completed portions of the brick sewer.

Backfilling Pipe Sewer Trenches.

For backfilling these pipe-sewer trenches, small backfillers are used. One of these observed is operated by the builders, A. Vogt and Son, and they have had it in use about four years. The frame on which the gasoline engine, hoisting machinery and boom are mounted is on wide-rim wheels of small diameter and the machine is moved forward as desired by means of a block and tackle attached to a pin driven in the ground ahead and pulled by a horse. The boom does not swing. The flat scraper is hauled back by a man and held in place to drag its load into the trench. The operator, a scraper man and a horse driver who is also a general utility man, are required to operate the machine. It will fill 400 to 600 feet of trench a day. The price for filling pipe sewer trench is 6 to 7 cents a linear foot, according to depth and conditions, heaping the earth up over the trench. If the trench must be flushed or otherwise consolidated, so that the machine must go over it a second time, the cost is increased.

Another trench filler in operation on pipe sewer connections was the P. & H. machine described in MUNICIPAL ENGINEERING in September. This machine, made by Pawling and Harnischfeger, of Milwaukee, Wis., is mounted on a caterpillar tractor and is moved forward and back at will by its own power. The design of bucket is such that it is drawn into the earth to be moved by the line to the hoisting engine, so that on straight work but one man is necessary to complete the filling. When the earth is to be heaped up over the sewer and not otherwise compacted, this machine will fill 900 feet of pipe sewer trench per 9-hour day. The machine is light and is easily handled and the caterpillar tractor makes it possible to run over irregular and loose soil and even bridge small trenches.

We are indebted to C. D. Hill, chief engineer for the Board of Local Improvements, for data, and to *The Excavating Engineer* for illustrations used in this article.

LOOKING BACK FROM THE STEAM SHOVEL OVER THE BRICK-LAYING GANG, SHOWING COMPLETED INVERT IN FOREGROUND, ARCH FORMS, BRACING AND SHEETING IN PLACE, BRICK LAYERS AT WORK AND FIRST STAGE OF TRENCH-FILLING PROCESS.

Paving by Direct Labor versus Contract Work

By Charles A. Mullen, Director of Paving Department of Milton Hersey Company, Montreal, Quebec.

The author, who is director of the paving department of the Milton Hersey Company, chemists, engineers and inspectors, prepared for A. Guy Ross, one of the five members of the board of control or city commissioners of Montreal, Que., the following parallel between street paving by the city on force account and by contract. There is a pronounced tendency in the comparison to put the statements on the day labor side of the page in the form most favorable to that system, and to put the statements on the contract side in the form most unfavorable thereto, which makes it necessary for the reader to weigh each comparison carefully and correct it according to his own knowledge and experience. Nevertheless, the points for consideration are clearly and concisely stated and the ground is very thoroly covered, so that the article can be used as a guide to a thoro study of all phases of the subject.

The points on the two sides are arranged in two columns opposite each other for convenience of comparison. The left hand column shows the case for the day-labor system and the right hand column the case against the contractor.

Mr. Mullen wrote this article in advocacy of day labor, and is quite willing to have some advocate of the contract system recast the facts as he sees them, which Municipal Engineering *will also be very glad to publish.*

THE City can, if it will, employ the best men, purchase the best materials and equipment, and proceed with paving or other public work in the best possible way. No one can do better.

The City, having control of a definite and large amount of work, can employ men steadily, and guarantee them better working conditions.

The City, having control of the full purchasing power and a knowledge of the local supply, can secure the best unit prices and best deliveries.

The City, knowing that it will be in business this year, next year and the year after, can afford to purchase and install the most modern and efficient equipment, and to acquire sources of supply for materials where possible. A sand bank and stone quarry should be acquired in the case of nearly every City.

The City knows it can proceed with its paving industry in a definite and assured manner, with more work to do each year, and its equipment never idle or scrapped for lack of work ahead.

The City knows it can do the work as economically as any one. If labor gets more pay, the cost goes up correspondingly and no more. If labor is more efficient, it results in a benefit to the general public. The City gets what it pays for and pays for what it gets.

The City employes have no incentive to do poor work. They do not profit by putting less than the required amount of material into a mixture, or by laying less than the required thickness. If their work is not good, they are very likely to lose their jobs. The quality of the work is the primary factor, the cost is secondary.

The City Manager of public works will require, if he is a good man at his job, that the work be well done, without the waste of either labor or material, so that ultimate human economy will be attained.

The Contractor can, if he will, employ the same men, purchase the same materials and equipment, and proceed with paving or other public work in the same way, and no better.

The Contractor, depending upon the chance of each letting of contracts for his work, cannot guarantee men steady employment.

The Contractor, having control of but that part of the purchasing power embraced in his contract, cannot secure the best unit prices or the best deliveries.

The Contractor, not knowing that he will ever get another job at the same place, must be very circumspect in his investments in equipment, often using inferior machinery that represents a smaller investment and therefore a smaller possible loss. He cannot afford to acquire sources of supply especially for the purpose of a single paving contract.

The Contractor has no assurance of what tomorrow will bring. He takes a gambler's chance, and charges for it in the price of pavement. Gambler's chances do not wear well as street surfaces.

The Contractor knows he cannot do the work as economically as the City, but believes that by paying his labor less and working his men harder, he can overcome the difference. To this he must add his various expenses, and—last but not least—his profit.

The Contractor's employes have no incentive to do good work. Their employer profits by putting less than the required amount of material into a mixture, or by laying less than the required thickness. If their work is not cheap, they are very likely to lose their jobs. The cost of the work is the primary factor, the quality is secondary.

The Contractor Manager of public works will require, if he is a good man at his job, that the work be done at a profit —honestly if possible, but at a profit anyhow. He has no thought of ultimate human economy in the matter.

The City can do all its paving work under one centralized management. It occupies but one office. Employs but one estimator, one cashier and one overhead organization thruout, thereby effecting the greatest possible economy in those who are indirect and not direct producers.

The City employes do public work with a view to having it last as long as possible at a given unit cost that is based on a study of ultimate economy. They have not in mind the showing of a profit on their employer's books, and can work scientifically and unhampered.

The City can re-use all old material that is taken from the street in the process of preparing it for paving, or other old material that it may be securing at the same time from other sources, or that it may have on hand. This is an important item that will grow in importance as the years pass.

The City will do the best possible job under a given specification. It is to the City's interest to do so.—Note *a*.

The City can easily adapt its work to any change in conditions as time, material, supplies, the public demand, and more modern knowledge seem to dictate. It makes no iron-bound contract with itself. (*b*)

The City does not need to give itself a surety bond. It wants the work done, can do it, and proceeds at once with the actual construction. (*c*)

The City does not need to give itself a guarantee. It does the work itself, knows what it is and whether or not it will last. City-made pavements usually do last—without the guarantee. (*d*)

The City asphalt plants have never been known to bribe or attempt to bribe city inspectors, city engineers, city superintendents or the mayors of cities.

The City does not need to employ "stand up" inspectors on its own work. It only requires a force of men to control and direct its operations, and these men can proceed without outside interference from counter interests.

The City usually has in the bank, while the work is in progress, the money to pay for the work as it is completed. If this money is not being used by the City, the bank has it to loan to the contractor at a high rate of interest.

The City asphalt plants do not hire lawyers to bring suits against the City for "extras," breach of contract, and a number of other items well known to the legal profession.

The City, in doing its own work, will make many improvements in the equipment for and the process of manufacture, and the improvements will belong to the City.

The City lays street paving for use. All its employes' efforts are naturally bent in the direction of securing the greatest use value. (*e*)

The Contractor must have his own overhead management, and each other contractor competing with him must have the same. He must have his separate office, his separate estimator, his separate cashier and his separate complete staff of clerks, whether he always has business for them or not.

The Contractor does public work with a view to having it last—if he is a wise contractor—at least until he can get to the City Hall and collect the money. All contractors have not been wise, and some paving work the writer has in mind did not even last that long.

The Contractor cannot be trusted to use old materials judiciously, and if he could, it is above reasonably human possibility to draw a contract, in most cases, that would give reasonably definite limits for the re-use of old material and a just credit to the City therefor.

The Contractor will do the cheapest possible job under a given specification. It is to the Contractor's interest to do so.

The Contractor will stick to his contract, and if the City wants to make a change, the City will have to pay the Contractor liberally for the privilege of doing so, as he has acquired contract rights.

The Contractor must give the City a bond, which costs him in the neighborhood of one cent per square yard. This he adds to the price he quotes the City.

The Contractor gives the City a guarantee bond. The bonding company charges him about one cent a square yard for this, which the Contractor also adds to the price he quotes the City.

The Contractors have been notoriously guilty of bribery in all its forms, even reaching in some cases to the bribery of the governors of states.

The Contractor must employ the same men to control and direct his work that the city would require, and the City must then employ and pay additional men as "stand up" inspectors to see that the contractor's men do as directed.

The Contractor usually goes to the bank, borrows practically the City's money, pays interest on it, and then charges the City interest for the use of practically its own money, figured as an overhead cost, in the Contractor's unit price for paving.

The Contractor frequently works on the basis that there is more money in suing the City than in doing the work. He knows how to trump up all sorts of fictitious claims, and his lawyers frequently put them over.

The Contractor, in doing the City's work, will also make some improvements in the equipment for and the process of manufacture, and the improvements will not belong to the City.

The Contractor lays street pavement for profit. All his employes' efforts are naturally bent in the direction of extracting the greatest possible profit.

a—The difference between the best job and the poorest job that can be done under the standard specifications for asphalt pavement is very considerable—yet, both will meet the requirements of the specifications and the contractor would be able to collect the same amount of money for the poorest as for the best. Specifications must be drawn with some latitude, or they are unworkable and will not hold at law.

b—The City of New York built a driveway for speeding horses about ten years after the public had taken to speeding automobiles. The contract had been let many years before, and while the preliminary work of regulating and grading was in progress, the public demand changed. This was a contract running into several millions of dollars.

c—Contractor's surety company bonds are notoriously not good, as the writer found out in detail at Schenectady, New

York, where a contractor, whose city specifications had called for concrete under curb, had "forgotten" it; and when this was found out, the City was not able to collect damages from him or his surety, or to make him deliver the goods for which one of his former associates in the City employ had paid him.

d—What the City wants is good pavements on its streets, not red tape and gilt-sealed guarantees on bonding company stationery. A good asphalt pavement should last ten years on a very heavy traffic street and one has now lasted thirty-seven years on a medium traffic street, Vermont avenue in Washington, D. C., laid in 1879, in front of the old Arlington Hotel. Why then should a City be satisfied with a pavement that is guaranteed by some Contractor and his bonding company to last five years, and laid by the Contractor of the cheapest quality that he thinks will last just five years and one day.

If the Contractor's pavement fails, before his five-year guarantee expires, the bonding company pays its lawyers liberal fees to prove it wasn't the Contractor's fault anyway—and the lawyers usually succeed.

e—The City that, having its own municipal asphalt plants, talks of abandoning them to go back to the contract system, if its officials are honest but misguided, merely seeks to exchange the evils that it knows for the far greater evils that it knows not of. The City government that is too incompetent to do work by direct employment will also be too incompetent to get any but the worst results from the contract system, plus all the disadvantages above enumerated.

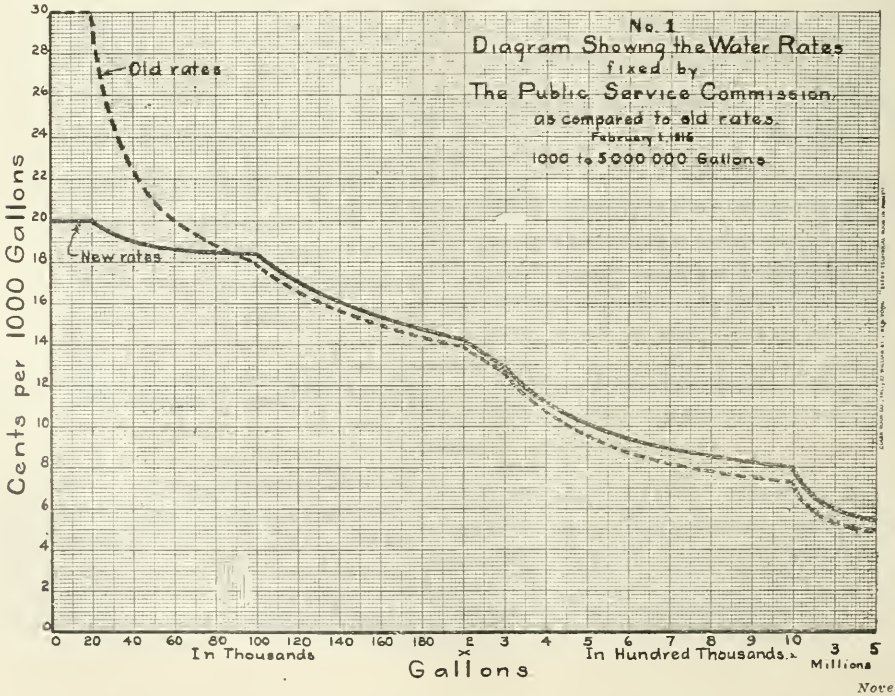
In conclusion, whenever a City government is in a position to take the entire output of an economical unit of any industry, the City should own such a unit of that industry and operate it by direct labor efficiently employed under specialists in the particular field, paying the best of wages, maintaining the best possible working condition, and requiring faithful and loyal public service from the men employed therein. A City will thereby create its own public monopoly, doing away with the duplication, and waste, and private profit for which no adequate service is rendered, that are the undeniable fruits of competition for the right to take an unearned profit from the City treasury.

Effect of Water Rate Changes

In February the Indiana Public Service Commission modified the rates for metered water of the Terre Haute Water Works Company, the following table showing the new rates and the old rates. The reductions are for the small consumers, and there are increases of most of the rates for the larger consumers:

	Per 1000 Gallons. New Rates.	Old Rates.
For the first 20,000 gallons in one month.	20c	30c
For the next 80,000 gallons after the first 20,000 gallons, in same month.....	18c	15c
For the next 200,000 gallons after the first 100,000 gallons, in same month...	10c	10c
For the next 700,000 gallons after the first 300,000 gallons, in same month...	6c	5c
For the next 2,000,000 gallons after the first 1,000,000 gallons, in same month..	5c	4½c
For the next 6,000,000 gallons after the first 3,000,000 gallons, in same month..	4½c	4½c
For all in excess of, or in addition to, the first 9,000,000 gallons, in same month	4½c	4¼c

The company has prepared a diagram showing the two schedules of rates, the old shown by the broken line and the new by the full black line. The sudden changes in the lines are caused by the change in the horizontal scale at the 1,000, 100,000 and 1,000,000-gallon points.



November, 1916

REMOVAL OF SNOW IN PARKS

PROBLEMS AND METHODS

By H. S. Richards, Superintendent of Maintenance and Repair, South Park Commissioners, Chicago, Ill.

Prompt removal of snow is found to be the most efficient and economical method in the parks of Chicago, as well as in the streets of New York. The system in the latter city was described in MUNICIPAL ENGINEERING *for February, 1916, vol. L, p. 220. In the following article the author describes the system in use in the South Park district of Chicago. It was presented to the American Society of Municipal Improvements at its last meeting.*

ONE of the most exacting duties of a park official is that of maintaining walks and drives in good condition for travel at all times, even during or shortly after the severe snowstorms of winter. In a park and boulevard system like that of the South Parks in Chicago, which has boulevards leading thru the crowded downtown business districts, where the traffic at certain hours is exceedingly dense, as well as thru the residence districts in which travel is rapidly increasing year by year, problems are met with that are sometimes quite difficult of solution. In this paper I will deal with those concerning snow removal and disposal as they are handled by the South Park Commissioners, Chicago.

The operations connected with this line of work may be outlined as follows:

1. The necessity for an immediate opening of paths thru the snow on the walks and drives and this for several reasons—

(a) to facilitate traffic;

(b) to prevent packing the snow which would result in an increased cost of removal;

(c) to protect the pavements from the wear occasioned by traffic, which usually follows the ruts worn in packed snow;

(d) to prevent the possible formation of a dangerous icy coating by alternate thawing and freezing.

2. The actual removal or disposal as soon as possible after paths have been opened, of all snow from walks and drives in the busy downtown sections by hauling to the dump or otherwise.

Horse-Drawn Plows.

As to the methods of handling the snow-cleaning problems, the first means used for cleaning the walks and opening paths on the drives was that of horse-drawn plows. On all the walks, except those in front of business houses in the downtown district, who clean the snow off their walks and deposit it in the streets, both one and two-horse plows are used—the V-shaped plow for one horse and small road graders for teams. These types have answered the purpose fairly well as they are easily handled.

Snow removal from the drives has proved a more difficult problem, as some traffic is constantly passing along packing the snow, even while it is falling. The type of horse-drawn plow that has given most satisfactory service has been the four-wheeled adjustable-blade road grader. Hitches of from two to four horses, depending on the depth of snowfall and its character, as to whether it was dry and light or wet and heavy, have been used on a machine. On most of the boulevards and in the larger parks these plows are used in groups of four to six, all traveling in the same direction and lined up diagonally in such a way as to clean the entire drive in one round trip. The first plow throws the snow from the center of the drive toward the gutter, each succeeding plow cleaning its swath and throwing the ridge of snow closer to the gutter until the last plow has piled it up along the curb. In going in one direction one-half of the driveway is cleaned and on the return trip the other half. Some of the boulevards have two drives, one on each side of a central strip of lawn. On these the snow is all cleaned towards the central parkway so as not to pile it up in front of the homes on either side of the boulevard.

In the South Park System there are at present 45 miles of drive from which snow is cleaned in winter. To cover these drives with horse-drawn plows in a reasonable time would require a larger equipment of horses and plows than now on hand—in fact, several times as large—as the horses cannot travel faster than a walk thru the snow and altho heavy draft horses have always been used, the work with a moderate snowfall is quite wearing on them. While horse-drawn plows are covering their routes some snow is being densely compacted by the constantly passing traffic, with the result that these plows remove little more than the loose snow, being practically unable to rip the packed snow off the pavements, to which it adheres very firmly. Ruts are formed in the packed snow and traffic following these ruts wears down thru the snow to the pavement. As automobile tires in winter are usually equipped with chains, the resulting wear of such traffic on the narrow strips of pavement at the bottoms of the ruts damages the pavement considerably, necessitating costly repairs in spring.

Motor Snow Plows.

As soon as motor trucks became practical vehicles we tried various snow plow attachments on them, but have never found one that will clean snow as desired. Quite a little time and money was spent in fitting up a five-ton truck for snow cleaning work, but it did not give satisfactory service. One of the chief difficulties for a long time was the lack of traction when moving ridges of snow from the centers to the sides of the drives, even after a moderate fall of snow. As soon as the ridges acquired any depth to speak of the motor plows became helpless thru lack of traction, not that the motors were not powerful enough, but because the trucks become "stalled" and slide sideways with the rear wheels revolving on the pavement.

In the winter of 1914-1915 a new type of snow-cleaning machine came to my notice. This outfit consisted of a three-wheeled gasoline tractor fitted in front with a V-shaped plow or mold-board which was removable, and a large revolving street broom mounted on wheels to be attached behind the tractor. The construction of the outfit was quite heavy so as to withstand the strain of plowing thru banks of heavy wet snow. The plow blade has considerable curve, which causes it to travel quite close to the pavement when plowing, and on one side of the plow there is an adjustable extension or wing, which can be set at any desired angle as conditions require.

Demonstrations were given which showed the ability of the outfit to operate satisfactorily under the different conditions of snowfall usually met with, and the result was that the Park Commissioners ordered three of the outfits for service in the winter of 1915-1916. As the need for snow cleaning is felt most in the congested downtown district, which is also the most difficult district to clean, the three tractor plows

TRACTOR HAULING LOADED WAGON.

were assigned principally to that district. After various preliminary trials it was learned that the broom attachments were the best for cleaning walks and for very light snow on the drives, while for the heavier snows the tractors gave better service with the plow attachments. It was finally decided that the best plan for this district was to fight the snow while it was falling and not permit it to accumulate at all nor give it any chance to become compacted by traffic.

So it was arranged that two of the tractors with brooms and the third with plow as well as revolving broom should be put into operation shortly after snowfall began and continue operating as long as snow was falling. The third tractor was equipped with a plow in addition to a broom because it had to move the ridge of snow swept aside by the two tractors immediately preceding it. The snow was cleaned from the center to the sides of the drive, the machines traveling with the traffic at a rate up to ten miles per hour, so that they made a round trip over a particularly busy stretch of downtown boulevard a little over a mile in length every fifteen or twenty minutes. The snow is continually being brushed towards the sides of the drive ready for hauling to the dump, so that practically as soon as the snowfall ceases the machines are thru with this stretch of downtown driveway and it is in good condition.

When the machines finish work on the above mentioned drive the revolving brooms are removed, the tractors hook on the plow attachments and are then sent out to assist the horse-drawn plows in cleaning the balance of the park and boulevard drives, the tractors being given the preference for the busy boulevards, as their rate of travel is much greater than that of the horse plows, making them less inconvenient to the traveling public. By changing shifts of drivers the tractors can be operated twenty-four hours per day; this makes them of special value for work during the night, when we do not have horse-drawn plows in operation and when the traffic is not so heavy as in the daytime. Altho the road graders could also be operated all day and all night with changes of horses and drivers, that plan is not so practical on account of our inability to secure additional teams and drivers after storms, which is the time we need them the most; and the additional cost would be considerable.

These outfits have been tried out on light dry snow, heavy wet snow, sleety or icy snow and snow packed by traffic, and under these different conditions they have given first-rate service. At their rate of speed of nine to ten miles per hour, with sweeper attachments, they are able to secure good results with revolving brooms in places where horse-drawn sweepers will not operate properly. The speed of the latter is not sufficient to revolve the brooms fast enough to prevent the bristles becoming clogged with snow, in which condition they will not sweep the snow aside. This trouble is not experienced with the tractor brooms, as they revolve too rapidly to become clogged, and consequently clean the walk or drive pretty thoroly. With our three tractor outfits we have been able to keep a section of down-town drive one and an eighth miles long practically clean and open for traffic during a snow falling at a rate not exceeding one inch per hour. It is our intention to add to our motor snow-cleaning equipment year by year so as to gradually replace the horse-drawn plows.

Cost of Snow Removal.

As to the comparative cost of work done by tractor plows and by horse-drawn plows, carefully kept records show that we have been able to do snow cleaning with tractors at a cost considerably less than that of work done by horse-drawn machines. The tractor outfits are particularly valuable in breaking up packed snow and ice, and in plowing on the drives they can throw the snow in ridges several feet deep on top of the curb, leaving the gutters entirely free and open, which is a most desirable feature. Horse-drawn machines are able to plow only a part of the snow up over the curb, leaving most of it in the gutters.

No matter how well a working force may be organized, it seems that at times, as in emergencies for instance, previously

DUMPING LOADED WAGON. 11,600 LBS. OR 14 CU. YDS. AT 830 LBS. PER CU. YD.

made plans will not work out to perfection. Sometimes we get caught by sleet storms, which cover the drives with frozen slush and ice, leaving them in a bad and dangerous condition. After one such storm last winter considerable slush was frozen on one section of driveway which we had been unable to finish cleaning before it froze. The next day the ice was picked loose and hauled to the dump. When using laborers it was found that it required four men with picks to loosen enough to keep a team busy hauling it away. We soon learned that a tractor pulling a road grader worked very well on the frozen slush and ice and with this combination enough was loosened in one hour to keep seven teams busy four hours.

Disposal of Snow.

In addition to plowing or sweeping, the tractors, with plow and broom attachments removed, have been repeatedly used to good advantage in hauling wagons loaded with snow from the down-town district to the dump. For one of the tractors an especially large wagon, holding 14 cubic yards, water measure, was built, and the tractor had no trouble handling it. A special device fitted to this wagon enabled the tractor to dump out the 14 yards of snow in a few seconds.

I have for some time thought of disposing of the snow on the down-town boulevards thru the sewers, so as to eliminate the expense of taking it to the dump, so last winter a device consisting of a water turbine armed with three free blades and mounted in a wire cage or basket of a size to permit it to be set in a sewer manhole was made and tried out. The water turbine was connected with a fire hydrant, the stream of water revolving the turbine and then flowing thru the wire basket into the sewer. The free blades on the turbine agitated the snow shoveled into the basket and mixed it with the water, which carried it on thru the sewer. With a pressure of 15 to 25 pounds the machine disposed of all the snow that two men could shovel into the wire basket, and with a higher pressure it should take care of all that four men can shovel into it.

Granulated rock salt sprinkled over the drives has also been used for removing snow. There have been some complaints, however, against its use on the park and boulevard drives, the chief objections being that it has a tendency to melt the snow and form puddles of water, which is splashed upon automobile bodies, where it forms white spots when dry, due to the salt dissolved in the water; also, that it is tracked into stores and houses, soiling floors and carpets. For this reason we have had to use it sparingly, and then usually to "rot" or weaken the icy coatings formed after sleet storms or on densely compacted snow and ice, so that snow plows or graders would be able to rip such coatings loose from the pavements. Immediately after sleet storms walks and drives are made safe for travel, until the snow-cleaning machinery can remove the ice, by spreading torpedo sand lightly over them from specially designed wagons and carts.

The problems connected with snow removal and disposal are becoming of more and more importance every year and merit considerable attention, but it will undoubtedly be some years before machinery and methods are perfected which will enable us to meet all the requirements in a practical, efficient and economical manner. Until then every contribution towards the solution of these problems will be heartily welcomed by those who realize the importance of snow-cleaning work in our large cities.

Concrete Street Light Post

This is one of the variations in concrete of a standard three-light design for street light post. It has the common fault of many such posts, whether of metal or concrete, in that the post and the arm are quite too heavy in appearance for the day-lit street. They look too heavy, both because the post takes too much room in the street and because they are so much heavier than the work they are doing requires. They will not withstand a shock from collision much better than a smaller, reinforced post, and so they are really not much more dependable and the loss of one occasionally may be made up by the material saved in using a lighter construction.

The New York State Bureau of Municipal Information

The State Bureau of Municipal Information, operated by the New York State Conference of Mayors and Other Officials, from its office in Albany, is now a year old and should be quite proud of its record.

The number of reports sent to city officials of the state during the year was 1,583, an average of 132 a month. The number of general municipal subjects under research on which reports were prepared was 172. The in-and-out mail of the bureau in eight months was 10,508 pieces.

The bureau is now making a comparative analysis of the 1916 budgets of cities, classified by size, as a basis for comparison of conditions, expenditures, total and per capita, populations, etc.

Two full reports, on street cleaning and on sewage disposal, were prepared and distributed during the summer.

Among the subjects on which minor reports were made are snow and ice removal from sidewalks, sidewalk and curb assessments, billboard ordinances.

WORKERS IN THE FIELD

Tests of Concrete Blocks and Vitrified Brick

The Editor of MUNICIPAL ENGINEERING:

Sir—Comparative tests of paving or other materials ought to establish at least a reasonable basis for comparison. Tests which demonstrate with mathematical precision the known fact that no legitimate comparison can be made between two things have no practical utility for engineers or others who understand the purpose of tests to be to add to the sum of useful knowledge.

In the August number of MUNICIPAL ENGINEERING appeared an illustrated article setting forth the results of rattler tests conducted in part for the purpose of determining the wearing qualities of vitrified paving brick as compared with concrete.

Concrete blocks, composed respectively of mortar concrete, concrete, gravel concrete and crushed stone concrete, were made the size and shape of paving brick.

The brick and the concrete blocks were subjected to a rattler test at 900 revolutions, 1,800 revolutions and 2,700 revolutions for all kinds, and 3,600 revolutions for the brick and a portion of the concrete blocks.

The results show the average percentage of loss in weight at 900 revolutions of the rattler as: Brick, 13.7; mortar blocks, 23.2; concrete blocks, 36.6; crushed stone concrete, 37.5; gravel concrete, 35.7.

At 1,800 revolutions the average losses were: Brick, 20.6; mortar blocks, 41.4; concrete, 56.4; crushed stone concrete, 59.1; gravel concrete, 53.7.

At 2,700 revolutions the average was: Brick, 26.2; mortar concrete, 62.7; concrete, 71.1; crushed stone concrete, 75.5; gravel concrete, 65.6.

It is not necessary to carry the report out to the fourth dimension, as the usual test for paving brick, as required by the American Society for Testing Materials, is 1,800 revolutions at a speed of not less than 29.5 nor more than 30.5 revolutions per minute.

The test under consideration was made with the rattler revolving thirty times per minute, a speed conforming with standardized requirements.

The report of the test shows that at 1,800 revolutions brick had abrasion loss as low as 16.4 and as high as 24.2, with an average of 20.6.

The concrete blocks had a minimum loss of 37.5 and a maximum loss of 63.4, with a general average of 52.65.

It is difficult to understand how a paving material having an average abrasion loss of more than 50 per cent. in weight can be brought into serious comparison for wearing qualities with a material having a loss of only about 20 per cent. of weight, more especially as the maximum allowed loss in weight of brick in a rattler test is fixed at 22 per cent. to 24 per cent. in most of the cities of the United States.

But a test ought to be conducted under true competitive conditions. Brick are as ready to be rattled and laid in a pavement when they are taken from the kiln as they will be after a lapse of time. A brick pavement usually is kept closed ten days or two weeks, but only in order to allow the cement grout to set thoroly.

Concrete is placed in a pavement in a plastic state and a concrete pavement usually is opened to traffic three or four weeks after its completion. At the utmost, six weeks are allowed. As a rule a brick pavement is ready for traffic in half the time required to render a concrete pavement usable at all.

But in the test reported in MUNICIPAL ENGINEERING the concrete blocks subjected to rattler test were allowed to stand for ninety days, or three months, before being tested.

The fact that the brick also were kept ninety days has no significance, as brick do not vary in hardness or toughness after being taken from the kiln. The concrete blocks, however, were given an extraordinarily long time in which to harden before they were put in the rattler. This can hardly be regarded as a test of concrete under service conditions. If the concrete blocks had been tested for abrasion at the expiration of the period at which concrete roads are opened to traffic after being finished, the test would have been more just, as both brick and concrete roads are opened to traffic, and, therefore, they are subject to traffic abrasion, long before ninety days from time of completion.

But under no conditions would an unbiased engineer of competent judgment regard a 52.65 per cent. material as comparable with a 20.6 per cent. material for road surfacing.

In the report of the test under discussion the implication is made that concrete in a pavement wears better than would small concrete blocks, for the reason that concrete pavements are laid in large blocks or slabs.

The implication is justified by the facts; but the argument applies with even greater force to brick in pavements, since a grouted brick pavement is one continuous monolithic slab from end to end, and the individual brick have several times the abrasive resistance of concrete, either in blocks or slabs.

Concrete pavement slabs, on the other hand, are only 25 feet long, the slabs being divided by transverse joints.

Any defects which develop in modern brick pavements can always be traced to weakening of either the concrete foundation or the cement-grout bond. The brick themselves will wear indefinitely—at least for fifty years—without repairs, if the foundation and the bonding material hold. Weakness, if any, always develops in the cement or concrete used in construction.

It is obvious that Mr. Roman's test does not establish a justly comparable relationship between the wearing qualities of concrete and brick as road surfacing materials. The test, as Mr. Roman says, was chiefly valuable as a means of bringing out certain facts relating to the comparative wearing qualities of neat cement, mortar and concrete. So far as the test

determines this point, it is of practical service to the engineering profession.

Nevertheless, the fact that the concrete blocks were fashioned of the size and shape of paving brick, and were tested in competition with brick, indicates that one of the purposes of the test was to determine the comparative wearing qualities of paving brick and concrete. As the result shows that there is really no practicable comparison, on account of the great superiority of brick, it is logical to infer that one object of the test having failed to produce expected results, the secondary results assume prime importance.

These comments are not offered in a spirit of criticism of either Mr. Roman's intent or his results. Mr. Roman is to be commended for undertaking the tests. It is thru the efforts of such independent investigators to ascertain facts and reduce them to a basis of scientific accuracy that the range of helpful knowledge is extended.

In all fields of modern activity scientific inquiry and experiment are needed, nor is the department of highway engineering an exception to the rule.

While Mr. Roman's test has demonstrated the futility of entering concrete in competition with vitrified brick for durability, Mr. Roman did not invent his facts; he merely recorded the results of his tests, as an impartial investigator is in duty bound to do.

F. A. CHURCHILL,
Dunn Wire-Cut Lug Brick Co., Conneaut, O.

Hand Road Oiler Used in Los Angeles County

The Editor of MUNICIPAL ENGINEERING:

Complying with your request I would advise that the Los Angeles county road department adopted the use of a small hand oiler which is part of the equipment of the trucks in the maintenance of paved ways.

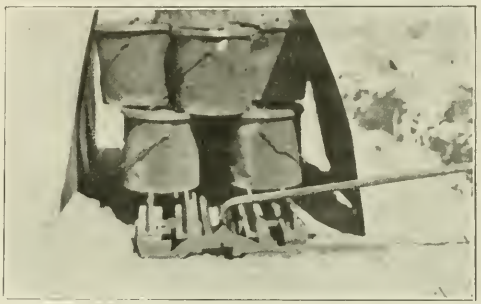
The hand oiler is made of a sheet iron boiler about 2½ ft. in diameter and 3½ ft. long. It has a cast iron pot hanging in the center of the boiler capable of holding 20 gal. of oil. A fire box surrounds the pot, which is used sometimes to keep the oil at a certain temperature. The boiler is supported between 2 iron wheels and is so balanced that the center of gravity is below the axles, thereby always keeping the pot in an upright position. There is a handle on one side of the boiler which is used to move the machine from one place to another.

On the opposite side and on top of the boiler, the hand crank for the oil pump is located. The oil pump is the most important part of the little heater and is fastened to the bottom of the oil pot. The pump is a rotary pump and is driven by a sprocket and chain, which runs to the sprocket on the hand crank located on the top of the boiler. This pump is capable of a pressure of from 6 to 10 lb. The pump is connected with a 20-ft. metallic ¾-in. hose, with a 3½-ft. piece of ¾-in. pipe at the discharge end. The pipe is plugged up with a plug having a slot cut in it so that the oil discharges in a spray. The pipe also has a throttle for turning on or shutting off the oil.

ROAD OILER WITH HEATER AND HAND PUMP.

The oil that is used in the heater is hauled to the various warehouses when hot and is put into 4-gal. pressed steel buckets. The oil cools very quickly and is cold when it is loaded on the maintenance trucks to be taken to the job. When the oil arrives at its destination the buckets are placed in 2 long rows on the ground, one upon the other, so that a fire may be built between the buckets and the oil heated to the necessary temperature.

Up to about 2 months ago wood was used to heat the oil, but at the present time the oil is heated by a distillate and water burner invented by one of our foremen of paved ways gangs. The burner occupies very little room and oil is easily heated in 15 min. to 500 deg. F. during rain or shine. The burner is especially efficient in winter, as it does away with using wet wood for a fire.



HEATER FOR BUCKETS OF OIL.

With this new heater about 80 buckets of oil may be heated at one time. When the oil is heated to between 400 and 500 deg. F., about 15 to 20 gal. are poured into the hand oiler. One man pushes the oiler to the spot to be repaired, another works the pump, and a third man does the spraying of the oil.

On street oiling as much as 125 gallons per hour may be applied. The best results may be obtained from this hand oiler by heating the oil to about 500 deg. By heating the oil to the above temperature it is not necessary to maintain a fire in the hand oiler. A fire in the hand oiler often proves very injurious to the oil pump, as it causes a coating of oil cake to form in the bottom and sides of the pot. This in turn will get into and clog up the pump.

A man, after handling the spraying nozzle, can apply any specified amount of oil to the square yard very accurately. This hand oiling machine, after castings are made, is assembled at our mechanical shop.

I am enclosing photographs of this machine.

F. H. JOYNER,
Road Commissioner, Los Angeles, Cal.

Civic Co-operation in Chicago

The civic co-operation plan of The Industrial Club of Chicago, which as been in operation for a period of more than six months, is believed to be a practical success. About 3,000 citizens are now enrolled, and reports of their activities show that they have been given a continued and practical opportunity for civic helpfulness. No report has yet been made of over-officiousness of any kind. The city authorities are co-operating heartily and practical results are being accomplished. The Industrial Club at its recent annual meeting voted unanimously to continue the Co-operator movement at its own expense. Angus S. Hibbard is chairman of the committee.

FIRE DEPARTMENT

Motorizing the Small Department

The passage of the "Maintenance and Equipment" bill in the state of Kansas has enabled many cities of the second and third classes to take advantage of the new tax levy and invest in up-to-date apparatus for various municipal departments. In many cases new equipment was sadly needed. Statistics for the last year show that 31 towns made the levy, ranging from 0.1 mill up to the limit of 0.5 mill. In fully 50 per cent. of these instances the main object of the levy was investment in chemical cars or combination motor trucks for the fire departments.

The Expense Bugaboo.

Almost every fire chief, however small the department under his supervision, is anxious to keep his equipment thoroly modernized. Some of the difficulties in effecting this ambition were forcefully touched upon by George T. Mohrbacher, chief of the fire department of the city of Marysville, Kan., in his address before the annual convention of the Kansas State Firemen's Association at Topeka last month. He said:

I presume that there are chiefs present at the meeting this morning who have had their share of grief in trying to show their respective city administrations the necessity of better equipment in their departments. The bugaboo of high taxes is invariably held up to prominence and the customary watchdog of the treasury gets busy. If the party who has been elected to any public position on a platform of this nature has succeeded in cutting down expenses without a serious handicap to his constituency or depriving the public of certain improvements and efficiency which they demand and require, the case has so far escaped my notice.

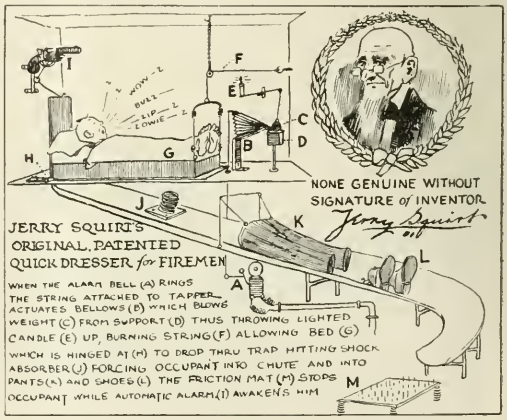
We are living in a day of progressiveness. There's hardly an item or a line but what we not only ask, but absolutely demand the best there is, but I am sorry to say that in too many instances in Kansas the city officials have not seen the light as to fire department equipment and departments are expected to get along with what was purchased when the town was perhaps one-half or one-fourth the size, all to keep the taxes down. The fact that we are burning up $2.55 worth of property for every man, woman and child in Kansas each year is a minor consideration because the people's money has been saved by not squandering any for better fire protection. I do not say that this is the case in many towns in Kansas, but that it does exist in some cannot be denied.

Dependability of Motor Apparatus

At this time when we speak of better equipment in a fire department in a small town we naturally think of motor equipment, either a combination truck, where waterworks have been installed, or a motor chemical in the smaller towns without waterworks, because the experimental stage of motor equipment has long since passed, the auto has come to stay and factories and inventors are vying with each other to reach the stage of perfection as nearly as possible. The objection put up by those who oppose motor equipment on account of impracticability in muddy weather or deep snow is indeed a lame one. True, there are times (and they are exceptionally rare) when it might be impossible to reach a fire on account of extreme mud or snow conditions—but, in such cases it would be just as impossible to get there with any kind of apparatus.

While a motor truck will of course give better service on paved streets than on dirt streets, yet a paved street is not absolutely necessary for its successful operation, and there is as much reason in condemning a motor truck on these grounds as there would be in not building any more houses in the city because some have burned down at some time or other. I do not believe it necessary to comment on the relative efficiency of motor-driven apparatus over horse-drawn as it is a foregone conclusion that the horse-drawn apparatus in fire departments is fast becoming a thing of the past.

This is not only proven by action taken in the larger cities but in smaller ones as well. In Grand Island, Neb., the fire chief's report states that 78 alarms had been answered, at 65 of which the fires had been extinguished with the chemical and the total cost of upkeep, repairs, lubricating oil and gaso-



(Courtesy of American LaFrance Fire Engine Co.)

line, had been $31.68 for the year, this being the third year for their motor truck.

First Motor in Kansas.

Neodesha, Kan., has the first combination auto-truck shipped into the state for fire department purposes, obtained about 9 years ago. This car has been operated by a volunteer department very successfully since its installation, no paid men are maintained, no one stays at the station. Six or 7 of the 27 men in the department are able to handle the car and in the 9 years they have had the truck there is only one instance in which they failed to reach the fire with it, which was on account of a broken shaft. While Neodesha now has about 6 miles of paving, at the time of the installation of the truck there were none, and as Chief Pingree tells me: "A real piece of fire apparatus will travel any street that can be used for traffic; I don't care how muddy it is." I can cite 2 instances where horse-drawn apparatus has been stuck in the mud, while a motor truck would go right thru, and then come back and hitch on ahead of the horse-drawn apparatus and pull them out.

Good Volunteer System.

Fredonia is another town that has successfully handled the auto-truck proposition for a period of 3 years with a volunteer department. The reason I am quoting volunteer departments is that I take it "Motorizing Small Town Departments" means where paid men could not be maintained, it either not being necessary owing to the infrequency of alarms or on account of the expense. Chief Wolever of the Fredonia department says: "We certainly think it the only thing." In this department two men are detailed to look after the care of the fire station and apparatus for a period of two weeks at a time—they are notified by card when their duties are to begin and are responsible for the apparatus, etc., being in first class condition and that everything is in readiness in case of an alarm. This does not necessitate their staying at the station, neither does it take much of their time, and the result is that every member of the department feels a certain amount of responsibility, which we sometimes find lacking in departments, and a greater amount of efficiency is attained.

Personally, I am very favorably impressed with this system. There are a number of towns in Kansas that are falling into line. Liberal, for instance, away out in the short grass country, has installed a truck in the last few months. Hiawatha is doing the same. Seneca contemplates the installation of a triple combination and expects to render service in the surrounding country when advisable. This same idea of service in the country is being successfully handled in a small town in Iowa and has been for several years.

To sum up the advantages of a motor truck we have: speed in reaching the fire; condition of the men on arrival—I would rather have 2 men to start on a fire who rode to it than 10 men who arrive winded and exhausted from having pulled hand-drawn apparatus from the fire station; greater amount of equipment carried; no waiting for the hook and ladder trucks or hose cart to arrive, as everything that is necessary is carried on the 1 truck and the chemical is worthy of special comment. You chiefs who are getting along with the hand-drawn apparatus and no chemical, think of how often a small fire inside could have been put out had you had a chemical, perhaps a few gallons would have done the business, but you are compelled to turn in your fire hose and at least a hundred gallons of water, doing 10 times the damage with water that the chemical would have done. Think of the difference in damage in a private residence, a stock of dry goods of clothing, or for instance, in a drug store, between going in with a small chemical hose or turning water into the same place. Statistics show that about 85 per cent. of the fires are extinguished with chemicals.

WHITE 5-TON FIRE APPARATUS, EQUIPPED COMPLETE WITH LADDERS, HOSE AND CHEMICAL TANKS, OPERATED BY THE FIRE DEPARTMENT OF THE CITY OF QUINCY, MASS.

STEGEMAN 2½-TON FIRE TRUCK, EQUIPPED WITH HOSE, CHEMICAL TANK AND HOSE EXTENSION LADDERS, OPERATED BY THE FIRE DEPARTMENT OF THE BORO OF RANKIN, PA.

PACKARD 2-TON CHAINLESS FIRE TRUCK, EQUIPPED WITH HOSE, CHEMICAL TANK AND HOSE EXTENSION LADDERS, AXES AND OTHER PARAPHERNALIA, OPERATED BY CITY OF ALMEDA, CAL.

PACKARD 3-TON CHAINLESS FIRE TRUCK, EQUIPPED WITH HOSE, TWO CHEMICAL TANKS AND HOSE, EXTENSION LADDERS AND MISCELLANEOUS PARAPHERNALIA, OPERATED BY THE BORO OF SOUTH BROWNSVILLE, PA.

STEGEMAN 1½-TON FIRE TRUCK, EQUIPPED WITH HOSE, EXTENSION LADDER AND SEARCHLIGHT, OPERATED BY FIRE DEPARTMENT OF THE CITY OF COLUMBUS, WIS.

WHITE 5-TON FIRST-AID FIRE TRUCK OWNED BY PEOPLES GAS, LIGHT & COKE CO., CHICAGO. ANSWERS ALL FIRE ALARMS, EXPLOSIONS, SUICIDES AND OTHER EMERGENCIES. COVERS ENTIRE CITY AND MAKES NO CHARGE FOR ITS SERVICES.

Pays to Buy Standard Goods.

Considerable discussion as to the kind of apparatus to buy is going on over the country, that is, standard apparatus. By this I mean that which is turned out by the factories specializing along that line, or the buying of a chassis of any good heavy car and having it equipped at home. I do not feel that I am in a position to pass judgment on this proposition, to recommend the one and condemn the other, but in my experience in other lines of business I have always found that it pays to buy from the man who specializes. In other words, it is reasonable to believe that the man or men who make a study of any certain problem or proposition will come nearer reaching the desired result than where it is partly or all experimental.

The principal thing in fire apparatus motorization should be the high powered car, not so much for speed on the race-track street, but ample power to apply at the right time. A maximum speed of say 30 miles per hour is all that should be necessary; faster than this endangers the life of the firemen as well as citizens on the street, and the apparatus. Some towns have bought the chassis of a good heavy car and mounted the equipment at home very successfully, and it is not for me to say that this is not good judgment. Also in some cases the funds for the purchase of standard equipment have not been available and a cheaper layout would have to be used. This is commendable and in my mind should be encouraged rather than to have the same department get along without the better facilities.

In some cases where I have had the opportunity of discussing this subject with parties interested, the principal objection to motorizing was the expense of maintaining a paid man or two for the handling of the apparatus. In this respect a number of ideas have suggested themselves.

Combination Chauffeur and City Clerk

In the average town of from 1,500 to 4,000 the duties of the city clerk are not enough to take more than a small portion of his time and these appointments are consequently often given to an older man or to some one who perhaps is incapacitated from other work and at a salary ranging from $150 to $300 a year, which is paid out of the general fund of the city. In such cases and where motor equipment is installed in the fire department, appoint some man who is qualified to do the work of the city clerk and who can also look after your motor truck. You of course will have to pay a man of this kind more money, and you should expect to, but take the amount the other man has been getting, say $20 or $25 per month and add $40 to it and you'll find the good material anxious for the job. And if the general fund won't stand it, charge it all to the maintenance fund, after you have your equipment, and they'll have $300 more in their general fund. I wouldn't expect the city clerk to take care of the house at night. Let the night marshal do it. Or better yet, any one of 4 to 10 members of the volunteer department would be only too glad to sleep at headquarters in a room furnished free of charge.

Cost of Maintenance.

As regards the expense of the upkeep of the car, lubricating oil, gasoline and ordinary repairs for a motor truck in a small town, most of us are carrying too many men in our departments. If you are allowed 35 or 40 men, all exempt from poll tax, chances are that there are 15 or 20 that are always on hand when an alarm is sounded. By cutting your department down to 10 or 15 men the amount of extra poll tax going into the city treasurer will more than pay the bill of upkeep for the car. Some will say that you must have a steam-heated building to keep the car in. The principal expense in most cases would be the installing of the heating apparatus, as most cities have no adequate building, after which the amount of coal burned would be very little more than is used in the 2 or 3 stoves used. Quite often it is possible to keep the truck at a convenient garage where heat is installed and where drivers are handy day and night in case they are needed. But if this is impossible a small electric heater can be used under the hood of the car or anti-freeze can be used in the radiator.

In conclusion, let me say, that there is no reasonable excuse for the departments in the smaller towns not having motor equipment. Talk it over with your city officials and citizens, show how little it will cost each individual and what the benefits will be in greater efficiency. Then, and not until then, can we expect a cutting down of our insurance rates.

Norwich Deputy Gets There Quick

Norwich, Conn., not being large enough to have attained the dignity of a permanent department, was for a long while confronted by a serious problem in the matter of getting its deputy chief to fires. The deputy is not a permanent man, and, when not on fire duty, is employed in a local factory, about two miles from the center of the city.

Norwich, however, was fortunate in possessing a public-spirited citizen in the person of C. V. Pendleton, Jr., who volunteered to take the chief to fires in the side car of his Indian motorcycle. The deputy accepted the offer with alacrity and Mr. Pendleton got busy. He commenced to pick the deputy up

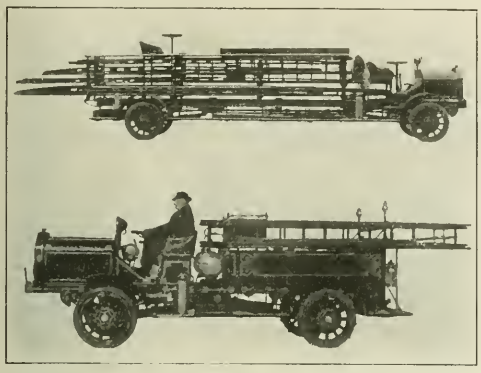
whenever an alarm sounded, and not infrequently landed him at the scene of the fire before the rest of the department had time to put in an appearance. In fact, his work in this direction proved so good that in a short while the city government hired him to do it regularly, giving him the right of way over traffic and the right to run thru the city streets with his cut-out open. In the past three years the outfit has responded to over 200 bell alarms without a single accident or delay in reaching the fires.

Motor Apparatus in Somerville Fire Department

With the installation of the new Ahrens-Fox chassis, equipped, furnished and fitted up in the department's machine shop, four of the eight stations of the Somerville, Mass., fire department will be fully motorized, according to the report of Chief Sewall M. Rich. The motor apparatus includes, besides the above, a ladder truck, three combination chemical and hose, a tractor-drawn engine, a supply and wrecking wagon and two cars for chief and assistant.

Snow Test for Holland Trucks

Possibly the heaviest snowfall ever recorded in Holland, Mich., occurred late last March. The snow was wet and heavy; stuck to everything it touched. Local street-car service was greatly delayed and even the railroads experienced difficulty in getting into town. Traffic was impeded every-



where, and it was generally agreed that a better time to test the new Duplex motor fire trucks could not have been desired.

Fully thirty persons were taken aboard and Holland's first motor fire truck started out to convince the skeptical of that town of well-known conservatism. It tore its way at full speed thru the soft sand and packed snow of the city's outskirts, surmounted the hills without slackening and plowed thru the tightly-packed heaps which had been shoveled into a long windrow the full length of Eighth street, where the merchants had had shovelers at work. Thus the conservative town of Holland was won over to strictly modern and efficacious fire-fighting apparatus. Possibilities of slightly greater initial expense no longer weighed in comparison to visual achievement in a test like that.

The truck in question is a 4-wheel drive combination chemical and hose apparatus, with a pumping attachment. It has a hose capacity of from 1,500 to 2,000 ft.

The accompanying photographs illustrate similar Duplex apparatus, the upper view being that of a 3-ton hook and ladder truck, and the lower that of a 3-ton combination chemical and hose truck.

Successful Chemical Pumper Test

At a recent test of the Thomas automatic chemical pumping engine at Buckeye Lake, near Newark, Ohio, the complete efficiency of a chemical hose stream for putting out fires was again demonstrated. This is one of the most interesting tests yet conducted by the Thomas Automatic Fire Engine Company.

More than 12,000 cu. ft. of combustible base was fired in five places and permitted to burn six minutes, thus insuring an exceedingly hot fire, before the chemical stream was turned on. The fire was extinguished within ten seconds with plain soda water, thrown at fire pressure.

The structure burned was 100 ft. long, 12 ft. wide and 10 ft. high, inclosed on one long side and on both ends, and roofed with old iron. Thirty wagon loads of old pine siding and sheeting in various lengths were placed in stalls,—many of them standing on end, thus filling the whole interior of the building with highly combustible material so arranged that free ventilation was provided for the flames. Further than this, a large quantity of excelsior was distributed thruout the piles of lumber, together with old, dry barrels and boxes. The entire contents were completely saturated with 100 gal. of kerosene, the object sought being not only to show a burning building, but especially to ensure a tremendous volume of heat and blaze at a very high temperature.

When fired in 5 places, the 12,000 cu. ft. of combustibles instantly became one mass of flames, which after burning 6 min., developed an estimated minimum heat of 1,400 deg.

The soda water was turned on at the rate of 200 gal. per min. and, as before stated, completely extinguished the flames within 10 seconds. The pipemen started at the left and kept the stream moving to the right. The actual amount of water used was 60 gal., chemicalized with 6 lbs. of plain baking soda. Pump pressure was 120 lb. and 80 lb. at the 1¼-in. nozzle. The volume of soda water was one-third the capacity of the engine.

The efficiency there demonstrated staggers all calculations of chemical authorities. According to recognized chemical laws and a 15 per cent. air diffusion of carbon dioxide gas, 144 lbs. of soda and 576 gal. of water would have been required to do what was obtained in practical application of 6 lb. of soda and 60 gal. of water. Or, if this stream of soda water extinguished 12,000 cu. ft. of fire in 10 sec., 72,000 cu. ft. could have been put out in one minute. The capacity of the engine would have extinguished 3 times the amount of fire in 1 minute, or 216,000 cu. ft.; the equivalent of a building 1,800 ft. long, 12 ft. wide and 10 ft. high.

Electric Fire Vehicles Increasing

"The advantages of electrically-propelled fireapparatus are rapidly being appreciated, and many municipalities both here and abroad are electrifying their equipment," writes A. Jackson Marshall, secretary of the Electric Vehicle Section of the N. E. L. A.

"About a year ago the fire and police commissioners of Paterson, N. J., realized that additional fire apparatus was necessary to increase the efficiency of the fire department, and it was decided to completely motorize the department. Following the wholesale conversion of electric fire apparatus in

Camden, N. J., the city of Patterson, N. J., made a thoro investigation and some rigid tests, which demonstrated to them the fact that the electric has quick get-away, hill-climbing ability, simplicity of operation, economy and general reliability.

"On the strength of these tests an order was placed for 2 steam fire engines with 2-wheel front-drive electric tractors, four 2-wheel front-drive tractors, 5 electric combination chemical engines and hose wagons, and one 85-foot 4-wheel drive electric aerial truck. Charging apparatus for each engine-house was also ordered.

"Another example of the success of electrically-propelled fire apparatus is the installation in Grand Rapids, Mich. The fire department in this city has 6 pieces of electrically-driven apparatus—5 ladder trucks and 1 steam fire engine. The department reports that its electric apparatus has proven absolutely dependable at all times, the upkeep expense has been very light, and it has been generally satisfactory. The district thru which these engines and trucks travel is very hilly and in every instance the electric apparatus has proven its value.

"Some of the other fire departments using electric apparatus are those of Philadelphia, Brooklyn, Akron, Ohio, and Springfield, Mass., and all are fully appreciative of the electric's dependability and economy. Battery-propelled fire apparatus is also used extensively in Germany and England."

New York Calls for "Double Duty"

The city of New York has just ordered 10 pieces of motor-driven fire apparatus from the South Bend Motor Car Works, South Bend, Ind., the first "Double Duty" equipment to be installed in that city. The purchaser calls for 7 hose wagons, 70-h.p. each, equipped with the regular New York standard turret-pipe, and 3 combination wagons of the same h.p. rating, equipped with double 35-gal. chemical tanks and hose bodies, carrying 1,200 ft. of hose and 300 ft. of chemical hose.

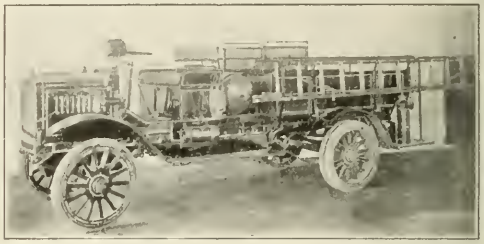
All of the 10 pieces of apparatus are to be fitted with solid tires, dual rear, and the regular "Double Duty" chain drive.

The city of Three Rivers, Mich., also recently purchased a 6-cylinder, 95-h.p. Double Duty combination fire truck, equipped with the old horse-drawn apparatus, which has been in local service for more than 20 years past and is still in good condition. This car is to be fitted with 38 by 7-in. pneumatic tires on all 4 wheels and has a speed of 50-mi. per hour. The car was driven overland from South Bend to Three Rivers, having as its passengers a member of the Board of Public Safety and the major himself.

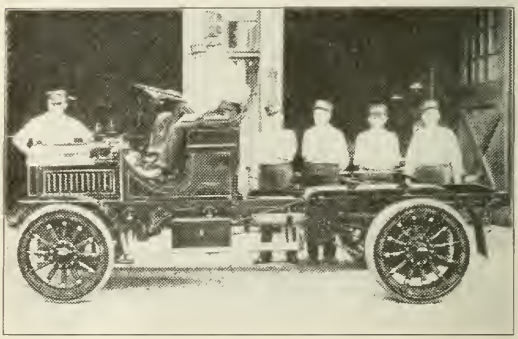
The city of Greenfield, Ind., has just received a 4-cylinder Double Duty combination chemical and hose cart, equipped with cushion demountable tires. It has a speed of 40 mi. per hour.

Texas Fire Chiefs Using Wichita

Georgetown, Hamlin and Hereford, Tex., are now operating 3½-ton Wichita combination hose and chemical motor-driven fire truck on the order of that herewith illustrated, which is owned by the first-named municipality. Wichita hose and

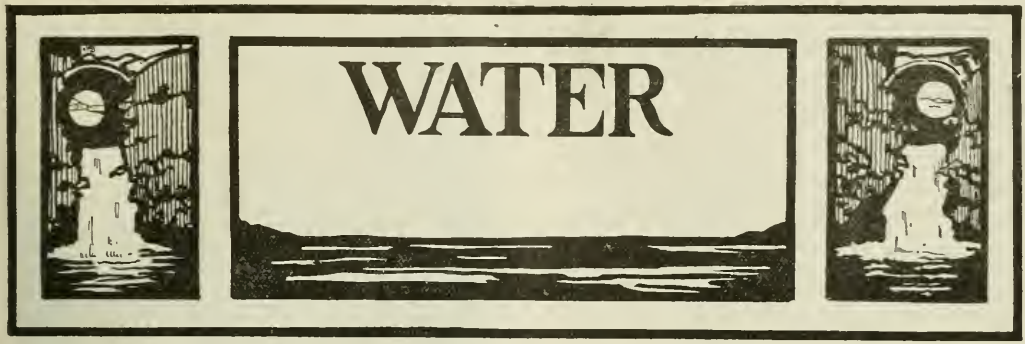


chemical apparatus tractors also have lately been installed by the fire departments at Texarkana, Tex., Anadarko, Okla., Seymour, Tex., and Calvert, Tex.



U. S. TRACTOR, FIRE DEPT., CITY OF COVINGTON, KY.

JEFFERY QUAD FIRE TRUCK RECENTLY SOLD TO THE EAST YOUNGSTOWN (OHIO) AUTHORITIES BY JONES & SAXTON. W. N. SAXTON IS STANDING IN FRONT. THOSE ON THE SEAT ARE COUNCILMEN G. N. REED AND DAN FERRIS. FIRE CHIEF GILBRIDE, COUNCILMAN DIXON AND CITY CLERK ANDERSON ARE SEATED ON THE TRUCK.



Scotch Method of Cleaning Water Mains

Water mains lose capacity because of the formation of incrustations upon the inner surface and by sedimentary deposits. Both reduce the effective cross-section and increase the friction. Perhaps the formation of incrustations is the more important of the two. The reduction in capacity may become very great. A loss of 30 or 40 per cent. is not at all unusual. The modern remedy for such conditions is to clean out the mains. There are American methods of doing this, but it is the purpose of this article to give an account of a Scotch apparatus and the methods of using it.

The city of Ayr, in Scotland, derives its water supply chiefly from a lake in the neighborhood of the headwaters of the Doon river. This lake, Loch Finlas, is some twenty-odd miles to the south of Ayr. The supply is conveyed by a main 17 miles long to a service reservoir near Dalrymple which has a capacity of 7,000,000 gallons. For 2½ miles the main consists of 18-inch fire-clay pipe. The gradient of this stretch is 1 in 350. All the rest of the main consists of cast-iron, coated pipe. For 8 miles this main has a diameter of 16 inches and for 6½ miles, of 14 inches.

Scraping Cast-Iron Mains.

It was determined to scrape the cast-iron sections. The consideration impelling to this determination was the necessity of quickly increasing the water supply some half million gallons per day. It was hoped that this increase might be realized and the laying of a new main deferred for a time. The main was laid in 1887 and was calculated to have at that time a capacity of 2,592,000 gallons per day; but whether this calculation was ever verified is doubtful. However, in 1903 the measured capacity was found to be 2,037,000 gallons, and for 1911 the capacity was determined to be 1,865,000. It would seem that there had been a total loss of some 727,000 gallons daily. It was not unreasonable to anticipate, in view of these figures, that cleaning might restore the main to a condition equal to the necessities at the moment. This hope was fully realized. In fact, the capacity determined subsequently to cleaning was found to be within 46,000 gallons per day of the original calculated capacity.

Cleaning is supposed by some to promote incrustation afterwards. Granting this, the cost is not great, especially when proper provisions have been made in the pipe line, and cleaning may very well prove economical.

Cost of Scraping.

The cost, as reported by Mr. Jas. Macfazdean, assistant burgh engineer, Ayr, is divided between the 14-inch and the 16-inch lines and includes in both cases certain apparatus of a more or less permanent character. For the 14-inch pipe, 6.43 miles, the total expense was $1,061. and for the 16-inch pipe $1,926, or a grand total of $2,987. The apparatus cost for both sections amounted, however, to $2,091. It will be seen from these figures that the actual cost really chargeable against the one cleaning is no great amount—perhaps $1,200 (including depreciation, etc.), or $82.76 per mile. In the United States, these figures would doubtless be increased somewhat because of the presumably higher cost of labor.

A sample of incrustation from the main was subjected to chemical analysis with the result that 70 per cent. was found to be peroxide of iron. A much smaller percentage (2.57) was protoxide of iron. The carbonic acid percentage was 1.12. Water and organic matter accounted for 24.42 per cent. The remainder, totaling less than 2 per cent., was divided amongst several inorganic compounds. It will thus be seen that fully half of the incrustation came from the pipe. The water itself contains no iron. It is quite soft. Its analysis may be of practical interest, as affording a means of comparison:

	Grains per. gal.
Total solids in solution	3.92
Chlorine	0.84
Sodium chloride equivalent	1.38
Ammonia (free)	0.0035
Ammonia (albuminoid)	0.0055
Oxygen necessary to oxidation of organic matter	0.42

The total hardness is estimated at 0.84 degrees.

It was decided to scrape the 14-inch section first. This decision seems now to be regarded as wrong, as that section was the lower part of the line. With the 14-inch main cleaned, the resistance to the oncoming water from the 16-inch pipe was so much less than with the smaller pipe uncleaned, that the pressure was reduced below proper working conditions in certain places, as described below.

Description of Process.

The whole line of cast-iron main was divided up into sections containing 1 or 2 miles each and hatch boxes were placed in position at the points of division. The bends were disregarded. This was permissible for the reason that the minimum radius of curvature was 18 feet. In placing hatch boxes, it is important, as Mr. Macfazdean points out, to take into account the disposal of large quantities of water in such wise as to effect no damage or inconvenience. These boxes may require to be left open for quite a number of hours, so that it is not permissible to locate them just anywhere. There will be an excavation, of course. It may seem advisable, in built-up sections, to wall these up and otherwise provide for permanence and accessibility. It is suggested that it is undesirable so to locate a hatch box as to have back drainage from any considerable length of pipe. Further, it is of importance to be able to control the water entering a given section at a point near the beginning of that section.

In the present case, the difficulties to be cared for were somewhat simplified because the main itself discharged into

a reservoir containing nearly a three-days supply. The hatch boxes were placed, two at a time, every other day, under a requirement that water was to be shut off for no longer than 6 hours per day. There was only one considerable departure from the time requirement, and this was due to flood from the river.

The method of cleaning is briefly this. The hatch box is opened up and the scraping device put in place, when the lid is securely bolted on. Upon turning on the water, its forward impetus, operating against the pistons of the device, will serve to drive it ahead. Scrapers suitably disposed are carried along and perform their duty upon the incrusted surface of the pipe. The pressure was reckoned as a hydraulic head of 15 feet. There were two places where this head could not be relied upon, so that here hatch boxes were placed at either end of each of these short sections, so that the scraper could be hauled thru by means of a line.

Prior to the cleaning of a section, the water is cut off from its length and a complete drainage effected. The hatch box covers are lifted off by means of a suitable derrick or other device, and the scraper is lowered into position in the upper box.

In a section about to be scraped, the main valves should be opened wide to avoid hindrance to the scraper. In order to prevent filling of service pipes with debris from the scraper's activity, they are to be shut off. As the air valves must be left open, they should be cleaned out after the work is over.

There will be a heavy discharge of water thru the open hatch box at the far end of the section. A plug is put in place at one end where the hatch box opens into the section of main next to be cleaned. Thus is prevented the washing of debris into that section. In the American system, a riser pipe is put in place at the far end of a section. This is inclined to the vertical and serves to throw the water out upon the general surface.

MACHINE FOR CLEANING WATER MAINS IN PLACE IN SPECIAL BOX CONSTRUCTED IN THE MAIN FOR THE PURPOSE OF INSERTING AND REMOVING THE CLEANING MACHINE. A COVER IS BOLTED TO THE BOX WITH A WATER-TIGHT JOINT.

STETHOSCOPES IN USE TO TRACE MOTION OF CLEANING MACHINE THRU THE PIPE. AS THE MACHINE PASSES EACH MAN HE WALKS QUICKLY TO THE OTHER END OF THE LINE OF OBSERVERS SO THAT THE LINE OF MEN ROLLS ALONG THE ROAD AT SAME RATE THAT THE MACHINE TRAVELS.

The scraper used on the 16-inch main weighed about 335 pounds. Going thru the main it had an average speed of perhaps 2 miles an hour with a 15-foot hydraulic head back of it. It will be seen from this that the actual normal cleaning operation is by no means protracted. There were no very steep climbs taken by the scraper. There was one incline of 1 in 9½, 980 feet long, and no difficulty whatever was experienced in negotiating it.

The lower hatch box and its excavation must be pumped out after the work is over.

After the scraper arrives at the hatch box, which is its destination, the water is shut off. It is judged important to do this quite promptly, if the drainage from this point is not good. As the scraper passes the successive scour valves they are shut off. When the scraper has finished the section, these valves are opened up again. In order to get word back to the point of water control at the head of the section when the scraper finishes, a field telephone may be employed. Or, as in the present case, a system of signalling may be used.

Locating the Scraper.

When the scraper finished its first trip thru a section, it was hauled back for a second. In this way, each section was given two cleanings without any delay between.

When the scraper is working its way between termini, it is very important to have some adequate means of locating it. It may, in fact, encounter an obstruction which it is incapable of passing or carrying along. There are ways of stirring it into activity, but these sometimes fail, when the only alternative left is to excavate down to the main and cut out a short length where the scraper is or else quite close to it. There are two principal methods of keeping track of the apparatus. One, employed in the United States, and perhaps elsewhere, is to attach a line to the rear end. The length of line at any moment will indicate the advance of the machine. Another method is to follow the ongoing apparatus by sound. Sometimes the noise is able to penetrate to the surface and reach the ear of an attendant workman without the aid of a special apparatus. At other times, a kind of stethoscope is employed. In this case, a number of men will set up the

THE PILE ON THE LEFT SHOWS THE AMOUNT OF MATERIAL, TUBERCULATION, SCRAPED FROM 6,600 FEET OF 14-INCH MAIN. THE COVER OF THE BOX FOR INSERTING THE MACHINE IN THE LINE IS SEEN SUPPORTED OVER THE HOLE DUG DOWN TO THE BOX.

stethoscope at short intervals. When the slowly moving scraper passes the rear man he goes forward and sets up his instrument at the head of the line, and so on.

If the machine stops, it may at times be persuaded to resume by means of an induced water hammer. Presumably this is effected by a quick shutting off of the water and a quick subsequent release. Sometimes a mere jarring of the main will be sufficient; at others, a wisp of hay floated down to the rear end of the scraper may be successful in getting it going again.

Results of Cleaning.

The two portions of the cast-iron main were cleaned one year apart. The 16-inch main was originally laid in order to get a flow over high ground that was located in the first 8 miles. When the 14-inch main was scraped and its capacity restored, the pressure line at the junction fell to such an extent that at one point it was no higher than the pipe itself. The result was that the remainder of the line became nothing more than a series of inverted siphons and certain consumers were cut off from their supply. This condition required the closing down of some of the valves and a consequent throwing of the pressure back on the main behind. In consequence, the natural advantages of the cleaning operations upon this 14-inch section were not secured until the 16-inch section above was cleaned one year later.

The capacity was then almost fully restored to its original theoretical amount.

After a period of two years subsequent to the completion of the scraping, a capacity test was tried with the result that 40.5 per cent. of the gain was found to have been lost. In other words, in two years—or possibly we should call the interval something over two years because of the early cleaning of the 14-inch main—the interior condition was two-fifths as bad as before scraping.

It would seem that the necessity of a yearly cleaning, or even a more frequent one, is indicated. The actual cost of cleaning is not great, once the hatch boxes have been built into the line and walled-in excavations provided. In the present instance, the scrapers themselves were purchased, one for each size of main. New leads and leathers are necessary for each cleaning operation.

The incrustations in the pipe line were due to an oxidation of the iron, presumably at points left exposed by some imperfection in the coating process. Apparently, a nodule grows upward and radially from this center, while a corrosive activity goes on downward into the metal and over the surface beneath the growing nodule. Layer grows upon layer, causing the nodule to project more and more. The spread of the corrosion on the metallic surface undermines the coating. A nodule cited by Mr. Macfazdean had a diameter of 1½ inches. The central decomposition of the iron was 3/16 inch deep and the general decomposition 1/16 inch. The coating and the iron were sound beyond the area covered by the nodule. Apparently, there is a somewhat regular increase of the corrosive effects while individual nodules continue distinct. Upon their coalescence, however, and the formation of a continuous layer of incrustation, corrosion slows up. There is reason to think that it will cease altogether when the coating of incrustation has reached a definite thickness, presumably different for differences in conditions as respects the chemical constitution of the iron and the water.

It will be of interest to add here that one main at least is known in which cleaning is done regularly year by year, where the loss of capacity and restoration are also regular and equal in amount. That is to say, during the year the capacity falls off, but is fully restored by the cleaning operation. This would not appear to bear out the idea that the pipe requires more frequent cleaning because of the cleaning itself.

It seems that some trouble has been experienced with having the plug at the lower hatch box driven up into the main ahead. A method of avoiding this difficulty has been to use a scoop in the pipe over the plug. It seems that a "fish cutter" has proved serviceable in preventing the scraper from sticking in the main.

How Wilmington Set 10,000 Water Meters

By S. N. Van Trump, Assistant City Engineer and Superintendent

Prior to May, 1914, only about one-half of the 21,306 water services in the city of Wilmington, Del., had been metered, but beginning with that month the board of water commissioners authorized the project of a pan-city installation, and work was at once undertaken.

By the close of the year the project was about 94 per cent. completed, and the result of this policy is being manifested today by decreased consumption of water. As yet the meters have not been sufficiently long in service to obtain exact statistics, but the following data are of interest as indicating approximately the effect of this work:

Total decrease in pumpage for year.....641,054,900 gallons
Decrease in manufacturing consumption...296,397,288 gallons

The decrease in manufacturing consumption was due to general business depression, but this cause is not fairly applicable to domestic consumers. With the exception of a few special industries, Wilmington has experienced an unprecedented era of prosperity, and under such conditions the do-

PIPE AND METER SHOP.

mestic consumption would naturally tend to increase. This is especially true under the present system of meter charges, where water rents are paid yearly in advance and carry an extremely liberal minimum allowance.

In the light of the rather limited data available at present, it seems reasonable to state that a large percentage of the decrease in domestic consumption is due to the moral effect of

INTERIOR OF PIPE AND METER SHOP.

installing meters, combined with the department's firm ruling that extravagant non-metered or schedule consumers must pay for water by meter measurement.

The total decrease in domestic consumption, as indicated above, is equivalent to nearly 1,000,000 gallons per day (944,000), but how long this decrease may continue is problematical in view of the extremely rapid growth of the city.

Service and Meter Extension.

During the year a total of 819 new services were connected to the distribution system, and 336 old services were renewed. In addition, 92 parts of services were installed where repairs and replacements were necessary.

The total number of services in use at the end of the year was 21,306, of which 19.3 per cent. were metered. The total number of meters installed during the year was 9,948, of which 768 were replacements of damaged or broken meters and 9,180 were new installations. In addition, 170 meters were repaired in place.

The work of metering every service in the city is being rapidly pushed to completion, despite the fact that all consumers are not required to pay by meter rates (unless extravagant in the use of water) during the work of revising the existing schedule of charges. A subdivision of the total number of new meter installations (9,180) shows that 5,125 were set in cellars, and 4,055 at the curb.

In this connection it is interesting to note that the Department was confronted with the question of deciding on curb or cellar settings, when plans for metering the entire city were under contemplation. After carefully considering the advantages of curb installations, and the additional expense necessitated thereby, the problem was solved by adopting the following policy:

1. Meters to be set at curb on all new properties.
2. Meters to be set at curb on properties without cellars; except where the probable life and nature of the building did not warrant the expense of a curb setting.
3. Meters to be set at curb when requested by property owner.
4. Meters to be set at curb where danger of freezing existed, if installed in cellar or where cellar did not permit of convenient location from meter reader's standpoint.
5. All meters not covered by above stipulations to be located in cellars.

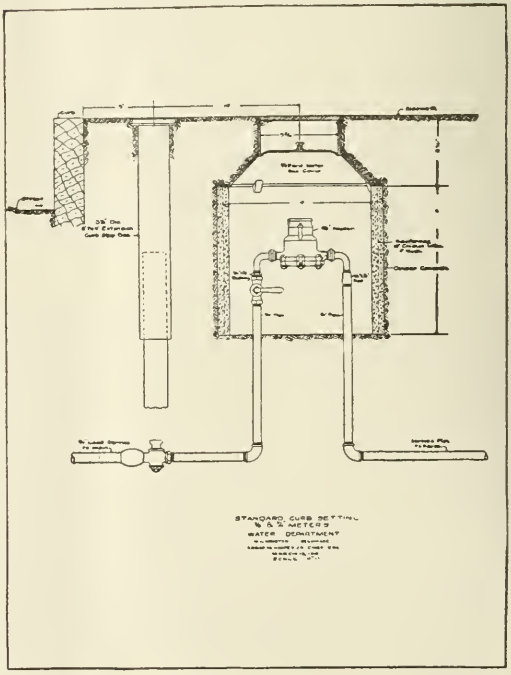
The practical results of the above policy have been entirely satisfactory to the Department and the property owner.

How Organized and Equipped.

The first step in establishing a working program was to subdivide the city into 5 installation districts and to work each district individually and in the order decided upon. The force engaged on the work varied from time to time, but conformed on the average to the following schedule: 1 plumber; 7 pipe fitters; 8 helpers; 2 pavers; 2 drivers; and from 10 to 20 laborers. The equipment comprised a cart and horse, a motor truck and a street shop wagon. (See illustrations herewith). Under the direct supervision of the engineering department, the plumber acted as the foreman of the working force. All employees reported each morning to the street shop wagon, which was located at the point of starting the day's work. The necessary equipment of tools and supplies was contained in this wagon, depletions of stock being filled daily from the main store room, by use of the auto truck.

Plan of Operation.

Slips were prepared each day at the main office, contain-



ing the street number of every house in the district in which the force was working, and a notation as to whether or not the house was already metered. These slips were distributed to the fitters at the start of the day's work, and were turned in to the foreman as the meters were installed. They were then approved by him, and returned to the main office for the purpose of permanent entry in the department's books. In addition each fitter was required to enter on a printed form a report of each meter installed, with its location or notation of any service complications or other reason preventing its installation.

When such complications existed, the fitter's report was returned to the engineering department, and the property owner notified by letter to remedy the condition within 30 days. At the expiration of this time an inspection was made, and if the situation had been corrected, the meter was ordered installed.

In cases where the property owner failed to comply with our requirements, the contract for a supply of water to such property was cancelled. In this connection it is important to note that service complications existing between the main and curb line were taken care of by this department, while those existing between the curb and building line were corrected by the property owner. It is also interesting to note that before any meter was installed, and prior to making an inspection for such purpose, the tenant of each house was supplied with literature explaining the nature of the work, and the benefits resulting therefrom.

Progress and Cost of Work.

From May 8 to June 30, 1914, 1,233 meters were placed, of which 239 were curb and 994 cellar installations. From June 30, 1914, to July 1, 1915, the number of installations was 9,180 of which 4,055 were curb and 5,125 cellar settings. Thruout the winter the work was continued without interruption, the working force being confined to cellar installations during periods of bad weather.

The average cost of installing ⅝-inch meters at the curb, including meter, meter box, top, pipe and fittings as shown in the illustration of the department's standard installations, was $12.85. This price includes the cost of repaving, but not the cost of the curb stop box or curb stop. The average cost of installing meters in the cellar or other inside location was $8.55 including all necessary labor and material.

The standard meter box (Ford) is of cinder concrete. These boxes were manufactured in large quantities by the department and to their use is due largely the low cost of curb installations. While the box is 19 inches deep, experiments conducted by the department have demonstrated that there is no danger of freezing in this climate from such comparatively shallow settings.

The city of Wilmington is to be congratulated in having achieved the enviable and dignified position among muncipalities of being 100 per cent. metered. The benefits of this system are not yet evident to the consumer, but will at once become so with the revision of the present schedule of water rates.

The work of installing meters also disclosed an enormous amount of service complications and bad plumbing. A system of notices by letter, as well as frequent inspections, has resulted in correcting such conditions. The value of this work in reducing the consumption, aside from the installation of meters, is difficult to estimate.

High-Pressure Fire Service in Boston

For some years Boston has been working on a system of high pressure fire mains and now has some 6½ miles installed. The plans call for over 14 miles of such mains and a large pumping station on the Charles river, all of which would cost about $1,500,000. The city has secured nearly all the reductions in insurance rates which the entire system would justify and its available funds are small. It is proposed, therefore, to install a small gasoline pumping station, capable of supplying about 6,500 gallons a minute at 240 pounds delivery pressure, to the present high pressure mains. This plant would be located on the Charles river close to the Cambridge bridge and would cost but a small fraction of the above estimate. With fire-boats and the fire department's engines to help supply the high pressure mains in emergencies, the heavy expenditure provided for in the original plans is not considered necessary and the installation of the small plant is recommended by Joseph A. Rourke, engineer in chief of the high pressure service.

Method of Raising Money for Public Improvements

A method of anticipating revenues in order to secure the benefits of earlier construction of needed public improvements has been practiced in New Orleans. It seems that the New Orleans Sewerage and Water Board and the Orleans Levee Board have more calls for new construction than they have present funds to meet, but they have annual revenues which can be used to pay off debts incurred for improvements.

In one case a land company wanting a levee loaned the Levee Board the money needed to build it without interest with an agreement that the money be repaid in installments within five years. In another case the property owners did the same thing on a certificate plan whereby they borrowed the money from a bank at 2 per cent. discount and obligated themselves to pay 6 per cent. interest the first year, each on his share of the loan, and 5 per cent. for the following five years, when the loan became extinguished by the payments from the Levee Board. The property owners gained much more than the interest they paid, thru the early and rapid development of the district on account of the improvement.

The Sewerage and Water Board, in similar straits for ready money, is proposing the same plan to those wishing water and sewer mains in advance of sufficient settlement to produce a revenue giving proper return on the investment. The property owners thus carry the cost over the period of development, and on account of the more rapid development of the improved property, they gain much more than they have expended.

Alexandria, La., Owns Its Street Railway and Lighting Plant

Alexandria, La., has recently acquired its street railway system and is now operating it, in connection with the municipal water and lighting plant.

The plant has been completely changed and enlarged within the past four or five years, and is now considered strictly "up to the present" in every particular. Every improvement and addition to the power house and to the machinery, as well as to the water and light plant thruout the city, has been paid for out of the proceeds of the plant.

Among the improvements that have been made in the past few months is the enlargement of the main building, which is now about 60 by 100 feet. There are concrete floors in the engine room. The large turbine engine is a 1,000 kw. This machinery takes care of the city light business and furnishes power for the street railway.

Many new light lines have been constructed to new sections of the city, as well as water main extensions. The power plant is taking care of the city's newly acquired street railway system without the addition of a great amount of machinery. This part of the business is being operated at a much smaller cost than it was formerly by the independent street car company.

ROADS AND PAVEMENTS

Resurfacing Old Concrete With a New Concrete Wearing Surface

From advance sheets of report by Edward N. Hines, Chairman of Wayne County Highway Commission, Detroit, Mich.

We have a large and constantly growing mileage of concrete roads and we regard the present as the opportune time to determine the feasibility of resurfacing an old concrete road with a thin layer of new concrete. Had any other section of the country undertaken such an experiment we would have been content to watch the result. However, we hope to put ourselves in a position to successfully carry on a resurfacing job should the need arise, and with this object in view we have resurfaced a section of concrete road, built in 1910, with a 3-inch surface of new concrete. Grand River Road was selected for this experiment, because we felt that it would receive the severest kind of test, on account of the heavy mixed traffic which uses this highway, and because the section selected was rough and uneven.

This section of road was built by the Owosso Construction Company, of Owosso, in 1910, and is of a two-course construction. It is 6½ inches thick, 16 feet wide, built on a crowned sub-grade. The bottom course is a 1:2½:5 mix, using crushed limestone for the coarse aggregate, 4 inches thick. The wearing course is a 1:2:3 mix, 2½ inches thick, using crushed field stone, ranging in size from ¼ to 2½ inches, for the coarse aggregate. It was put down in 25-foot sections, with ¼-inch tar paper strips cutting entirely through the concrete. The surface was struck off with a template, and somewhat irregular in finish, as we were not as careful and as thoro at that time with regard to finishing as we are at present. The edges of the road were rounded off with about a 3-inch radius (a practice which we have since abandoned). During the week of August 17, 1912, 7,444 vehicles passed a given point on this road; and during the week of September 18, 1912, 7,580 vehicles, by actual count, passed the same point, which is near where we resurfaced the road; 40 per cent. plus of these vehicles were horse-drawn, the balance being motor-driven. This territory has been built up rapidly since the above traffic count was taken, and an actual count at the present time would undoubtedly show a very material increase in the number of vehicles passing a given point. To better accommodate this increased traffic, we decided to widen the road to 20 feet. In order to do this, we broke off the rounded edge and added concrete on each side of the old road, to bring it out to the required width. A 1:2:4 mix, 6 inches deep, of washed and screened pebbles and washed and screened sand, of the same quality as our standard specifications, was used.

All the tarvia surfacing and filling, used to cover the cracks, was removed. The cracks and holes were then filled with concrete to make an even surface 20 feet wide. The expansion joints—as steel protection plates were not used—were mostly worn down. Where the joint was spalled to a considerable extent the old concrete was broken away sufficiently to give a bond for new concrete on both sides of the joint. Expansion felt was then placed and the whole surface brought up to an even grade. On the top layer of this base we placed a 3-inch layer of 1:1½:2½ concrete, using Marquette, Mich., trap rock, graded in size from ¼ to 1 inch for the coarse aggregate and washed and screened bank sand for the fine aggregate. The surface in no place is less than 3 inches thick, reinforced with No. 26 triangular mesh wire. We did not try to bond the top course to the old road with a rigid bond. The surface of the old concrete was first sprinkled with water, after which a mixture of tarvia A and tarvia X was sprinkled on, hot, with an ordinary sprinkling can, immediately before placing the new wearing surface. The tarvia, falling on the moist concrete, spread in a very thin layer and was immediately chilled, thus forming an even coat over the old surface. The expansion joints in this top course coincide exactly with the expansion joints in the bottom course. A piece of wood, 3 in. by 4 in. by 20 ft. long, was laid over the old joint, and the concrete deposited as tho no joint was to be made. A Baker automatic finishing machine was used to finish the surface. Afterward this piece of wood was removed and armor plates, suspended from installing bars, with expansion felt, were set into place on the side forms, the felt of the new joint meeting the tar paper of the base joint. We believe this method to be better than pouring the top course directly onto the bottom one, as a slight movement, due to difference of expansion or heaving, would result in cracks to the top course, if they were rigidly bonded together. The tarvia, although very thinly spread, permits a slight movement of each course without interfering with the other.

Before approving of this type of construction small slabs of concrete were made, a coat of tarvia put on top and another course of concrete deposited. It was found not only impossible to separate these two layers, but a blow on the upper, sufficient to crack the top course, would also crack the bottom one. The road was covered in the regulation manner, to hold the moisture, and sprinkled daily for two weeks. Traffic was permitted to use the road twenty-five days after the last concrete was placed.

The cost of this work, $15,573.67, is high, due to conditions at time work was undertaken, and should not be regarded as a factor in this particular instance, as it is the determining of a principle that was being undertaken. If the principle is correct, the working methods can be perfected to bring the cost down where it belongs.

This section of road has been in use about four months and to date is apparently successful. A much longer period of time must elapse before we can make a positive statement as to its success.

While the road was closed during the construction of this experimental section, we provided a good detour which took traffic only a short distance out of its regular course, and it

was necessary to use considerable quantities of crushed stone to put the detour in a fair condition.

We believe it wise to add a word of caution that this resurfacing is regarded by us as wholly in the nature of an experiment which should be watched and studied, rather than generally advocated, until it has proven itself out.

Road Improvement in West Virginia

Of the $33,000,000 of road improvement funds provided in the southern Appalachian states, in the 10 preceding years, 38 per cent. has been produced in West Virginia in the past 3 years, and 23 per cent. has been provided for in the past 12 months in West Virginia. This is a great showing for the new State Road Department. There being now $12,968,500 authorized bonds of which $12,088,500 has been voted since the department was organized.

The county court of Taylor has called for a vote on a $100,000 bond issue in Knottsville district, November 7, and on the same date the voters of Lewis county will pass upon a bond issue of $1,000,000.

The county of Preston has recently entered an order authorizing the beginning of work in Portland district under $280,000 bond issue voted December 7, 1915, which has been by a recent decision of the supreme court released for operation.

Demonstration of Monolithic Brick Pavement Construction

Following the annual meeting of the National Paving Brick Manufacturers Association at Terre Haute, Ind., on October 5, the organization, together with thirty-five or more engineers, street and highway officials and others, invited guests, inspected the monolithic brick road built last year

ALLEN J. PARRISH, CONTRACTOR, AND W. T. BLACKBURN, ENGINEER OF EDGAR COUNTY, ILL., WHO DEVELOPED THE MONOLITHIC PROCESS.

near Paris, Ill., and watched the process of building a similar pavement on a road under contract just outside of Paris, by A. J. Parrish, of Paris.

The method of construction of the road was detailed last month in MUNICIPAL ENGINEERING in an article on the construction of brick pavements, which need not be repeated here. The photographs show the engineer who designed the road, W. T. Blackburn, or Paris; the contractor who is building it, A. J. Parrish, of Paris, who is standing on the rolled brick surface which is being grouted in the background; and the party in automobiles supplied by the public spirited citizens of Paris, traveling over the first monolithic brick highway pavement constructed.

A COMPLETED MONOLITHIC BRICK HIGHWAY.

Mr. Parrish laid 800 square yards of pavement during the day, notwithstanding the interference of the crowd of visitors with the work. Organizations, efficient supervision and co-operation of workmen were clearly visible and resulted in first-class construction.

Before going to Paris some Terre Haute streets were inspected, including the historic South Sixth street, probably the oldest existing cement-filled brick street, and still in excellent condition in the areas between intersecting streets after some 25 years of heavy use with only incidental repairs.

Brick Paving on the Lincoln Highway in Crawford County, Ohio

Eight and three-quarters miles of the total of 22 on the Lincoln Highway thru Crawford county, Ohio, have already been paved with brick and an additional mile and three-quarters are under construction as this is written. The balance of the county's Lincoln Highway mileage, 11½ miles, is surfaced with waterbound macadam in various stages of wear.

The highway passes thru the progressive machinery-manufacturing cities of Bucyrus and Galion, within the corporate limits of which lie approximately 3½ miles of the brick paving. Of the balance, 2 miles lie to the west of Bucyrus and a mile and three-quarters now under construction to the east. On the east and west of Galion are 2 miles and 1¼ miles respectively. Petitions from property owners have already been filed with the county commissioners for an additional 2 miles of brick to extend that now laid west of Bucyrus.

The portion west of Galion was built in 1914. That east of Galion and west of Bucyrus, late in 1915. Outside of city

LINCOLN HIGHWAY, WEST OF BUCYRUS, OHIO.

limits the construction is in accordance with the specifications of the State Highway Department.

The sections already built follow this design:

Width of brick pavement, 14 feet. Concrete edging integral with the base, 8 inches on each side. Total width of pavement, 15 feet 4 inches.

Depth of brick, 4 inches.

The base, 4 inches of concrete, crushed limestone coarse aggregate.

The cushion, 2 inches of sand.

The filler, cement grout, 1 to 1 mixture.

The mile and three-quarters east of Bucyrus now under construction is being built by the monolithic method whereby the brick are laid in the green concrete foundation. Following is a detailed description:

The base, 4 inches concrete, crushed limestone coarse aggregate, 1½ to 2 inches maximum size.

Width of brick pavement, 16 feet, no edging.

Depth of brick, 4 inches.

The filler, cement grout, 1 to 1 mixture.

The base is struck off to the required depth by a double template drawn forward by the mixer upon the steel side forms. Green mortar is then brought to the surface by means of a slap board. This method is different from that specified

LINCOLN HIGHWAY, NEAR BUCYRUS, OHIO.

by the National Paving Brick Manufacturers' Association. This Association has recommended the use of a double template which spreads over the surface of the green concrete base a thin film of premixed sand and cement at the same time that it strikes off the concrete.

Brick-laying follows immediately from boards laid upon the brick surface already placed. The surface is then immediately smoothed with a hand roller weighing about 350 pounds.

Grouting is delayed until the end of each working period.

Work on the pavement is progressing on an average of 200 linear feet each working day.

We are indebted to Maurice B. Greenough, instructor in highway engineering, Case School of Applied Science, and consulting engineer for the National Paving Brick Manufacturers' Association, Cleveland, Ohio, for the data and photographs regarding this road.

New York State Roads

The report of the New York State Commissioner of Highways gives many interesting facts concerning highway construction and maintenance, from which the following are selected:

Of the 1,073.2 miles of road for which contracts were awarded in 1915, 381 miles were of water-bound macadam, which cost an average of $10,250 per mile, 16 to 26 feet wide, the pavement alone costing 64.8 cents per square yard; 347 miles were of bituminous macadam, penetration method, averaging $12,970 a mile, 16 to 26 feet wide, the cost of pavement only being 87.1 cents per square yard; 176 miles were of water-bound macadam, surface treatment; 113 miles were of cement concrete, averaging $15,320 per mile, 16 to 26 feet wide, the cost of pavement only being $1.121 per square yard, 6 inches thick; 31 miles were of brick, averaging $25,750 per mile, 16 to 26 feet wide, the cost of pavement only on 5-inch concrete foundation being $2.015 per square yard; 2.2 miles were of bituminous macadam, mixed method, cost included in bituminous macadam above; 23 miles were of other types not classified. The details of cost are for pavements 6 inches thick, except that the brick pavement is 9 inches thick.

The length of road completed during the year was 1,083.35 miles.

The cost of water-bound macadam in the nine districts of the state varied from $8,189 to $12,400 per mile, 16 to 26 feet wide; that of bituminous macadam, penetration method, from $8,718 to $11,600; that of bituminous macadam, mixing method, from $16,600 to $18,700, with extra width in villages not counted; concrete, part of which is Hassam, $10,700 to $18,800; brick, from $21,500 to $47,269, not counting extra width in cities; asphalt block, $22,300 to $68,782; stone block, $34,300 to $38,500; bitulithic, $13,972, not including extra width in cities. Heavy excavation and concrete retaining walls account for the upper cost figures when they seem excessive.

The Spot Test in St. Paul

During the first half of the last month the Commissioners of St. Paul, Minn., have been occupied with a discussion of the spot test for determining adulterations for treating paving blocks and has retained the test, which was originally adopted a year or two ago, in an attempt to prevent the bleeding of blocks with which the city has been afflicted.

This test for determining the purity of an oil was devised several years ago and consists in dropping six drops of the oil on clean white blotting paper. If the oil is pure the paper will be stained a color and tint characteristic of the oil tested. If the oil contains impurities they will gather about the center of the spot and will show clearly.

The spot test, according to the investigations of the Forest Products Laboratory at Madison, Wis., will detect in creosote oil percentages of lampblack, representing free carbon, as low as 0.005 per cent. If the impurity is greater than 0.5 per cent. the amount of impurity cannot be judged, the center of the spot being too black to differentiate, but for smaller proportions it can be judged by the appearance with a fair degree of accuracy.

The same test has been adopted by European Diesel Engine users to determine the adulteration with raw tar of the heavier oils distilled from tar, which they use as engine fuel, the carbon resulting from the combustion of tar in the cylinders being very objectionable and injurious.

A coking test was presented as a possible substitute for the spot test in the St. Paul specifications, but Profs. E. E. Nicholson and I. H. Derby of the department of chemistry in the University of Minnesota showed that the proposed test could not determine the amount of tar in the mixture within the desired percentage of variation, and it was shown that the dilution of the creosote oil with tar must be accompanied with a corresponding dilution with light oils to keep the resulting mixture within the requirements of the specifications, so that the actual percentage of tar, as compared with that of creosote was not to be determined by the coking test. The spot test was therefore retained by a vote of 5 to 2, Mayor Irvin voting with the majority.

Street Paving in Texas

L. W. Kemp, editor of *Texaco Tips*, published weekly by the paving and roads division of The Texas Company for the benefit of contractors in Texas, has made a compilation of the reports of pavements laid in Texas cities in 1916, which shows the following facts:

PAVEMENTS LAID IN 1916.

Class of Paving.	Square Yards.	Miles.
Asphaltic Concrete	352,611.53	19.736
Bitulithic	337,413.18	17.082
Vertical Fiber Brick	293,527.85	15.060
Creosoted Wood Block	211,564.20	8.838
Asphalt Macadam	148,433.80	6.666
Uvalde Rock Asphalt	107,649.73	6.188
One Course Plain Concrete	90,182.20	4.914
Two Course Reinforced Concrete	87,656.50	4.643
Oklahoma Rock Asphalt	76,334.69	3.844
Granitoid	54,639.10	3.000
Two Course Plain Concrete	45,315.00	1.832
One Course Reinforced Concrete	22,829.00	1.031
Standard Brick Blocks	24,353.00	1.089
Vibrolithic	8,206.00	.441
Sheet Asphalt	6,986.00	.117
Westrumite	4,718.43	.430
Granited Concrete	1,336.20	.059
Total	1,872,656.32	94.970

ARRANGED ACCORDING TO CITIES.

1	San Antonio	703,365.96	37.149
2	Dallas	155,782.92	8.710
3	Temple	125,440.53	7.200
4	Fort Worth	79,285.00	3.655
5	Mineral Wells	74,458.00	3.584
6	Paris	62,876.41	3.900
7	Houston	61,437.88	2.733
8	Sulphur Springs	60,072.47	3.030
9	Galveston	40,232.15	1.929
10	Waco	39,288.77	1.610
11	El Paso	38,437.00	1.640
12	Arlington	37,391.00	1.360
13	McKinney	36,325.00	2.834
13	McKinney	36,325.00	2.834
14	Yoakum	36,297.00	1.570
15	CORSICANA	34,484.40	1.220
16	Denison	33,651.00	1.350
17	Corpus Christi	32,953.63	1.470
18	Ennis	27,966.00	.830
19	Wichita Falls	27,544.80	1,213
20	Terrell	27,000.00	1.487
21	Marshall	22,616.60	1,260
22	Austin	19,026.80	.922
23	Abilene	15,860.80	.720
24	Lufkin	14,044.00	.750
25	Mt. Pleasant	13,480.00	.520
26	Vernon	12,662.00	.400
27	Bryan	11,231.00	.304
28	Hillsboro	9,155.00	.590
29	Sweetwater	7,956.00	.280
30	Greenville	7,220.20	.600
31	San Angelo	2,028.00	.....
32	Texarkana	1,689.00	.070
33	Highland Park	1,499.00	.090
Total		1,872,656.32	94.970

Seattle Municipal Asphalt Plant

Until August, 1912, Seattle, Wash., let its asphalt street repairing to the contractors laying the streets at an average price of about 3 cents per square yard per year. If the city had continued the contract policy it would have paid the contractors for such repairs $109,511.40 in the 3½ years or so since the city took the repair contracts over. During 1914-5 the operation of the asphalt plant cost $6,969.89 more than was received from work done for other parties, showing a saving of $102,541.51. This saving would take care of much of the cost of the plant as well as of depreciation and interest charges and of other overhead charges if the $1,500 included in the figures of cost is not considered sufficient.

Maintenance by the department is reported to have cost 0.283 cent a square yard a year as compared with the former contract prices of 2.8 to 3.5 cents per square yard per year. The average cost per square yard of repairs actually made was $1.56 a square yard in 1915.

Good Roads Notes

The latest report of the State Road Commissioner of New Jersey states that the cost of the roads which it was intended to build with the $7,000,000 bond issue authorized by the legislature will be more than doubled on account of the higher cost of labor and materials, due to the return of laborers to European countries to go into the war and the high prices paid for labor in munitions factories. The latest estimates bring the probable cost of these roads up to $15,000,000.

The Illinois State Highway Commission has awarded to Walter H. Lienesch, chief engineer, Universal Concrete Products Co., 208 South LaSalle street, Chicago, Ill., the prize which it offered for the best design for a road sign to be used on state-aid roads. The concrete sign-board with inlaid concrete letters is removable from the concrete post with a galvanized pipe cast in it, a concrete cap on top covering a metal nut which screws on the upper end of this pipe to hold the sign in place.

According to the U. S. Office of Public Roads expenditures for road and bridge work in the U. S. have increased from $80,000,000 in 1904 to $282,000,000 in 1915. State expenditures increased from $2,550,000 to $53,000,000.

The first concrete street pavements, 9,000 square yards, to be built in Maine, were started a few days ago at Norway, Oxford county.

Since January 1, 1916, the Maryland State Highway Department has let contracts for nearly 60 miles of concrete road. Indications are that a total of 80 miles will be reached before the end of this year.

Three and three-fourths miles of concrete has been finished and opened to traffic on the Princess-Anne road, Norfolk county, Va. This is the first important stretch of concrete road in the state.

The National Highways Association and the Meridian Road Association have published a map of the Meridian road, which runs from Pembina, N. D., at the Canadian line, almost on a meridian line to Galveston, Tex., with a branch from Waco to Laredo on the Mexican line. There are but few cities of very considerable importance upon the line.

Hillside wire-cut-lug brick will be used on 650 feet of a hill on the Elmira-North Elmira, N. Y., state highway, contract for which has been let to P. F. Connelly, of Horseheads, N. Y., the width to be 39 feet. Part of the 4¼ miles of the contract will be of brick on concrete foundation, 30 feet wide, except on the hill, part of bituminous macadam, 16 feet wide, and part of water-bound macadam, 14 feet wide.

Clay county, Missouri, has voted $1,250,000, being about $6,500 a mile for some 200 miles of good roads construction, which, if judiciously expended, will furnish the hard surfaces necessary on the main lines and excellent surfaces for the less traveled roads.

The board of supervisors of Forrest county, Miss., have set the prisoners in the county jail to work on the county roads to repair the serious damage done to roads and bridges in the southern part of the county by the hurricane of July 5 and 6. The other work in the county, partly due to the storm, was provided for the first week in July.

The Good Roads Year Book of the American Highway Association has been issued for 1916 and sustains the high reputation gained by previous issues in keeping up to date the information about road laws, road systems, financing of road construction and maintenance, names of producers of road materials and machinery, etc. The book is sold at $1 or five copies for $4. Fairfax Harrison, president of the Southern Railway Company, is president of the association, whose offices are in the Colorado building, Washington, D. C.

Proceedings of the thirteenth annual convention of the American Road Builders' Association, containing all the information about the organization, as well as the valuable papers presented at the convention. E. L. Powers, secretary, New York.

MISCELLANEOUS

Meetings of Associations

Nov. 20-25 at Springfield, Mass., 10 conventions will be held as follows: National Municipal League, 23-25; City Managers' Association, 21-23; Civic Secretaries' Conference, 23, 24; Conference on Municipal Research, 22, 23; Training School for Public Service, 22, 23; Intercollegiate Division of National Municipal League, 22, 23; Massachusetts Federation of Planning Boards, 23, 24; Western New England Chamber of Commerce, 22; Massachusetts Civic League, 21; and Massachusetts Single Tax League. Most of these associations join with the first named in one cession or more. A graphic chart of the conventions has been prepared by the Springfield Bureau of Municipal Research and will be sent on request.

Feb. 5, 1917 in Mechanics building, Boston, Mass., American Road Builders' Association.

Feb. 7-15, 1917, at the Coliseum, Chicago, Ill. The 10th Chicago Cement Show. Cement Products Exhibition Co., Chicago, Ill.

Feb. 8-10, 1917, at Hotel La Salle, Chicago, Ill. The American Concrete Institute.

Feb. 11, 12, at Hotel Sherman, Chicago, Ill. National Builders Supply Association.

Feb. 13, 14, at Hotel Sherman, Chicago, Ill. Illinois Lumber and Builders Supply Dealers Association.

The Newark Convention of the American Society of Municipal Improvements

The convention of the American Society of Municipal Improvements at Newark, New Jersey, October 10 to 13, was so interesting that it was proof against the counter attractions of New York and the many attractions offered the members by the generosity of the local committee and their friends, who gave individuals and small parties every opportunity to investigate the objects of municipal and engineering interest in this interesting region.

The program was followed closely, with two exceptions, and was thruout of absorbing interest as judged from the large attendance at the sessions. On Wednesday afternoon was scheduled the discussion of sewage treatment, represented on the program in papers and written discussions of the papers by nearly all the experts engaged in developing the process. There was also a paper on the latest experience with the Imhoff tank. Nearly all the discussion had been arranged for beforehand by George A. Carpenter, the chairman of the committee having the meeting in charge, and all the papers but one were printed and in the hands of members. Two papers were carried over from the morning session on account of the use of stereopticon and all the papers on the sewage disposal program were presented in abstract or in full. The deprivation came from the stopping of the discussion because of an eleventh hour notice that the room must be vacated to prepare for the evening. This cut an hour and a half off the scheduled length of the session and prevented the asking of questions on points on which minor detail was desired. Groups of those specially interested got together and continued the discussions but the audience as a whole missed the interest of question and answer, tho the advance papers contain practically all the information which could be brought out.

The association has a custom of devoting but two sessions to entertainment and excursion features, but Newark had so much to offer of the latter class that the discussion of paving problems, set for Thursday, was crowded. It was supposed that the discussions of paving specifications would be worked out in committees, as usual, but the probability of discussion on the convention floor developed in the committee meetings and the report of the committee on standard specifications was set forward. The discussions occurred and were extremely interesting to all the large audience present. But the result, as usual, was that the recommendations of the general committee were adopted without modification. This relegated the evening papers on paving subjects to the list read by title. It is doubtful, however, if any of those present at the evening discussions on specifications or on the excursion, which occupied half the morning and all the afternoon, would have voted for the elimination of the excursion or the cutting off of the discussions.

At the meeting of the executive board on Tuesday morning before the convention opened, a committee was appointed to consider changes in the constitution as to treatment of questions regarding changes in specifications on the floor of the convention and as to classification of members. On Friday morning the association provided for such a committee to report far enough in advance of the next convention to transmit its report to the members with the volume of advance papers.

An increase of 25 per cent. in membership during the year and applications from about 140 more at the convention, including delegates from municipal members, showed the growing interest in the society and the increasing appreciation of its earnest and efficient work during its long life of usefulness.

The first vice-president, Norman S. Sprague, of Pittsburgh, Pa., was elected president, E. R. Conant of Savannah, Ga., G. H. Norton of Buffalo, N. Y., and R. K. Compton of Baltimore, Md., were elected first, second and third vice-presidents, Charles C. Brown was continued as secretary, F. J. Cellarius of Dayton, O., was elected treasurer, and George A. Carpenter of Pawtucket, R. I., F. A. Reimer of East Orange, N. J., and Hal Moseley of Dallas, Tex., were elected on the finance committee.

New Orleans was selected as the next place of meeting, with City Engineer W. J. Hardee in charge of the local arrangements. The meeting will be held in the middle of November, 1917.

Fellowship Established for Asphaltic Research

With the co-operation of Harvard University and the Massachusetts Institute of Technology, The Barber Asphalt Paving Company has established at these institutions a fellowship for research in asphaltic materials and their uses. The fellowship is to be known as "The Clifford Richardson Fellowship." Mr. Richardson is a distinguished alumnus of Harvard and this, taken in connection with his great contributions to asphaltic highway construction and his work in the chemistry of bitumens, makes the designation of the fellowship particularly appropriate. The appointment of the incumbent of the fellowship and the choice of subjects for investigation, as well as the disposition to be made of the results of such investigations as may be undertaken, are to be decided by the institute faculty or the joint committees of the university and the institute having control of engineering work.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

Nov. 8: Junior drainage engineer in Office of Public Roads at $960 to $1,440; copyist draftsman in Navy Department at Washington, D. C., at $2 to $3.44 a day; assistant inspector of hull material at any navy yard, at $4.48 a day.

Nov. 8-9: Laboratory assistant qualified in petrography in Bureau of Standards at Pittsburg, Pa., at $1,080 a year.

Nov. 14: Expert electrical and mechanical aid in Bureau of Yards and Docks, Washington, D. C., at $12.48 a day; general mechanic in Indian Service at Sac and Fox Sanitarium, Iowa, at $720 a year.

Nov. 21: Assistant petroleum engineer in Bureau of Mines, in the field, at $1,800 to $2,500 a year; expert aeronautical aid in Department of Construction and Repair, navy yard, Washington, D. C., at $13 a day; designing mechanical engineer under Board of Engineers, U. S. Army, New York city, at $2,100 a year; petroleum technologist in Bureau of Mines, in the field, at $2,500 to $3,000 a year; radio draftsman in Navy Department, Washington, D. C., at $3.04 to $6 a day.

Nov. 22: Laboratory assistant in ceramics in Bureau of Standards, Pittsburg, Pa., at $900 to $1,200 a year; observer and meteorologist in Weather Bureau, at $1,260 to $1,620 for observer and $1,440 to $1,800 for meteorologist.

Nov. 22; 23: Assistant engineer at $1,500 up and junior engineer at $900 up, in Reclamation Service; clerk draftsman in General Land Office Service, at $1,200 a year.

Technical Schools

The School of Commerce and Administration of the University of Chicago has issued its announcements of courses of training for business, commercial teaching and secretarial work for 1916-17. Leon Carroll Marshall, dean.

The Bureau of Municipal Research, 261 Broadway, New York, in its Training School for Public Service, offers courses in municipal highway enginering and in engineering administration, the first for a half year once a week beginning November 14, and the second for the last half of the school year, ending in May, 1917. The lectures will be given by Prof. A. H. Blanchard at the Automobile Club of America, 247 West 54th street, New York, at 8 p. m., the fee for 15 lectures being $10.

The dedication of the new Ceramic Enginering building of the University of Illinois, Urbana, has been postponed to December 6 and 7, 1916.

Municipal Notes

Silvam Springs, Ark., has completed its sewer system at a cost of $50,000. It includes 10.6 miles of pipe sewers and a sewage disposal plant capable of treating 300,000 gallons a day.

Municipal Reports

The first annual report of the city council of Beaufort, S. C., under the commission manager plan of city government, for the year ending May 1, 1916, has been issued. It shows a change from deficits to surpluses in city funds and the turnover of about $30,000 a year in general city and water departments together. H. G. Otis is city manager; H. R. Pollitzer is city engineer and superintendent of public work.

The ninth annual report of the Pasadena, Cal., municipal lighting works department, for 1915-6 has been issued. C. W. Koiner, general manager and electrical engineer.

The forty-seventh annual report of the West Chicago park commissioners is a handsomely illustrated volume of 211 pp. A. C. Schrader, superintendent and engineer.

Good Roads of Monroe Co.. New York, 1915, is the title of the report for 1915 of J. Y. McClintock, county superintendent of highways, Rochester, N. Y.

Annual report of County Engineer of Essex County, N. J. F. A. Reimer, county engineer, East Orange. N. J.

Report for 1915 of water commissioners of Danvers, Mass., Henry Newhall, superintendent.

First Report of the Municipal Recreation Committee of South Bend, Ind., F. B. Barnes, director.

Report for 1915 of water board of Auburn, N. Y., J. Walter Ackerman, chief engineer and superintendent. A pitometer and electrolysis survey of the distribution system were made and the books were audited by a certified public accountant.

Report for 1915 of the board of health of Concord, Mass., John M. Keyes, chairman.

Report for 1915 of road commissioners of Concord, Mass., John M. Keyes, commissioner of roads and bridges.

Report for 1915 of Board of Public Works and Water Commissioners of Little Falls, N. Y., Geo. I. Oakley, city engineer.

Report of the Board of Engineers on Sewage Disposal for Pasadena, South Pasadena and Alhambra, Cal., including form of contract between the municipalities. R. V. Orbison, city engineer of Pasadena, chairman.

Personal Notes

Robert H. Boynton, city engineer of Frankfort, Ind., died on September 18. He was a promising young engineer, a graduate of the University of Michigan in 1910.

William H. Reid, smoke inspector of Chicago, has been elected president of the National Smoke Prevention Association.

Publications Received

Standards for Electric Service is the title of Circular No. 56 of the U. S. Bureau of Standards, Washington, D. C., giving rules and recommendations for the regulation of electric service companies by State Commissions; three ordinances for such independent regulations by towns and small cities, cities generally, and large cities having electrical inspectors; also specifications for approval of types of electric meters by commissions.

Bulletin 89 of the Engineering Experiment Station, University of Illinois, Urbana, is on specific gravity studies of Illinois coals and is by M. L. Nebel.

Industrial Conditions in Springfield, Ill., by Louise C. Odencrantz and Zenas L. Potter, is the latest to be issued of the 10 parts of the report of the Springfield survey. It occupies 155 pp., has 20 illustrations and costs 25 cents. The series as a whole shows the methods and results of a thoro city survey of a typical city of moderate size and can be obtained either singly in paper or bound in 3 cloth volumes.

A professional paper on "The Flow of Water in Wood-Stave Pipe," by Fred C. Scobey, irrigation engineer, is published in Bulletin 376 of the U. S. Department of Agriculture.

MACHINERY AND SUPPLIES

The Double-Quick Backfiller

A trench backfiller devised and sold by the Waterloo Cement Machinery Corporation, Waterloo, Iowa, consists of a hoisting engine mounted on a wheeled truck with a revolving turntable, so that it can operate in almost any direction. When working on a trench its range is about 90 degrees at each setting of the machine.

A plain slip or drag scraper is used, drawn by a rope operated by the hoisting engine. The scraper is drawn back by a man for each draft of earth it makes. The earth can be handled exactly as desired.

The machine is moved forward by a block attached to a peg driven in the ground, attached at one end to the tongue of the truck and running at the other around the winch head of the hoisting engine, which has been turned to set squarely on the truck for this purpose.

Two men operate the machine the same as with a team, but can do twice as much work in the same time. The power is a 7-h.p. horizontal hopper-cooled Wonder gasoline engine.

The machine is available just as readily for lowering pipe into a trench, loading and unloading, snatching teams, pulling cables, pulling piles or cribbing, hoisting, hauling overground and any similar pulling or hoisting work.

Unique Truck Camera

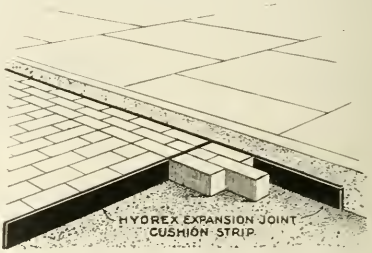
The most interesting newspaper innovation in the way of setting live-up-to-the-minute pictures before eyes of the reader goes to the credit of the Philadelphia Public Ledger. The Ledger has a photograph auto patrol equipped with high power cameras, especially designed for fast work. This patrol answers fire alarms, emergency calls of all kinds—anything that offers the possibility of real news pictures. And the rapidity with which the patrol travels and works makes newspaper pictures available that could not be thought of under the old conditions. The truck as illustrated is equipped with Goodrich tires.

Camera Patrol of the Philadelphia Public Ledger.

Hydrex Expansion Joint Strip

The accompanying illustration shows the adaptation of Hydrex expansion joint cushion strip for longitudinal and transverse purposes.

This type of prepared joint, which is manufactured by The Hydrex Felt & Engineering Co., consists of a special bitumen compound of great ductility and flexibility, which is made up into strips five feet long and of any width or thickness desired.



flexibility and cushion-like effect under varying degrees of temperature, being especially designed and used to meet these conditions.

Jeffery Fire Trucks Popular

The following cities are using Jeffery motor trucks, either as fire trucks or in the police service: Lebanon, N. H.; Chippewa Falls, Wis.; Whitewater, Wis.; Collinsville, Wis.; Kenosha, Wis.; Reading, Penn.; South Bend, Ind.; Waukegan, Ill.; Oakland, Cal.; Whittier, Cal.; Minneapolis, Minn.; Long Beach, Cal.; Boston, Mass.; Pomona, Cal.

New Concrete Mixer Accelerates Hawaiian Road Work

A new concrete mixer which arrived at Hilo, Hawaii, by the steamer Enterprise, was utilized by the road department, having been requisitioned by road overseer Lyman for the concreting of Front street.

This mixer immediately demonstrated itself to be a great improvement over the old equipment, the progress of the work of laying concrete on Front street will be considerably accelerated, so much so, in fact, that the work was finished many days earlier than expected.

The mixer is a Chain Belt mixer and was obtained by the county from the A. L. Young Machinery Company of San Francisco thru the Honolulu Iron Works. It has a capacity for mixing 14 cubic feet of concrete and distributing the mixture just where it is required, thus saving a great deal of unnecessary labor. At the beginning the mixer could not be operated to its full capacity, due to the fact that the workmen were too inexperienced to take full advantage of the facilities offered. Within two weeks the county was laying from 175 to 225 linear feet of concrete road daily, the road being 20 feet wide.

Tractor Pulls Up Old R. R. Track

In Redlands, Cal., it recently was decided to improve a certain thorofare which at one time was a railroad right-of-way, but which had not been used as such for a long time. Before putting down new paving it was, of course, necessary for the city to remove the old rails and ties, and conditions at the time made it requisite that this be done as cheaply as possible and in the very shortest time.

The ties were deeply imbedded and the rails were rusted tightly to them. Hand labor in removing the car tracks implied the necessity of prying the rails loose from each tie at considerable expenditure of both time and money.

Courtesy of Popular Mechanics.

A TRACTOR IN THE CITY OF REDLANDS, CAL., BEING EMPLOYED TO PULL UP A STRETCH OF ABANDONED RAILROAD TRACK.

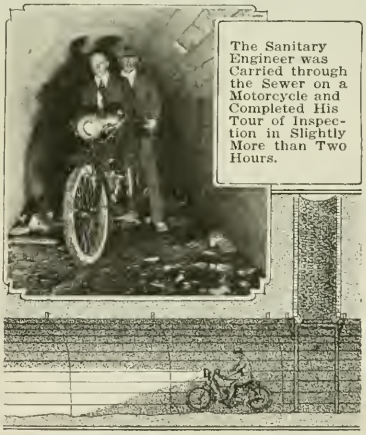
It was finally decided to employ an ordinary tractor, which, it was found, obviated all need of separating the rails from the ties for removal.

The procedure was simply to remove some of the earth from between the ties, after which the tractor was hitched to the car track and the signal to "Go ahead" given. The tractor was able to pull out sections about 20 ft. long with considerable rapidity and within 2 days had torn up more than a mile of track.

Motorcycle for Sewer Inspection

At Pasadena, Cal., a new 6½ mi. sewer is nearing completion. A local sanitary engineer recently was ordered to make an inspection tour through it, which implied a long, arduous walk with periodic halts for examination of certain phases of the construction. It was estimated that the trip would consume almost an entire day's time.

The engineer in question, however, accomplished the entire trip in only 2 hrs. and 15 min. via motorcycle instead of a-foot. The machine was lowered into the tunnel thru a shaft and was driven at low speed to the mouth of the underground bore. A mechanic operated the motorcycle, while the engineer occupied the auxiliary seat behind him and scrutinized the sewer walls as they slowly passed. Frequent stops were made and no difficulty whatever was experienced on the trip. The motorcycle's powerful headlight was the only illumination used, either for guiding the way over the rough sewer bottom or for examining the walls.



The Sanitary Engineer was Carried through the Sewer on a Motorcycle and Completed His Tour of Inspection in Slightly More than Two Hours.

Courtesy of Popular Mechanics.

A Tractor for Light Contract Work

Herewith is illustrated a small tractor weighing a total of 5,000 lbs., or about 5½ lb. per square inch of contact surface. Despite its diminutive size the tractor is guaranteed to develop 20-h.p. on the belt and 12-h.p. on the drawbar. The motor is a Waukesha, with four vertical cylinders, a 4½-inch

bore, 5¾-inch stroke and a speed of 800-r.p.m. The tank capacity is 20 gallons of gasoline and the steering wheels are 42 inches in diameter, carrying 8 by 3½-inch tires. A speed of

2.7 miles per hour can be attained on high gear, and 2.1 miles on low. The machine can be turned either backward or forward within a 15-foot circumference.

The tractor, which is made by the Tom Thumb Tractor Co., of Minneapolis, Minn., is designed primarily for use by the small contractor and farmer, or for lighter work on large contracting jobs. It is specially convenient where soft spongy soil must be worked over without packing it down, as often happens with large wheel-type outfits.

The accompanying photograph shows the tractor pulling a string of loaded trailers, which themselves are particularly designed for road construction work.

A New Tunneling Machine

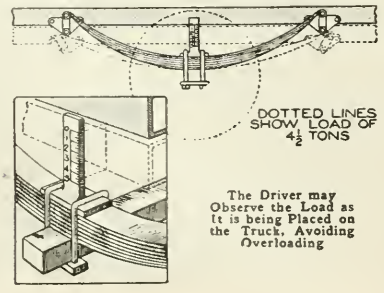
A new tunneling machine like one which soon is to begin the tube under the English Channel at Dover, England, is now operating beneath the Grand Central Railroad terminal, New York city, digging its way through solid rock.

The cost of tunneling with this machine is $13 a foot, as compared with $35 per foot under present methods. The crew consists of 3 men; the present methods require 50 men. Its rate of driving is 24 ft. a day, compared with 8 ft. under present methods.

A further feature, that it eliminates blasting, is in itself reason enough for its replacing the present method of tunnel driving.

New Load Scale for Trucks

One of the most common and, at the same time, severe abuses to which the average motor truck is subjected is overloading. To alleviate this condition Joseph Husson, of New York City, has devised a load scale consisting of two uprights, graduated and attached to the centers of the rear springs. They extend above the lower edge of the truck frame, by which the exact weight of the load is indicated on the scale. When empty, the lower edge of the truck frame should register at zero and when loaded to full capacity, it should be exactly opposite the maximum load mark, which is the highest figure on the scale.



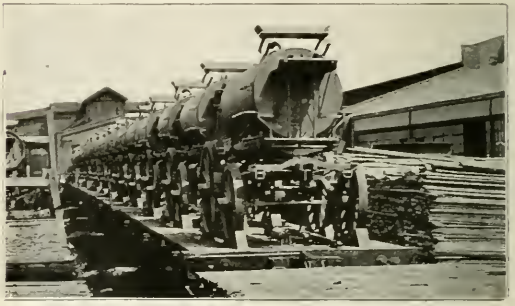
The Driver may Observe the Load as It is being Placed on the Truck, Avoiding Overloading

Mr. Husson determined his scale markings by placing the truck on a level and weighting its platform evenly with successive 1-ton loads, 1½-ton loads, etc., the markings on the scales being made at the lower edge of the frame. Of course the gradations are not equally spaced, on account of the small deflection of the springs under light loads.

Sprinkling Wagons for Army Use

The photograph herewith represents part of a shipment of 40 Austin sprinkling wagons ordered by the U. S. Government. The picture shows the trainload ready to leave the Austin factory. These machines are the Austin standard 600-gallon platform-spring type with steel tanks. They were purchased by the War Department for use with the troops in the southwest.

It is very much in favor of the construction of these machines to be able to say that the U. S. Army authorities have found the Austin standard construction so good that it was capable of passing their tests and standing up to the exceptionally rough work accorded these machines on the Mexican frontier, no alteration or reinforcement of the Austin stand-



ard construction being found necessary for this specially severe work. This ought to be a sort of assurance to the users of street sprinklers for more ordinary purposes in connection with street cleaning departments where the service is not anything like so severe, and it accounts for the long life which this Austin equipment possesses.

"Lightning" Loader Skip Economy

Devices for facilitating the loading and unloading of materials certainly have come into their own since the advent of the motor truck for transport. These loaders are being particularly favored for many classes of contracting work when so constructed that they may be quickly dismantled and moved about from job to job.

The "Lightning" loader ship is of this type and the illustration shows how it can be placed in position on loaded freight cars. The Garford Motor Truck Co., Columbus, the General Motors Co., the Carnegie Steel Co. and similar large corporations are making extensive use of them in this way.

It consists of a steel pan or body with an end gate and two demountable steel side-boards, together with a pair of short-coupled rigid-steel structural brackets. It can quickly be mounted on any type of an open gondola or freight car by simply setting the loader on the brackets which attach to the side of the car. The pan or tray is dropped into position and held there by means of an adjustable pivot bar, which, with its own supporting stem, is fitted with three holes permitting the raising or lowering of the body. The loader rests in a

slightly inclined horizontal position, allowing plenty of clearance between the extreme height of the truck and the ground level. This bar is seated in a cast-steel shoe, riveted to the sides of the body.

The construction of the pan or tray is such that it can be heaped with materials and gives a maximum load to the truck every trip.

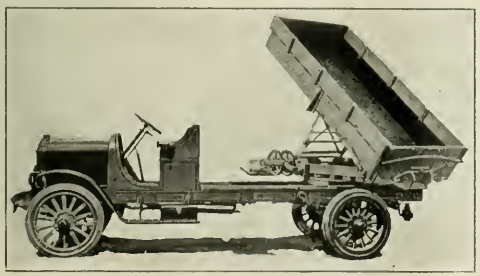
When in position on the car, the loader is prevented from dumping inopportunely by means of two steel levers which securely lock the chute. Any class of bulk materials can be handled and will receive a quick, clean discharge into the waiting truck. The fact that there are no pivot bars or other obstructions to prevent a quick movement of materials make this skip unusually satisfactory for the handling of coal and like materials.

Turn-Table Dumping Feature

The accompanying illustration is interesting in view of the fact that this Wilson truck has been specially designed for use by contractors in very narrow streets or confined quarters where it would be impossible for the vehicle to back to the curb or whatever other spot was intended for the dump. In addition to the hand-hoist feature, this body is mounted on a turn table, so that after the proper angle of elevation is obtained the body may be swung around in any direction to discharge its load.

This sort of truck is commonly known as the semi-trailer type because the forward end of a large 2-wheel trailer is supported on the turn table which is itself mounted on the motor truck chassis, and the major portion of the weight of the 3 to 5-yd. body rests on the two trailer wheels. In this type loads up to 5 tons are transported. Both hand and power-dumping devices also are noteworthy features.

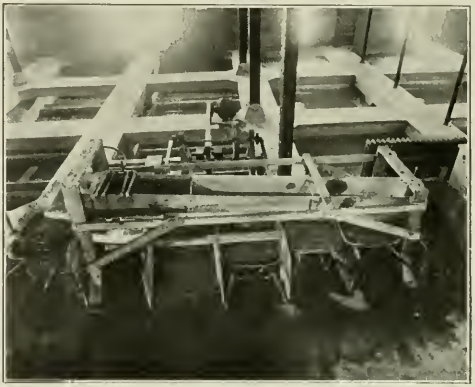
The Wilson semi-trailer outfits are designed to be fitted with any of the standard types of dumping bodies, such as the Lee, Lally, Woods, or the Watson bottom dump. Still other forms comprise variations of the well-known reach trucks for the transporting of steel, stone or timbers swung beneath the frame. For the carrying of heavy machinery, a low platform body with a minimum height of 18 in. may be had.



New Shaking Screen Grades in Six Sizes

Mr. Walter A. Sperry, chief chemist of the filtration plant of the board of public works, city of Grand Rapids, Mich., is the inventor of a simple riddling machine which lately has been doing in a single day all the work that formerly required a week to perform by hand labor.

A motor operates a shaft equipped with cams which shake a suspended trough into which the sand and gravel is emptied. The trough is set at a slight angle, causing the material to travel over some or all of the 6 screens of various sizes which constitute its bottom. In this way the gravel is



TROUGH WITH SCREENS FOR WASHING AND SCREENING GRAVEL FOR USE IN WATER FILTERS OF GRAND RAPIDS, MICH., WATER WORKS. NOTE SIX SIZES OF SCREENED GRAVEL AND SAND.

speedily divided into six grades and falls into separate bins. The material thus separated is used in the filter beds. L. I. Cutcheon, general manager of the Grand Rapids board of public works, states that the machine "has proved to be economical both from point of operating cost and in time saving."

Electric Pole-Setting Derrick on Truck

The Boston, Mass., telephone company has recently lessened the labors of at least one crew of linemen by inventing a special derrick which can be either attached or detached from their service truck in about 5 min. Its construction is simple.

The chief beam is a 6 by 6-in. spruce upright, 17 ft. in length, which is fastened to the rear of the motor truck. The lower end of the beam is so notched as to fit between the tailboard and the end of the body, the beam likewise being bolted to a heavy crossbar attached to the rear uprights of the truck's cover.

All lifting is done by a block and tackle in connection with an electrically operated winch which is firmly mounted on the truck. That the derrick is entirely practical is demonstrated by its recent record in picking up four 40-ft. chestnut poles, carrying them 200 ft. and there depositing them in the proper holes, all in 25 min.

Patents Issued on Colloidal Bitumens

United States patents have just been issued to Clifford Richardson on an improved "bituminous substance" and on the process by which this product is manufactured. Similar

patents have also been granted in Canada, Great Britain, France and Italy. It is believed that these are the first patents covering a product and process involving the introduction of colloidal matter into bitumens of all types. According to the inventor he obtains "an increased degree of body or stability in these bituminous substances, by means of the addition to and intimate and uniform dispersion through the bituminous substance of a proper proportion of a substance in the state of a disperse colloid. The process consists in the introduction of clay in the form of a colloidal aqueous paste and combining this paste with the bitumen in such a way that when the water is subsequently driven off, the bitumen forms the continuous phase of the colloidal material.

The products resulting from this method of incorporating clay in colloidal form with bitumen has markedly different properties from products into which the mineral matter is introduced in the form of a dry powder. The products made by the Richardson method range all the way from materials resembling vulcanized rubber to plastic but at the same time very stable mixtures suitable for paving and many other uses.

Cheap Water Supply for Concrete Mixer on Road Construction

Mr. G. B. Brodie, of the W. M. Brodie Co., contractors, Newcomerstown, Ohio, in reviewing the accomplishments of a 3-h.p. Domestic pump, states that the cost of operation has been less than $1 per day, whereas the cost of water haulage would have totalled $15 per day.

"This outfit," states Mr. Brodie, "takes water from the river, the pump being set 12 ft. above and 40 ft. distant from the supply. Suction line is 1½-in. We have laid 3,400 ft. of 1¼-in. line and are easily forcing sufficient water thru 2,800 ft. of it to take care of a concrete mixer operating at the rate of one batch per minute, and also to furnish water for the boiler and for sprinkling the sub-grade.

"The pipe cost us on cars here $5.3475 per 100 ft., and the laying ½ cent per ft. This does not include taking it up.

"We believe the pump will furnish water for an additional 1,000 ft. and perhaps more, as we have not been operating it at over 70 per cent. capacity thus far."

This gas engine, as above described, and which is made by the Domestic Engine & Pump Co., Shippensburg, Pa., will deliver 3 times as much water as will 2 teams.

The economy is indicated from the following authentic water cost data on actual contract work of puddling 1 mile of waterbound macadam. In both instances, the average water haul was ½ mile and the work required 20 days:

WHERE THE WATER IS USED. CONCRETE MIXER IN THE DISTANCE AND WATER SUPPLY PIPE AT THE RIGHT.

1. Sprinkler Cart Used; Road No. 1184, Aug. 1914.

—Investment—	
Sprinkler tank fitted with hand pump	$165.00
—Cost Data—	
Interest and depreciation at 16 % for 20 days	$ 2.00
250 hrs. of teaming at 60c per hr.	153.60
380 hrs. of labor at 20c per hr.	76.00
Cost of water	$231.60

2. Pump and Pipe System Used; Road No. 1258, Sept. 1915.

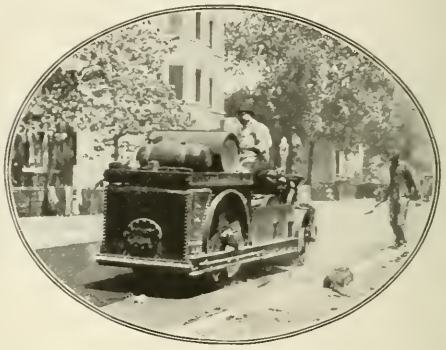
—Investment—	
Pump, 3 h.p.	$195.00
5,000-ft. of 1¼-in. second-hand pipe at .035c per foot	175.00
Tees, plugs, hose, etc.	28.00
	$398.00
—Cost Data—	
Interest and depreciation at 16% for 20 days	$ 4.40
Gasoline, 45 gallons, 18c.	8.10
Oil, 2½ gallons at 70c.	1.57
Attendance, 15 hrs. at 25c.	3.75
Connecting and taking apart pipe, 84 hrs. at 25c.	20.10
Cost for water	$ 37.92

Difference in cost equals $193.78 per mile.

Inasmuch as the average season's work is about 5 miles, a saving of $968.90 per season is effected.

New Gasoline Motor-Driven Road Roller

Private citizens now may be thankful that the old-fashioned steam-roller, with its heat, its smoke and constant racket, is now being so rapidly supplanted by gasoline motor-driven



Courtesy of Popular Science Monthly.

A GASOLINE MOTOR HAS ELIMINATED THE UPRIGHT BOILER, THE STEAM AND THE NOISE OF THE STREET-ROLLER OF THE OLDER TYPES.

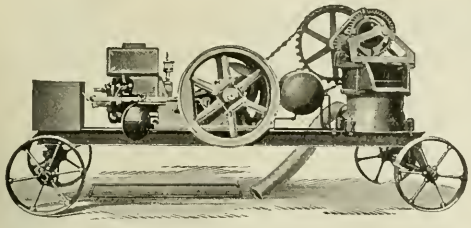
rollers which may be started at an instant's notice, have no fires to be kindled, no steam to get up and no dirty coal to carry.

When not actually in operation the motor can be shut off, whereas with the older steam type, steam must be kept on full head constantly. Further the elimination of the upright steam boiler allows the driver a far better view of his work and greatly lessens the weight on the rollers, without, however, reducing the pressure and, more than that, assuring a more steady movement of the rollers themselves.

Chain-Driven Trench Pump

Herewith is illustrated a power-driven trench pump, equipped with a sprocket-chain drive from the engine to the pump and a pump rod driven from an eccentric shaft instead of a rocker arm. The eccentric shaft is connected with the sprocket wheel shaft by a single set of gears and a compensating link attached to the connection of the eccentric with the pump rod keeps the rod in an upright position during its travels.

At the side of the pump is a 3-in. suction and a lateral discharge spout to which a chute, or trough, can be attached if



desired. All valves have openings sufficiently large to pass anything which goes through the suction hose.

The outfit as illustrated has a pump and 2-h.p. gasoline engine mounted on a steel-frame truck, the total weight being approximately 680 lb. If mounted on skids, this weight would be reduced to about 525 lb. Operating at 45 strokes per min., the capacity is from 3,500 to 4,000 gal. per min. This capacity, however, may be doubled by using a 2-pump outfit and a 3½-h.p. engine, with a total weight of 1,250 lb.

These trench-pumping outfits, as well as the gasoline engines, used in conjunction with them, are built by the Waterloo Cement Machinery Corporation, Waterloo, Ia.

Trade Notes

The city of New Orleans has changed its specifications for street pavement foundations, and brick masonry to permit the use of slag cement in the concrete, which is obtainable for 85 cents a barrel f. o. b. cars at Birmingham, Ala.

Lewis Institute, Chicago, Ill., and the Portland Cement Association will hereafter jointly operate the structural materials research laboratory at the Institute which has done much valuable work during the past 2 years.

The residents on the south side of Commonwealth avenue, Boston, Mass., think so well of bitulithic as a resurfacing for the macadam road on their half of the street that they have paid in to Mayor Curley a check for $7,990.90, the difference between the cost of bitulithic and the cost of an asphalt wearing surface, according to the lowest bid at a letting recently held. This check will protect the city in case any of the property owners refuse to pay the additional assessment of $1.25 a front foot on their property, necessary to secure bitulithic.

The Shawmut Paving Brick Works, of Shawmut, Pa., with one plant, and the Pennsylvania Clay Company, of Pittsburg, Pa., with three plants, have become licensees of the Dunn Wire-Cut-Lug Brick Company.

The John Kline Brick Company, Wickliffe, O., is the newest and the 34th member of the Dunn Wire-Cut Lug Brick Company's family of licensees. This is a well-constructed and well-managed plant with a daily capacity of 40,000. It is a progressive company that makes a high quality of bhick which has stood the test of service. Mr. J. C. Kline is president of the company and he has high repute in the business world.

The Asbestos Protected Metal Company announces that Mr. William H. Cummings, formerly of Providence, R. I., has become associated with its Waugh Glazing Department.

Photographers, both professional and amateur, can find a good market for a certain class of pictures by addressing the Portland Cement Association, 111 West Washington street, Chicago, and requesting details of a photographic competition which the association is now conducting. A number of cash prizes for best pictures received will be offered, in addition to which all prints received that are suitable for advertising or booklet illustrating will be purchased at a fair price. Write the Portland Cement Association for particulars.

Walter T. Sewell, sales manager of the Sewell Cushion Wheel Company, is making a trip through the east, and will visit their branches in Pittsburg, Baltimore, Philadelphia, New York, and Boston, where he will meet their branch selling organizations to discuss plans for the coming year.

Gasoline Locomotive for Contractors

The accompanying illustration shows how a certain large contracting firm (name deleted by request) is using a Type "M-20" 4½-ton, 24-inch-gage gasoline locomotive in connection with excavating and construction work. Being a self-contained unit of power and requiring only an ordinary track, this type of engine can operate successfully in districts where it is impossible to obtain power from a power plant, and where fuel and water are scarce.

The engine, which is made by the Milwaukee Locomotive Mfg. Co., of Milwaukee, Wis., is said to cost very little either to install or maintain, while its compact, simple construction especially adapts it to heavy hauling under adverse conditions.

Contracting News

AUTOMOBILE, FIRE APPARATUS & MOTOR EQUIPMENT.

CONTRACTS AWARDED.

Anderson, Ind.—Bilateral Fire Hose Co. was awarded contract for furnishing 1,000 ft. of fire hose, at $1 per ft.

Helena, Mont.—The Seagrave Company, Columbus, Ohio, were lowest bidders for furnishing city with hook and ladder truck, bid of $5,900.

Eagle Grove, Iowa—City council awarded contract for motor fire truck to Dart Motor Co., Waterloo; bid of $2,780. Other bidders were General Motor Co., $3,000; La-Verne Comm. Motor Co., $2,700, and American La France, $2,750.

Sacramento, Cal.—The lowest bidders for furnishing Fire Chief Anderson with an automobile, were: Laupee Garage, $1,190; Mitchell Motor Car Co., $1,650; Lincoln Highway Garage, $2,390.

Salem, Ohio—Robinson Fire Apparatus Mfg. Co., St. Louis, sold two motor fire trucks to city. Estimated cost, $15,000.

CONTEMPLATED WORK.

Anaconda, Mont.—The purchase of a chief's car has been recommended. Chas. Collins, Chief.

Aurora, Ill.—The purchase of a chief's car has been recommended. Geo. J. Rang, chief.

Alameda, Cal.—Contemplating purchasing, next month, one comb. chmical engine and hose wagon (motor driven). W. T. Steimetz, Chief.

Ashland, Ky.—Contemplating purchasing one hose and chemical truck within one year.

Cairo, Ill.—The purchase of 60 ft. ladders and 500 ft. of fire hose has been recommended. William Gillespie, Sec'y.

Canton, Ill.—A combination chemical and hose car has been recommended. C. H. Totten, Fire Marshall.

Bellefontaine, Ohio.—The purchase of combination chemical and hose car has been recommended. H. S. Blair, Fire Chief.

Delaware, Ohio—Contemplating the purchase of combination and pump engine car. C. W. Keiser, Chief.

East St. Louis, Ill.—The purchase of truck for city service, has been recommended. M. J. Tobin, Chief.

Elizabeth, N. J.—Contemplating purchasing, within three months, three pumping engines, three combination chemical cars and four tractors. Aug. Gerstung, Chief.

Erie, Pa.—The purchase of one triple combination and two chief's cars has been recommended. J. M. Duerner, Chief.

Galesburg, Ill.—Contemplating the motorization of fire dept. John E. Cater, Chief.

Grand Junction, Colo.—The purchase of 900-gal. triple combination truck has been recommended. Expected to be purchased 1917. J. S. Hynes, Chief.

Granite City, Ill.—Contemplating purchasing, next month, one six cylinder comb. chemical and hose truck. Fred Stegelmeyer, Chief.

Great Falls, Mont.—Council recommends the purchase of a motor-drawn ladder and service truck and triple combination truck, also 1,000 ft. of 2½-in. hose. Est. cost, $12,000.

Greenwich, N. Y.—$4,000 has been voted, and $3,500 more to be appropriated, for the purchase of auto pumping engine for the Boro Fire Dept.

Greensboro, N. C.—Contemplating purchasing, within six months, two combination motor trucks. H. N. Taylor, Chief.

Holland, Mich.—Contemplating purchasing, within three months, two hose and chemical trucks, also one hook and ladder truck. C. Bloom, Jr., Chief.

Hillsdale, Mich.—Contemplating purchasing one Ford chemical truck, within four months.

Joliet, Ill.—Aerial truck and motor hose wagon to be purchasel for reserve service. C. W. Royce, Chief.

Lackawanna, N. Y.—To vote on proposed $18,000 appropriation for purchase of auto fire trucks with chemical combinations.

LaCrosse, Wis.—Contemplating purchasing, within two months, two city service trucks. The purchase of one pumper chemical hose car has been recommended. Fred C. McGlachlin, Chief.

Little Falls, N. Y.—Contemplating purchase, within 12 months, tractor for hook and ladder and two combination hose and chemical cars. Edw. J. Cooney, Chief.

Malden, Mass.—Contemplating purchasing one triple combination hose pump and chemical. The purchase of 1,000 ft. of fire hose has been recommended. J. T. Nicolls, Acting Chief.

Mattoon, Ill.—Contemplating the purchase of two combination trucks. The purchase of 1,000 ft. hose has also been recommended. J. C. Weaver, Chief.

Merrill, Wis.—The purchase of gasoline pumper with hose and chemical, has been recommended. Andrew Milspaugh, Chief.

Munvere, Ind.—The purchase of two comb. hose and chemical motor trucks has been recommended. John E. Casey, Chief.

Painesville, Ohio—The purchase of a triple combination junior pump has been recommended. T. W. Morgan, Chief.

Pana, Ill.—Triple combination chemical hose and pumper has been requested of city council. Geo. W. Searles, Chief.

Plainfield, N. J.—Contemplating purchasing, within six months, one aerial hook and ladder truck. T. D. Doane, Chief.

Poplar Bluff, Mo.—Contemplating the purchase, within the next 18 months, of combination chemical and hose and pump combined. Chas. E. Langley, Chief.

Rome, N. Y.—The purchase of one city service truck and chief's car has been recommended. Geo. M. Bower, Chief.

Shreveport, La.—The purchase of one aerial truck has been recommended. Chris. O'Brien, Chief.

Springfield, Ill.—Contemplating the purchase of one 750-gal. combination pump or a double tank combination apparatus. Peter Jacobs, Chief.

St. Louis, Mo.—A bond issue of $400,000 to motorize fire dept., is being considered.

Terre Haute, Ind.—Contemplating the purchase of two motor trucks within four months. Harry Bledsae, Chief.

Watertown, Mass.—Contemplating purchasing, within 12 months, gasoline pumper with hose and chemical. John W. O'Hearn, Chief.

BRIDGES.

BIDS REQUESTED.

Baltimore City (Cecil Co.), Md.—Until Nov. 14, 12 noon, for construction of reinforced concrete bridge over Little Elk River. Contract No. CE-23. C. C. $500. Fra. H. Zouck, Chrman. St. Highway Comm.

Baltimore City (Charles Co.), Md.—Until Nov. 14, 12 noon, for construction of reinforced concrete bridge over Zewiah Swamp on State Road bet. Waldorf and Bryantown. C. C. $500. Contract No. 0153.

Benton Harbor, Mich.—Until November 9, for construction of steel bridge, 340 ft. long, 20 ft. wide, two 5-ft. walks. Est. cost about $19,000. Add City Council.

Cleveland, Ohio—Until Nov. 18, for construction of bridge work. (Report No. 3952.) Add. E. G. Krause, City Clerk.

Baltimore (Washington Co.), Md.—Until Nov. 14, 12 noon, for repairing bridge over Conocheague Creek on State Road. C. C. $500. Contract No. 0215. Add. Fra. H. Zouck, Chrmn. State Highway Comm.

Dayton, Ohio—Until Nov. 9, 12 noon, for construction of bridge on New Troy Pike and Springfield Rd. in Butler Twshp. Add. Co. Commrs. of Montgomery Co.

Doniphan, Mo.—Until Nov. 9, for construction of three reinforced concrete bridges over Ditch No. 2 in Ripley Co. Add. Co. Clk., Doniphan.

Des Moines, Iowa—Until Nov. 29, for construction of new concrete bridge at Grand Ave. Add. City Council.

Mitchell, S. D.—Until Jan. 1, for construction of eighteen bridges. Est. cost $20,000. Add. J. M. Crampton, Co. Aud. of Davidson Co.

Newton, Iowa—Until Jan. 1, for construction of bridges and culverts. Est. cost, $25,000. Add. C. O. Edge, Co. Audr.

Seale, Ala.—Until Nov. 15, for construction of bridge over Brush Creek in Russell Co., steel, concrete piers. Add. W. S. Keller, St. Highway Engr., Montgomery, Ala.

Tecumseh, Okla.—Until Nov. 9, for construction of two concrete bridges and one concrete culvert. Add. J. Krouch, Chmn. Co. Commrs.

CONTRACTS AWARDED.

Buffalo, N. Y.—The lowest bidders for reconstruction of viaducts in Abbott Road, were, Great Lakes Dredge & Docks Co., bid of $18,325. For Babcock Viaduct, Strobel Steel Constr. Co., bid of $44,923. For Elk Street-Abbott Rd. viaduct, Strobel Steel Constr. Co., bid of $333,274, and $45,-145 for Hamburg St. viaduct.

Buffalo, N. Y.—The lowest bidders for construction of wall along Dead Creek and Ohio basin, also bascule bridge across Dead Creek, were, Buffalo, Larkin & Sangster Co., bid of $534,615.

Carbondale, Pa.—To Phoenix Bridge Co., Phoenixville, contract for construction of viaduct on Dundaff St. Bid of $50,000.

Columbus, Ohio—To Capital Constr. Co., City, contract for construction of Rich St. bridge. Bid $21,039.

Des Moines, Iowa.—The building of reinforced concrete and steel bridge, 500 ft. long, over Des Moines River. Est. cost, $150,000. Plans filed with K. O. Kastberg, Eng., City Hall.

Indiana, Pa.—To Whitaker & Diehl, Harrisburg, contract for construction of concrete bridge over Twolick Creek, including 67-ft. spans, 18-ft. roadway. Bid of $10,-419.

Kankakee, Ill.—To M. & P. Constr. Co., Rockport, Ind., contract for construction of bridge across Kankakee River at Warner farm. Bid of $43,213.

Lynchburg, Va.—To M. M. Elgan, Macon, Ga., for construction of viaduct across River James and Ry. track, 1,800 ft. long, 30 ft. wide. Est. cost $350,000.

Ludlow, Ky.—To Butler & Tyler Co., Louisville, contract for construction of viaduct on Elm St. Bid of $25,751.

Marietta, Ohio—To Meridith Constr. Co., Lowell, contract for construction of viaduct between Marietta and Parkersburg. Bid of $60,000.

Narrows, Va.—To Champion Bridge Co., Wilmington, contract for construction of bridge across New River. Bid of $30,000.

Norfolk, Va.—To Laub & Stuart, Pittsburgh, Pa., contract for construction of steel bridge from Norfolk to Berkley, 2,100 ft. long. Bid of $350,000.

Pearlsburg, Va.—To Champion Bridge Co., Wilmington, Ohio, contract for construction of bridge over New River at Narrows. Bid of $30,970.

Shelby, N. C.—To Austin Bros., Dallas, Tex., contract for construction of steel bridge across Broad River. Bid of $39,800.

Simpson, Pa.—To E. Whalon, Towando, contract for construction of substructure for 850-ft. viaduct. Bid of $70,000.

CONTEMPLATED WORK.

Akron, Ohio—Plans to be prepared for construction of 2,300-ft. viaduct at North Hill Extension. Est. cost, $1,200,000. Add. E. W. Paul, Co. Engr., Summit Co.

Denver, Colo.—Contemplating constructing 2,700-ft. steel and concrete viaduct on 23d St., at an est. cost of $300,000. Add. R. W. Speer, Mayor, for information.

Crestview, Fla.—Plans completed for construction of bridge one-half mile long, over Shoal River at Millage Cox Plance crossing. Est. expenditure, $500,000.

Cincinnati, Ohio—Plans completed for construction of bridge over Mill Creek at No. Bend Rd. Est. cost, $46,000. Add. Co. Surv., William Boeh.

Ft. Wayne, Ind.—Plans being prepared by City for construction of State St. bridge. Est. cost $65,000. F. M. Randall, City Engr.

Great Falls, Mont.—Plans completed by Richard C. Schupper, City Engr., for construction of steel and cement span over Missouri River and west end of First Ave. Est. cost, $200,000.

Jacksonville, Fla.—Bridge to be constructed across the St. Johns River at Jacksonville. Est. cost, $850,000.

Johnstown, Pa.—$100,000 bond issue authorized, for construction of Luten concrete bridge between 8th and 17th wards. Add. J. R. Crissey, City Engr.

Kansas City, Mo.—Contracts to be awarded soon for construction of bridge 700 ft. long in Swope Park over Blue River. Est. cost, $160,000. Add. Waddel & Son, Engrs., 934 Wyandotte St.

Middletown, N. Y.—Footbridge and vehicle bridge to be constructed over Poughkeepsie bridge. Est. cost, $400,000.

Milwaukee, Wis.—James Pinney, Supt.

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Municipal Engineering

The World's Leading Municipal Publication

DECEMBER, 1916.

MOTOR TRUCK TRADE

The flood of American motor trucks going to the warring nations and the greater flood of stock in old and new motor-truck manufacturing concerns actually or prospectively in operation, which is being unloaded upon the American public, make the judicious stop and ask what will happen when the war is over.

This part of the business is so spectacular that it obscures the far greater legitimate business which has been developing at the same time.

The war has conferred one benefit upon the trade because its demands have developed the possibilities of the motor truck more in two years than would have been likely in ten years of ordinary times. What war wants it must have at whatever cost, and inventive and adaptive geniuses have had their fill of opportunities to make their products meet the work required of them. Strength, flexibility, durability, have all had their capabilities tried out until the limits seem to be almost reached.

In times of peace economy has a greater influence in retarding development, and the demand must be developed equally with the supply. In times of war the demand is made and must be supplied at once.

In the countries at peace the lessons learned in adapting the motor truck to the demands of war have been applied in adapting trucks to the demands of peaceable pursuits, and the results are trucks so evidently an advance upon any former method of "retail" transportation that the home demand for trucks has grown by leaps and bounds, until the truck trade increase is even more astonishing than that in the portland cement trade some ten years since.

The trade with foreign nations is likewise increasing because there is no other place to buy trucks and because the motor truck is proving its value everywhere.

The consequence is that the war trade in trucks has become a secondary consideration, and shortly will bear as small a ratio to the total truck trade as export of munitions of war bears to our total exports. A few concerns who have specialized on business with foreign nations may have some blows when the war stops, but no others. And even here the stoppage will last but a short time, for, as Vice President M. L. Pulcher, of the Federal Motor Truck Company, well says, the devastated nations will need everything they can buy, borrow or beg to start themselves in business again, and no one knows better than they the efficiency, economy and reliability of the American motor truck.

What the American must study is the adaptation of his roads to the new traffic, already so enormous. States like New Jersey, whose early good roads were too light for this new traffic, are finding it necessary to rebuild all their main roads. Connecticut, with still lighter roads, is in still worse condition. Massachusetts and New York have been learning the same lesson with greater or less willingness. The newer states in road construction, such as Ohio and Illinois, are profiting by the experiences of their sisters and are beginning with the harder roads.

The fact is that the further development of the motor truck as an economical carrier depends upon the construction of roads suitable for the traffic, and the only limit to that development is the ability or the willingness of the taxpayers and the truck owners themselves to contribute their respective shares to the cost of these roads.

The truck manufacturer and promoter can help his industry more by pressing the construction of suitable road surfaces than by any other line of endeavor.

FIRE DEPARTMENT STATISTICS

This number is a little late in order to make the tables of statistics of fire departments as complete as possible. The table in the motor-truck section, showing the motor-truck equipment of fire departments, is particularly illuminating. Scarcely a truck listed in this long table is more than five years old, and most of them are less than half that age. Not a few departments are now completely motorized. Another demonstration that the motor truck is making good wherever it is adapted by its designers to the work to be done.

The columns showing the cost of gasoline and oil compare most favorably with the cost of maintaining teams of horses, and in the average the columns showing cost of repairs are equally favorable to motor apparatus, the occasional year when the repair bills are high being offset by the number of years in which they run low. This is emphasized in nearly every case in which comparative figures are given of the annual cost of horse-drawn and motor-driven apparatus.

STREET AND ROAD PAVEMENTS

THEIR DESIGN, CONSTRUCTION AND MAINTENANCE

EDITED BY CHARLES CARROLL BROWN, M. AM. SOC. C. E.

THE DESIGN OF STONE BLOCK PAVEMENTS

Written and Compiled by the Editor

The stone block pavement is undoubtedly the oldest type of surface laid to take the wear of traffic on footways and wheelways, with brick a good second. It is not necessary to take up here the ancient methods of laying such pavements and this article is confined to the modern developments beginning with the cobble stone street and running down to the latest attempts at making the block street surface a monolithic structure. Later articles will take up details of practical construction and maintenance.

WITHIN the memory of many now living the only pavements to be found on city streets in America were of cobble stones and stone blocks, so rough and irregular in size, shape and surface that they gave a continuous series of small shocks to traffic. These cobble stones were mainly of granitic or hard limestone substance, which had been rounded by the action of glaciers or water or both and had not yet been reduced to the size generally classed as gravel. They were selected with some relation to sizes and were placed side by side to form a surface covering over the softer material which had theretofore provided the support for traffic or had given way under it when soaked with water. Sometimes the earth base was smoothed off and compacted slightly by ramming, but more frequently a copious supply of sand was spread over the surface of the street as it had been more or less hardened by the action of water under the same traffic. This sand layer was smoothed off somewhat and then the stones were set in place in holes dug in the sand by a laying tool, one end of which served as the scoop and the other as a hammer for settling the stone into place. The stones often were oblong in shape and in such case were set on end. Sand or fine gravel was then spread over the surface to fill the spaces between the stones and the pavement was finished.

Evidently such a pavement was rough from the beginning and the roughness of the surface was soon increased by the unequal settlement of areas of the stones, so that to the rattle of the impact of the wheels on the projecting tops of the cobbles was added the swaying of the wagon when the wheels dropped into the depressed areas.

Not all sections of the country are provided with convenient deposits of suitable stone for this sort of pavement, and the use of rough granite blocks in foreign countries suggested their use in this country. The first of these blocks were exceedingly rough, the art of cutting granite being in its infancy, and the cost of dressing the blocks to any degree being too great for their use as paving stones, at least in those early days when paving of any sort was a rarity. The blocks were roughly rectangular and those from the same quarry could be split into approximately equal thickness. They were laid in the same manner as the cobble stones and on the same inadequate sort of base. Consequently, tho the surface might be slightly less rough to begin with, the unequal settlements under traffic soon put the general shape of the surface into the same condition as the cobble stone streets, and the hammering of hoofs and wheels on the unprotected and generally projecting edges of the stones soon rounded them off until the stones became practically the same as cobble stones, except that they were laid on their sides instead of on their ends.

When this roughness became unbearable the stones were taken up, a few yards at a time, the base was evened up somewhat and the stones were relaid, bottom up, to go thru the same process of wearing smooth and round.

These early blocks were of quite large size, early specifications requiring 10 to 15 inches length, 8 to 10 inches depth and 3½ to 4½ inches width. Granite splits readily in one direction, with less readiness in a second direction at right angles to the first and still less readily in the third direction at right angles to the other two, and the ranges of dimensions depend somewhat upon these relative qualities and upon the thickness of the lifts or layers of the mass of granite in the quarry. In the early history of the industry much of the splitting into blocks was done elsewhere than in the quarry, where the paving block business was a secondary consideration. Experience with granite cutting and the increase in demand for paving blocks under modern conditions has made it possible to devote whole quarries to the manufacture of paving blocks and to re-

BELGIAN BLOCK PAVEMENTS OF SMALL TRAP BLOCKS, AS LAID BETWEEN 1870 AND 1890.

duce the cost of making them at the same time that they are cut more cleanly and closely to dimensions. Demand for better cut blocks has been met and in turn has demanded better laid pavements, so that the development in the past ten years has been very rapid.

The accompanying photograph of an old trap rock block pavement on Broad street, Elizabeth, N. J., shows an early street which is in condition much better than the average of these early pavements, tho it was rough enough, according to present-day ideas, to require replacement by a modern granite pavement last year, as described by City Engineer Collins for the American Society of Municipal Improvements.

This particular pavement was laid with so-called Belgian blocks, the term applying to the size, which was introduced as a possible improvement on the large block above described. This block is 4 to 5 inches thick, 5 to 6 inches long and 6 to 8 inches deep. This form of block and the pavement laid with it are also shown in the photograph of a street laid in New York with Belgian trap blocks early in the '70's, the use of which was not abandoned until 1890.

The two kinds of blocks above described were followed by the oblong granite block shown in a third photograph, which was the standard between 1890 and 1910, but is now called the old-style pavement in R. A. MacGregor's paper before the American Society of Municipal Improvements, to which we are indebted for the cuts.

The filler for these block pavements, whether granite or trap rock, was first of sand. The wide and irregular joints made necessary some gravel to "pin" the blocks so that they would not shift under the rammer or under the roller used later to compact them into the sand cushion, and the bituminous filler was introduced to keep water out of the foundations.

Of course the quality of the foundation was improved from time to time by compacting it by ramming or rolling, by cutting out soft spots, by putting on hard material and rolling it into place, but, so long as the deep blocks were used, a concrete foundation was considered to add more to the cost of the pavement than it was worth, and so stone block pavements were not given full opportunity to demonstrate their value.

A very progressive specification of 1893 required subgrade to be formed to stakes, thoroly flooded, rammed and

THE OLD-STYLE OBLONG RECTANGULAR GRANITE BLOCK, AS LAID WITHOUT CONCRETE BASE IN NEW YORK BETWEEN 1890 AND 1910.

OLD BELGIAN BLOCK OF TRAP ROCK ON BROAD STREET, ELIZABETH, N. J., AS IT EXISTED BEFORE 1915, SHOWING UNEQUAL SETTLEMENT OF STREET, DUE TO INSUFFICIENT FOUNDATION.

rolled; a layer of clean broken 1-inch to 2½-inch limestone, entirely free from dust or dirt and not less than 6 inches deep, after thoro rolling; filled with limestone screenings or fine clean bank gravel below 1½ inch, flooded in and rolled with a 15-ton roller to true surface and thoro compaction, stone and gravel base together being 7 inches thick, and surface 8 to 9 inches below finished surface of pavement; 2 to 3-inch sand cushion in which stone blocks were imbedded and rammed with 75-lb. rammer of 3½-in. diameter, 2 blows to a stone, finishing with a lighter rammer to an unyielding bed and uniform surface to proper grade. Granite blocks wearing roughly were preferred to the hardest stone and hard basaltic stone taking a smooth polish under traffic was prohibited. Variation of surface of more than ½ inch was prohibited and dimensions were fixed at 3½ to 4 in. wide, 6 to 7 in. deep and 6 to 10 in. long, with even top and bottom beds. End joints were between ¼ in. and ⅝ in. and lap of 2½ in. of blocks in adjacent courses was required: clean, screened, dry roofing gravel 1/16 to ½-in. size was raked into joints before ramming, leaving ¾ in. at top of joint for a hot bituminous filler poured until the joints stayed full flush with the surface, 2½ gallons or more to be used to the square yard. This filler was of pitch, tar and creosote of fixed proportions, prepared on the spot, or No. 5 or No. 6 tar. A light gravel coat ¾ in. and less in size finished the pavement.

The latest specification, adopted by the American Society of Municipal Improvements in October, 1916, differs from this mainly in requiring a concrete foundation and reducing the depths of the blocks to 4¾ to 5¼ inches, increasing the variation in width to 3½ to 4½ inches, but requiring the blocks to be selected in laying so that blocks of the same width shall be laid in a course and the joints shall not exceed ½ inch in width for an inch downward from the top nor more than 1 inch anywhere, and the top surface shall not vary more than ⅜ inch from a straight-edge applied in any direction on it. The length of blocks is made 8 to 12 inches. The essential differences in the blocks are in depth and smoothness of surfaces, and in selection of uniform widths for laying together. On account of the more uniform size of blocks the sand cushion is reduced to 1 inch thickness. Specifications for tar pitch, asphalt and cement grout fillers are presented for choice. No pinning with gravel or filling of joints with sand is permitted before the prepared filler is applied.

The fourth photograph shows the reconstructed

COMPLETED GROUTED GRANITE BLOCK STREET ON BROAD STREET, ELIZABETH, N. J., LAID ACCORDING TO THE LATEST STANDARD SPECIFICATIONS.

street of the second photograph, in which the standard specifications were followed.

In districts within reach of the sandstone quarries about Medina, N. Y., Denver, Colo., and the like, a comparatively smooth stone block pavement was developed 15 or 20 years ago, because these materials could be brought to straight, even surfaces of fracture with parallel sides and ends and right-angle joints. A specification for the pavement revised by City Engineer E. A. Fisher, of Rochester, N. Y., in 1901, provides that blocks might be 3 to 6 in. thick, 6 to 6½ in. deep, 7 to 12 in. in length, cut to lay with tight joints for 3½ in. down and a smooth, even surface, with no projection or depression of over ¼ in. These blocks were laid in courses of uniform width and depth with all longitudinal or end joints close and joints between courses not over ½ inch top and bottom. Hot dry gravel was brushed into these joints to fill them up 3 inches, the stones were rammed 3 times with an 80-lb. rammer, the joints again filled with hot, dry gravel between 1/64 and ¼-in. mesh screens, poured from a small spout and settled in place with wire picks, and then filled with paving pitch or portland cement grout as specified, the grout being applied in the manner described in the article on brick paving construction.

Excepting for the filling of the joints with gravel this specification agrees very closely with the latest standard stone block specifications described above, and indicates that the manufacturers of granite blocks have been able to prepare their more refractory material so that it can be laid in a manner which demonstrated its value for the softer materials nearly or quite 20 years ago.

The standard specification of the A. S. M. I. meets with the approval of engineers in almost every particular. The sand-cement cushion similar to that described in the article on brick pavement construction is used in Baltimore and Manhattan boro on account of the elimination of danger of shifting of the sand cushion, but it is not in general use as yet, one reason perhaps being that it adds about 16 cents a square yard to the cost of the pavement. In cities having heavy traffic the closing of a street is such a serious matter that the cement filler can not be used because it must set for several days without traffic if it is to be successful. With the small blocks described below the cement-sand cushion is very desirable.

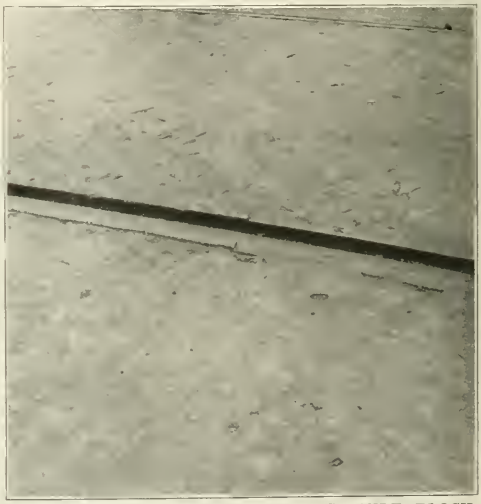
Street railway companies using granite blocks or Ligonier blocks for paving between the rails or adjacent to them often set the blocks in the green concrete and roll them down into it until an even surface is obtained, and use the cement grout filler.

If the cement filler is used on steep grades, say 4 per cent. or more, the joints should be raked out slightly before the grout takes its initial set, so as to give a foothold for horses similar to that obtained by the use of hillside brick.

Bituminous filler is most generally used in stone block pavements unless the small sizes are specified. In Baltimore the joints are filled with hot gravel and about four pourings of hot asphalt are necessary to fill the joints, and the pavement is finished by squeegeeing the filler over the entire surface of the blocks and sprinkling it with hot gravel. This coating lasts for some time and gives the appearance shown in one of the accompanying photographs, which is of a street following in all respects, except the gravel in the joints, the standard specifications.

A new filler composed of a mixture of pitch and sand in equal parts was used on Broadway, Brooklyn, N. Y., and was described in the September number of MUNICIPAL ENGINEERING. In Alabama street, Atlanta, Ga., half the street is filled with this pitch and sand mixture and half with an asphalt and sand mixture, which will give data for a comparison in that climate. The result would not be applicable in all respects to a pavement in the colder winter climates of the northern states.

There is so much good material in a large granite block after its surface has worn beyond further use that for the last 5 years the plan has been used of splitting the blocks in smaller sizes and laying them, on a concrete foundation, as has been described in several numbers of MUNICIPAL ENGINEERING. This has led to the adoption of a shallow standard block by some engineers and quarrymen, which is 4 to 4½ inches wide on top, 4 to 4½ inches deep and 8 to 12 inches long. Some quarries now cut a still smaller block for use in



A MODERN ASPHALT FILLED GRANITE BLOCK PAVEMENT IN BALTIMORE, MD., LAID IN JULY, 1914, AND PHOTOGRAPHED IN AUGUST, 1916. NOTE ASPHALT STILL CLINGING TO SURFACE OF BLOCKS.

replacing with granite other surfaces which have worn out. This block is 3¾ to 4½ inches on top, 3½ to 4 inches deep and 7 to 11 inches long.

A still smaller block, in cubes of 2¾ to 3½ inches dimensions, has been described in MUNICIPAL ENGINEERING. It is laid in concrete and in patterns of more or less irregularity so as to prevent regularity of joint position.

The standard specifications do not yet endorse these smaller sizes of blocks except as recut from the old large blocks for lighter pavements or cut new of the size of the resurfacing blocks above noted, of which the principal difference from the standard blocks is in the depth.

The trap blocks shown in two of the accompanying photographs are not as readily squared as the granite blocks and therefore they have a more irregular appearance than a granite block street of the same general description would show.

A MODERN ELECTRIC TURBINE PUMP

THE accompanying illustration shows the electric pumping unit in the High Level station on McTavish street, Toronto, which consists of a three-stage turbine pump, built by John McDougall Caledonian Iron Works Co., Ltd., driven by a 400-h.p. motor built by Allis-Chalmers-Bullock, Ltd., and operating under full load at 620 r.p.m. on a 2-phase, 60-cycle, 2,200-volt current. This pump contains several novel features to eliminate noise and vibration, and a special thrust bearing. A test was conducted by Mr. L. A. Herdt, professor of electrical engineering at McGill University, assisted by Mr. Charles Lester.

The duration of test was 24 hours and readings were taken every 30 minutes for the first 6 hours, after which readings were taken every hour. The test was carried out to determine the discharging capacity of the pump per 24 hours and the electric power required, also the over-all efficiency and the rise of temperature of the electric motor under full-load continuous run of 12 hours, as well as the smoothness of running of the machinery.

The discharging capacity of the pump was guaranteed to be 5,000,000 Imperial gallons per 24 hours pumped against a pressure of 110 pounds per square inch. The water pumped during the first 12 hours amounted to 2,725,000 gallons, against an average pressure of 107.2 pounds per square inch; during the second 12 hours, 2,745,000 gallons, against an average pressure of 106.3 pounds, or a total of 5,470,000 Imperial gallons for the 24 hours.

The average electric horse power consumed for the first 12 hours was 421 h.p., and 421.3 h.p. for the second 12 hours. The maximum power used was 438.5 h.p. The pump was then pumping at the rate of 4,080 gallons per minute, that is, over 5.8 million gallons per 24 hours. The over-all efficiency of the pump was as follows:

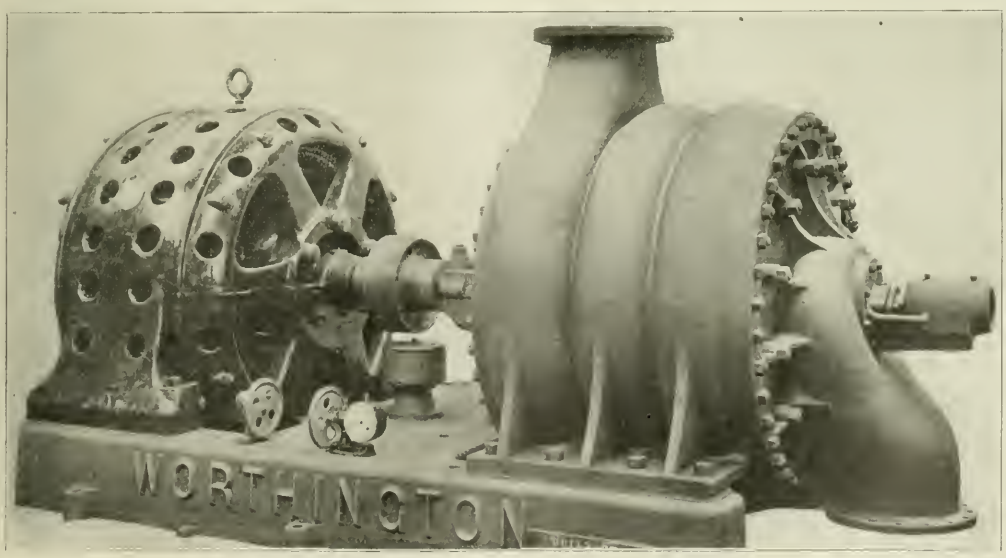
When pumping 3,500 gallons per minute, 65.00% average
When pumping 3,700 gallons per minute, 66.05% average
When pumping 4,000 gallons per minute, 67.00% average

The pump was guaranteed to show an over-all efficiency of not less than 65.00 per cent.

The rise of temperature of the electric motor above that of the surrounding air did not exceed 30 degrees centigrade; this comes well within the specifications, as a rise of 40 degrees was allowed at full load. The pump ran very well during the test with very little vibration and noise.

A noticeable feature was an increase in efficiency from 65 per cent., when running at its rated capacity of 5,000,000 gallons, to nearly 69 per cent., when running above its rating; in other words, when pumping at its most economical capacity it showed an efficiency of nearly 69 per cent. During the fire at McGill University, the city realized the advantage of this generous measure of capacity in both pump and motor. The record of the Venturi meter in the McTavish street pump house showed that when the demand for water was most pressing the pump operated at a rate exceeding 6,000,000 gallons per day, or more than 20 per cent. beyond its contract capacity.

A bonus of $10,000 was paid on this 12,000,000-gallon pump by the city of Montreal for economy over the contract guarantee.



SEGMENTAL BLOCK SEWERS

By J. F. Springer, New York.

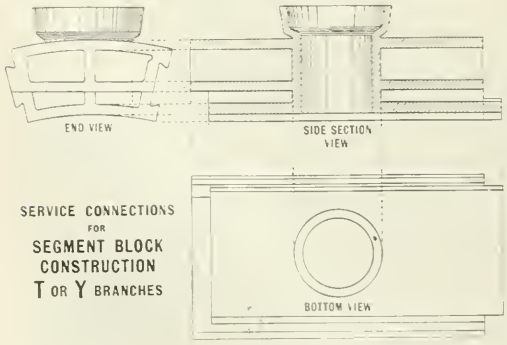
This article in the series on various materials used in sewer construction is devoted to one of the newer systems, that using segmental blocks, which differ from bricks in their size, in their material in concrete block sewers, and in the form in which that material is put up in vitrified clay block sewers.

There is a large field for this method of construction and success has been met with almost uniformly in building strong, durable and sanitary sewers and in keeping the cost within reasonable limits. As knowledge of the material and of the sewers built with it increases, the use of the system seems certain to increase.

SEGMENTAL block sewers are those constructed of blocks laid in place to form both invert and arch. Each block occupies a segment of the complete circumference or perimeter. The block is sometimes made of concrete, sometimes it is a vitrified clay product. The blocks are made and matured before being put in place. As each is of moderate size, it is possible to insure high-class manufacture, whether the material be vitrified clay or ordinary concrete. Ordinarily the blocks need not be larger than one-man size. Thus, in a patented system of concrete blocks the largest block has a weight of 180 pounds. It goes into the ring of a 48-inch sewer. More usual weights of concrete block segments range from 100 to 125 pounds. Weights of vitrified clay segments are, say, one-third of the latter or less.

A considerable advantage of the segmental block system, whether concrete or hollow tile be used, is the fact that the invert may be laid in water. Or we may lay the invert and allow water to run over it at once. In practical construction this may at times be an exceedingly advantageous possibility.

A further practical advantage consists in the fact that it will ordinarily be practicable to go ahead with the backfilling at once upon completion of the arch, or at most with a very inconsiderable delay.



1. SECTION OF AMCO SINGLE-TILE SEWER AND T-BRANCH.

The centering required for segmental block construction need be nothing more than a skeleton. This will be removable after a ring or two have been set in place. There are some special devices for centering for which advantages in handling are claimed.

Still further, in segmental block sewer construction, the difficulties of working in tunnels are reduced from what they would be with the placing of mass concrete.

Some of these advantages make for speed in construction. Some make for quality. Certain of the advantages are possessed, no doubt, by other systems. Ordinary brick sewer construction possesses some. But even here the segment block, being much larger than a brick, permits a single handling to produce the equivalent of many bricks. The reduction in joints is another advantage.

The advantages enumerated are possessed in common, tho perhaps not to precisely the same degree, by both the concrete block and the vitrified block.

The inventor of a patented concrete block claims the following additional advantages: (1) The steel reinforcement may be placed to great advantage. "The tensional regions of the intrados may be anchored against those of the extrados of the arch." (2) Minimum weight of steel required to secure effective reinforcement. With regard to the quality of the concrete the manufacture of small blocks above ground permits us to secure a high degree of imperviousness.

The vitrified block for use in segmental construction has been on the market for 5 or 6 years. Each block has partitions paralleling the axis of the sewer, which divide the hollow inside into two or more channels. When the blocks are assembled it is possible to lay the invert blocks so that a kind of sub-drain is formed by the junction of such longitudinal passages. The objection has, however, been made that when laid to secure this advantage, if advantage it be, it is difficult to make a water-tight joint where end of block joins end of block. It is said to require especial care to produce an impervious joint. The longitudinal joints are more easily made water-tight because of the increased area of surface with which the mortar is in contact and because the longitudinal joints surfaces are corrugated.

Segmental blocks of vitrified clay are made in a multitude of sizes corresponding to sewer diameters, varying from 30 to 108 inches.

The problems in laying segmental block sewers are in part the same as those encountered in laying masonry and brick sewers. There must be an adequate foundation. This will usually be afforded by the natural strata. However, it must be borne in mind that it is very necessary that the support provided be even. Hard and soft spots contribute a poor condition for vitrified pipe and concrete pipe. It will be safest to assume that such a condition will be even poorer for the barrel of a segment-block sewer, for the reason that this barrel is made of many parts and that there are many joints. If the soil does not have good supporting power we may enlarge the base of the sewer by means of a concrete invert having a flat base sufficiently wide to distribute the load.

Vitrified segmental blocks differ somewhat with different ranges of size. All ends are either formed or laid so as to break joint radially as well as longitudinally. The Amco block has an offset at one end fitting into a corresponding recess on the other end. The Natco block for the larger sizes of sewers is made in two layers so that the blocks break joint in all three directions—radially, circumferentially and

longitudinally. Corrugations or definite projections on the radial faces coming in contact, aid in making water-tight joints as well as in making the completed sewer more nearly monolithic. Because of the hollow construction we get a very stiff form along with a comparatively light weight.

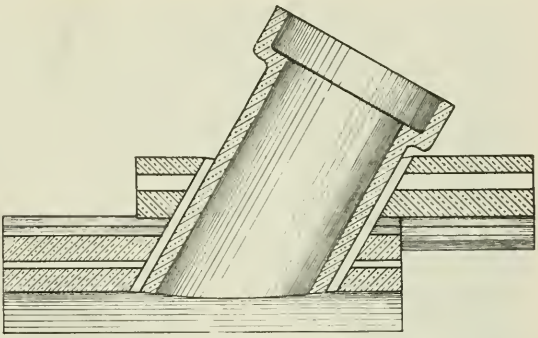
For a 24-inch Amco sewer each segment will occupy 45 degrees of the circuit and will weigh per linear foot of length 23 pounds. One foot of sewer will contain 184 pounds of segment block. The mortar will add something to this. The over-all thickness of the block will be 4 inches. The effective width of the block on the face which is to be on the inside of the sewer will be 9 1/16 inches.

A 72-inch Amco ring will have a radial thickness of 7 7/16 inches and a weight per linear foot of pipe of 930 pounds. Twenty blocks complete the circle. The standard length of vitrified blocks for sizes from 24 to 72 inches, including both extremes, is 24 inches.

For a Natco double-tile, 72-inch-ring sewer the thickness of wall is 8 inches and the weight per linear foot of sewer is 940 pounds. Fifteen double tile are required. The standard length of blocks is 18 inches, but they are also made 2 feet in length.

With concrete blocks the number of blocks in a ring may be less than with the hollow tile segments. For example, a rather large sewer may have only 3 blocks in the half-circle of the invert. But the length of a block may be only 12 inches. A 24-inch sewer may be constructed with 4 blocks to a ring. The thickness of the concrete will be 2½ inches. The bottom block may have a flat under surface which extends 45 degrees to either side of the bottom line of the invert. We have thus a 90-degree invert without longitudinal joint. The top block will be similarly placed immediately overhead. The reinforcing rods are placed partly in the joints between blocks, where they are covered with the mortar, and partly in the body of the concrete of the top and bottom blocks. It is possible to arrange the circumferential rods in the form of an ellipse flattened top and bottom. That is to say, the rods are nearer the inner surface of the concrete tubular shell at top and bottom and nearer the exterior surface at the ends of a horizontal diameter. There is more or less breaking of joints in laying the blocks.

Fifteen hundred feet of sewer of the segmental block type were constructed in Harrisburg, Pa. This tube is 48 inches in diameter. Each block covers 90 degrees of circuit and 1 foot of sewer length. As many as 225 segments were made in 1 working day of 10 hours with a crew of 9 men. Later on the same contractors were able to turn out 250 blocks with 8 men on a job at Johnstown. Apparently, the Harrisburg



III. SECTION OF NATCO DOUBLE-TILE SEWER AND Y-BRANCH.

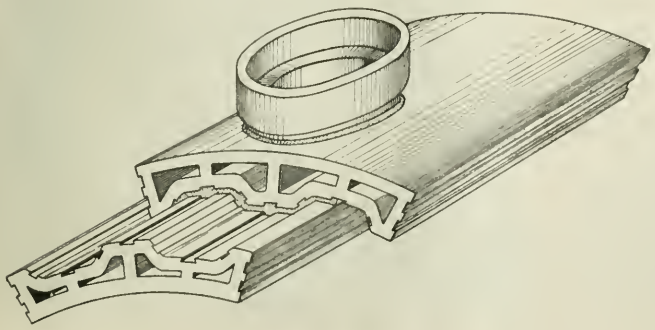
sewer was laid on the bare soil wherever the ground was considered good. Where the soil was thought bad two boards would be laid on the bottom and the space between and to either side of the pair of boards was leveled up with concrete. This formed a kind of bed upon which the flat side of the invert block was laid. However, tar paper 2 inches wide was interposed between bed and block at the end joint. The haunches were then filled in with concrete.

A part of this sewer is above the general surface. This is at the bottom of a partly filled gully. Here piles were placed in groups, caps put on the groups and longitudinal timbers laid. A thin stratum of concrete was placed on the timbers and the invert blocks put in place upon the bedding thus formed. The bed was completed by filling in the haunches with concrete and bringing it up to the level of the horizontal diameter. The concrete bed was made 4 inches thick at these upper points.

Concrete blocks of a different sort were used in the construction of eleven miles of sewer at Edmonton, Alberta, Canada. The sewer varied in diameter from 4 to 10½ feet. The joints in axial planes were very long for the purpose of placing longitudinal reinforcing rods. Circular reinforcing rods were used to envelop the barrel of the tube. The whole barrel with its exterior reinforcement was enveloped in concrete. All this is equivalent to a sewer of reinforced mass concrete lined with concrete blocks. The ring of reinforcement around the blocks consisted of four pieces. Two of these were rods, enveloping nearly the whole of the arch, and the other nearly the whole of the invert. At the ends of the horizontal diameters of the barrels of blocks special pieces were used to bridge the intervals between the upper and lower rods. These pieces were provided with openings or slots into which the rod ends might be passed. The rod ends were threaded and the form of the connecting pieces was such that the threads could be utilized by means of nuts to draw the ring tight against the barrel of blocks. Including rods and connecting pieces, the reinforcing ring fitted tight to the barrel, thruout nearly the total of the circuit. This arrangement provided circular reinforcement in a definite position and did not involve the complication of casting any of the blocks with reinforcement embedded.

All blocks had a standard circumferential length of 12 inches, a radial thickness of 4 inches and a length (along the sewer axis) of 12 inches. They were made of concrete in

II. PERSPECTIVE OF NATCO DOUBLE-TILE SEWER AND T-BRANCH.



IV. A 48-INCH SEGMENTAL BLOCK SEWER UNDER CONSTRUCTION IN WAUSAU, WIS.

accordance with the formula 1:2:3. The enveloping concrete surrounding the barrel of blocks followed the formula 1:3:6. This envelop had a minimum thickness of 4 inches. It will be understood, perhaps without my saying so, that without this envelop of protecting concrete the exterior circular reinforcement would not have been usable.

The making of connections with segment block sewers has been worked out very completely. The special block used for inserting T or Y branches in the Amco block is shown in one of the accompanying drawings. Another drawing shows a perspective of the construction of a T branch in the Natco double-tile sewer, and a third shows a section of a Y branch in a Natco double-tile sewer, and gives an excellent idea of the method of carrying the structure thru the two blocks making up the thickness of the ring.

One of the photographs shows a 48-inch sewer in Wausau, Wis., under construction with the Natco double tiles. Several interesting details are seen clearly. First, the trench has been excavated to the exact outline of the outside of the invert so that the blocks are laid directly on and beside the earth for the whole of the lower half-circle of the sewer. Second, the simple and inexpensive form used will be noted. Third, the breaking of joints longitudinally and circumferentially is evident in the finished invert. The same longitudinal breaking of joints between the outer and inner blocks is seen in the position of the blocks along the springing line, where part of the first layer of blocks in the arch has been laid preparatory to moving up the forms. The radial breaking of joints is seen in the invert in the foreground, each inner block spanning the joint between two outer blocks. The same is seen in the arch in the background.

The second photograph shows a 45-inch double-tile Natco block drain in Illinois, in which there were a number of constructive difficulties due to the irregularity of the old drainage ditch in which much of the drain was laid. The ability of the sewer to carry a heavy weight is shown by the crane following up the ditch and making the backfill. The loose earth of the fill makes this a particularly heavy test of the strength of the sewer, especially since the filling at the sides of the sewer is unusually broad and the consequent support of the sewer on haunches of invert and against the horizontal thrust of the arch at the springing line is less than is usually expected in sewer construction.

One of the strong points of the segment block sewer is the strength of the construction. In one test of a Natco single-block sewer of 36 inches inside diameter, 50 inches long and supported only on the invert, the arch being entirely uncovered, 22,040 pounds was loaded on a square 12-inch saddle resting on the center of the top of the sewer before a crack appeared. A 49-inch double-tile sewer carried 20,850 pounds without fracture under the same conditions.

While the segment block is scarcely ten years old made of concrete and is still younger as made of vitrified clay, its popularity has increased with great rapidity and the indications are that it will displace brick for sewer construction for the larger sizes to a great extent, and will successfully compete with the various methods of building concrete sewers.

(Editor's Note.—We are indebted to the National Fireproofing Company, Pittsburgh, Pa., for most of the illustrations used in this article.)

V. A 45-INCH SEGMENTAL BLOCK DRAIN UNDER CONSTRUCTION AT GIBSON, CITY, ILL.

MUNICIPAL LIGHT and POWER PLANT

OPERATING COSTS AT MILES CITY, MONTANA

By G. C. Pruett, City Engineer.

Altho this article is almost entirely statistical it will show another successful municipal plant; successful, as the author says, because it is practically free from interference and from loading up of its force of workers with men appointed for other reasons than their competence and efficiency. Examples enough of this kind will cause public opinion to demand the same excellence of service all the time in these plants and everywhere in like plants.

THE following data from the operating records of the light and power department of Miles City, Mont., show what can be done even in a small city with municipal ownership. This plant is not different from many other plants of a corresponding size and giving service to cities of a like size and under very similar conditions.

The claim is often made, and generally speaking the claim can be substantiated, that municipal operation is not as economical as is private operation. This is a fact because of several conditions which often enter into the case.

(1) Generally speaking, municipal accounts and records are not as carefully kept as are those of private plants, and without such accounts it is difficult to detect the leaks.

(2) In many instances municipally owned utilities are made the pension bureau of the parties in power, the jobs being used to pay political debts, and an organization is maintained which is not only inefficient, but thoroly incompetent as well, and with many more employes than are necessary for the work of the utility.

(3) The governing heads, being inexperienced and unqualified to direct the operation of a utility, are often averse nevertheless to delegate the proper authority to a competent operating official, feeling that such an act would lessen them politically in the eyes of the voters. Under such conditions it is not possible to get efficient and economical results.

(4) Inadequate and improper equipment is often maintained in service long after the time when it should have been discarded and replaced with other and more modern equipment. This comes from false notions of economy.

It is the injection of these conditions, as well as many others which might be mentioned, that handicaps municipal operation and makes it more expensive and less satisfactory than private operation. When these conditions can be eliminated it is then that municipal ownership will become more popular even than it is at the present time.

Getting back again to the Miles City plant, it can be truthfully stated that the conditions mentioned do not enter to any great extent into the operation, and it is for this reason that the plant is able to make a very creditable showing in comparison with many other municipal plants. In fact, there are few private plants under like conditions which could make a better showing.

The following data are given in complete detail and cover the operation from May 1, 1915, to April 30, 1916:

1. Operating Revenues.

Commercial lighting	$58,975.90	
Municipal lighting	8,448.71	
Commercial power	9,280.96	
Municipal power	3,657.35	
Miscellaneous	1,017.22	
		$81,380.14

2. Operating Expenses.

Power plant operation and Expenses—		
Boiler room, labor	$ 5,473.41	
Fuel	22,699.11	
Supplies and expense	641.42	
		$28,813.94
Engine room, labor	$ 4,393.00	
Lubricants	560.25	
Supplies and expense	1,106.88	
		$ 6,060.13
Electrical equipment, supplies and expense		791.49
Buildings, fixtures and grounds		411.92
Total power plant operation		$36,077.48
Distribution System—Maintenance—		
Overhead lines, labor	$ 1,206.36	
Material and supplies	214.41	
		$ 1,420.77
Transformers, labor	29.00	
Supplies and expense	21.88	
		50.88
Meters, labor	240.00	
Supplies and expense	52.48	
		292.48
Total		$ 1,764.13
Operating Expenses—		
Distribution, consumers premises, labor	$ 915.35	
Supplies and expense	135.25	
		$ 1,050.60
Municipal—		
Series street lights, labor	$ 311.51	
Supplies and expense	192.82	
Cluster posts, labor	250.75	
Supplies and expense	101.65	
		$ 856.73
Collection Expense—		
Clerk hire	$ 2,148.18	
Reading meters	717.00	
Testing meters	430.00	
Inspections	193.50	
Supplies and expense	279.13	
		$ 3,767.81
Advertising		195.00
Uncollectable accounts		700.00
General Office Expense—		
Salaries	$ 2,401.75	
Supplies and expense	639.82	
		$ 3,041.57
Undistributed		$ 2,668.85
Total		$12,280.56

Depreciation and Obsolescence—

	Value	Rate	Amount Depreciated
Buildings, fixtures & grounds	$ 13,682.14	5%	$ 684.10
Power plant	19,427.58	7½%	1,457.00
Boiler plant	34,534.35	8%	2,762.65
Distribution system	47,009.01	6%	2,820.55
Street lighting system	19,921.79	6%	1,195.50
Transformers	9,571.70	10%	957.15
Meters	14,083.58	10%	1,108.35
General office equipment	2,354.62	10%	235.45
Miscellaneous	5,281.29	12%	633.70
Totals	$165.869.06	7.35 *	$12,154.45

*Average.

Contingencies—

Contingencies	$112.57

3. Summary, Revenue and Expense.

Total Revenue	$81,380.14	
Total expense (incl. depreciation)	62,389.19	
Net earnings		$18,990.95
Net earnings, % of total investment		11.45%

The above statement does not make any allowance for bond interest for the following reasons:

(1) The depreciation reserve places sufficient money in this fund to retire all bonds as they come due.

(2) There is at the present time very little bonded indebtedness against the plant. The original bond issues were

taken up as fast as they became due from the money in the reserve fund. Since that time all other expansions have been taken care of from the earnings of the plant.

The following classification of accounts is also of interest when studied in connection with the "Revenues";

4. COMMERCIAL LIGHTING.

Class	Number	Connected load k.w.	Annual consumption k.w.
Residences	1,079	544	220,600
Saloons	18	165	75,241
Offices	83	35	35,732
Stores	86	75	100,871
Laundries	3	10	1,684
Livery stables	8	4	1,306
Hotels	9	23	60,081
Restaurants	13	6½	31,322
Theaters	4	17½	22,691
Churches	6	6	1,189
Lodge halls	3	4	3,896
Bowling and pool rooms	4	4	12,890
Schools	7	3½	9,897
Depots	2	1	2,824
Signs	2	2	1,010
Clubs	4	6½	20,150
Miscellaneous	49	24	49,647
Totals	1,380	928	651,011

5. MUNICIPAL LIGHTING.

Class	Number	Connected load k.w.	Annual consumption k.w.
Street lighting	....	40	250,287

6. COMMERCIAL POWER.

Bakeries	2	12	870
Butcher shops	4	27	34,672
Groceries	3	10	785
Confectioners	2	3	89
Elevators, grain	1	12	4,408
Printing offices	4	16	15,472
Miscellaneous	123	280	210,813
Totals	139	360	267,109

7. MUNICIPAL POWER.

Sewer pumping plant	1	15	34,980
Water pumping plant	1	220	296,380
Totals	2	235	331,360

8. GENERAL STATISTICS.

Kw. hr. generated during year	1,684,970
Maximum load, one day (Dec. 21, 1915)	5,790
Minimum load, one day (May 16, 1915)	3,020
Maximum station demand factor	100%
Average load factor	33.75%
Average cost coal delivered, per ton	$2.15
Coal used for year, tons	10,027
Water evaporated, year (thousand lb.)	130,351
Water evaporated per kw. hr. output, lb.	77.3
Water evaporated per lb. of coal, lb.	6.5
Connected Load—	
Commercial lighting	928 kw.
Municipal lighting	40 kw.
Commercial power	360 kw.
Municipal power	235 kw.
Total	1,563 kw.
Plant Capacity—	
Boiler h.p. (standard A. S. M. E. rating)	750
Engine h.p., nominal rating	660
Electrical, kva., full load	570
Ratio, output capacity, connected load	36%
Distribution lines, miles of wire—	
Special power	8.5
Primaries, Nos. 4 to 10	35.8
Secondaries, No. 4	78.8
Street lighting, No. 6	24.2
Total miles wire	147.3
Poles, 30 ft. to 45 ft., cedar, 6 in. and 7-in. tops	1,528

Meters—

Number	Size	Number	Size
1,181	5-A	18	50-A
160	10-A	3	75-A
13	15-A	4	100-A
92	25-A		
	Total number 1,471		

Transformers—

8	0.6 kw.	11	4 kw.
50	1	38	5
17	1½	10	7½
17	2	13	10
12	2½	4	15
31	3	2	20

Total, 213; Capacity, 776.3 kw.

Ratio, output capacity to transformer capacity	72.5%
Costs—	
Power plant, per kw. capacity	$119.00
Complete cost of entire system, per capita (8,000)	20.75
Connected load per capita, for	
Commercial lighting	116 watts
Commercial power	45 watts
Municipal lighting	5 watts
Municipal power	30 watts
Total	196 watts

Which is on the basis of a population of 8,000.

Revenue per capita per year—	
Municipal lighting	$ 1.05
Commercial lighting	7.37
Municipal power	.46
Commercial power	1.16
Miscellaneous	.13
	$10.17
Expense per capita per year—	
Power plant	$ 4.51
Distribution	.93
Miscellaneous	.84
Depreciation	1.52
	$7.80
Power consumption per capita per year—	
Commercial lighting	81.4 kw. hr.
Municipal lighting	31.3 kw. hr.
Commercial power	33.4 kw. hr.
Municipal power	41.4 kw. hr.
Miscellaneous	23.1 kw. hr.
	210.6 kw. hr.
Cost per kw. hr.—	
Power plant	2.14c
Total, exclusive of depreciation	2.98c

9. MONTHLY RECORD STATION OUTPUT.

Month	Output kw. hr.	Month	Output kw. hr.
May	120,770	November	151,400
June	114,990	December	165,080
July	119,090	January	164,920
August	126,940	February	145,630
September	142,430	March	147,910
October	146,990	April	138,820

10. RATES.

The following schedule of rates applies to the above data:

Commercial lighting—
- First 10 kw. hr. per month ..... 12c per kw. hr.
- Next 40 kw. hr. per month ..... 10c per kw. hr.
- Next 50 kw. hr. per month ..... 9c per kw. hr.
- Next 200 kw. hr. per month ..... 8c per kw. hr.
- Next 200 kw. hr. per month ..... 7c per kw. hr.
- All over 500 kw. hr. per month ..... 6c per kw. hr.

Minimum charge, $1.10 per month.
Discounts, 10 per cent. if paid on or before the 25th of the month following the service.

Commercial power—
- First 100 kw. hr. per month ..... 5c per kw. hr.
- Next 100 kw. hr. per month ..... 4½c per kw. hr.
- Next 200 kw. hr. per month ..... 4c per kw. hr.
- Next 200 kw. hr. per month ..... 3½c per kw. hr.
- Next 200 kw. hr. per month ..... 3c per kw. hr.
- Next 200 kw. hr. per month ..... 2c per kw. hr.
- All over 1,000 kw. hr. per month ..... 1½c per kw. hr.

Minimum rate, 1 h.p. or less, $1.50 per month.
Minimum rate, 2 h.p. or over, $1.00 per month per h.p.
Discounts as given above.

Special rates, municipal—
- Water plant, pumping ..... 1c per kw. hr.
  (Used only during valley load except in case of fire.)
- Street lighting ..... 3c per kw. hr.

No discounts on special rates.

The following is the schedule of wages paid to the employes:

Engineers	50c per hour
Firemen	40½c per hour
Linemen	50c per hour
Trouble men	50c per hour
Meter readers	50c per hour
Helpers and laborers	37½c per hour

All are on an 8-hour schedule, and with the exception of engineers and firemen, are allowed time and a half for holiday and Sunday work, all get time-and-a-half for overtime.

The above data do not take into consideration any expense or revenue caused by or derived from the operation of the central steam heating plant, which was described in the July number of MUNICIPAL ENGINEERING. This plant is an adjunct of the light and power plant, intended primarily to make use of the exhaust steam, thus turning into a revenue that which is now going to waste. When this plant is in full operation it is expected that the net revenues will be increased by about $8,400 per year, and that the percentage on the present basis for plant and equipment, including the additional cost for the heating system, will be raised to 15.8 per cent. instead of 11.45, as shown by this statement.

The city is, however, at the present time installing additional equipment to the power plant, which when completed will not only add additional power to the plant, but will also cheapen the cost for operation.

These extensions, as well as the central steam heating system, were and are being paid from the revenues of the plant.

STREET CLEANING IN SAVANNAH

METHODS AND RESULTS

By E. R. Conant, Chief Engineer of Savannah, Georgia.

This account of methods and cost of street cleaning in one of the smaller cities will be of interest because few cities of this size pay proper attention to this work and Mr. Conant has given some practical instruction as to how the work can be done satisfactorily and how much it will cost. It is from a paper before the American Society of Municipal Improvements.

To be sure he does not have snow to contend with nor the freezing and thawing winter weather of our northern cities so that the figures of cost must be modified for such cities and they cannot be kept as clean in the winter season.

White labor is entirely employed in Savannah for street cleaning, but to a considerable extent the force is composed of a class which, on account of its physical condition, is unable to do an ordinary day's work; 48 per cent. employed are over 50 years of age, and 9 per cent. over 70 years of age.

The organization of street cleaning consists of one superintendent at $110.00 per month, four foremen averaging $2.50 per day, and 70 laborers, including cart and wagon drivers, at $1.75 per day.

Sheet asphalt streets are cleaned daily except Sundays with scrapers, and the scrapings placed in the gutters are promptly taken up with carts; with asphalt block and vitrified brick pavement, 40 per cent. of the area is cleaned twice a week, 40 per cent. three times a week, and 20 per cent. twice a week; with granite block, 50 per cent. is cleaned twice a week, 20 per cent. three times a week, and 30 per cent. once a week. Cobble-stone pavements are cleaned once in about ten days. The method of cleaning asphalt block, vitrified brick, and to a large extent granite block, is by horse-driven sweepers, preceded by sprinklers, all of this being done at night. Hand brooms and scrapers are used in collecting the sweepings in piles at the gutters, and these are taken up as formed by carts and wagons during the day. Cobble-stone is hand cleaned with brooms.

The material collected from the streets amounts to approximately 20,000 cubic yards per year. A large proportion of the sweepings are delivered to a local concern, which pays the city the nominal amount of $250 per annum for same. This party picks the coarser rubbish from the sweepings and mechanically grinds the refuse up and adds a certain percentage of cotton-seed meal and potash and sells the resulting mixture in Florida as fertilizer for truck farming.

The following tabulation, prepared from accurate data, gives the cost of cleaning the paved streets of the city:

Class of Pavement	Average Width in Feet, Total	Condition of Surface	Area in Sq. Yds.	Length in Miles	Cost of Cleaning per Year Including Removal of Debris	Cost per Mile per Year	Cost of Cleaning per 1,000 Sq. Yds. per Year	Cost per Cleaning 1,000 Sq. Yds. per Cleaning
Concrete	30	Good	22,000	1.25	$ 480.00	$ 322.00	$22.00	$0.204
Asphalt block	35	Good	329,209	12.89	7,361.00	571.00	22.36	0.205
Vitrified brick	36	60% Good, 40% Rough	393,450	17.00	13,816.00	813.00	35.12	0.322
Granite block	31	Fair	116,962	5.95	4,800.00	807.00	41.04	0.415
Cobble stone	28	Rough	76,478	4.13	4,968.00	1,203.00	64.96	1.249
Sheet asphalt	40	Good	141,319	5.04	12,226.00	2,426.00	86.52	0.277
Totals			1,079,418	46.26	$43,650.00			

The above tabulation of cost for Savannah is only another instance as shown by other cities where correct data have been kept, where cost for street cleaning is directly proportional to the smoothness of the surface of the pavements. The tabulation shows that the cost of cleaning concrete and smooth asphalt block pavement is practically the same. The cleaning of brick is considerably higher, as the surface of worn brick pavement increases the difficulty of properly cleaning the same. The cleaning of granite block costs, per equal area, much more than the smoother types of pavement. Sheet asphalt being hand cleaned, makes the cost greater than if it was machine cleaned. The cost of cleaning cobble stone is five times as much as the cleaning of smooth pavement. Thus it will be seen that in adopting the type of pavement, the question of cost of cleaning should be considered just as much as the cost of the material required for pavement. This matter is overlooked except by those cities which have made proper study of the situation.

An efficient time-keeper is employed, whose duty, besides keeping the time of all the employes of my department, is keeping an itemized record of cost of the various branches of the work in such a manner that the unit cost of same is always ascertainable. The party employed is a technical graduate, who takes much interest in his duties, and I do not hesitate in saying that the employment of this employe saves the city many times the salary paid him.

The above covers the cleaning of the city as regards the permanently paved streets, but this city, like many others, has a portion of its streets and lanes unpaved with permanent material. An expenditure of $4,500 will be made this year in cleaning the unpaved streets and lanes, and the method followed is to go thru the unpaved streets and lanes, gathering newspapers, small quantities of building material and ashes thrown into the lanes, and to some extent shaping up the gutters.

The collection of loose paper in the business district of Savannah is, I believe, somewhat novel. The city, without cost to the merchants and others, places wooden boxes of one to two yards capacity at various localities in the lanes. By the way, this city has a regular system of lanes thruout perhaps 90 per cent. of its area. At this time there have been placed approximately 150 of these boxes, and the result of this has been a marked improvement as regards the cleanliness of the city. These boxes are emptied daily, and at this time the paper collected from the boxes is sold unbaled for $3.50 per ton.

Referring briefly to garbage collection, which, if not attended to properly, is to some extent responsible for an unsanitary condition of the city, perhaps nowhere is the collection of garbage made more regularly than in Savannah. A daily collection is made over 80 per cent. of the city—that is, in the populated section of the city—and elsewhere every other day, excepting on the outskirts, where collection is made two times a week. The normal amount collected averages 76 tons

daily. The cost of collection and delivering to the destructor plant is $2.16 per ton. In connection with garbage collection, it will be seen from the above that this city has not adopted motor apparatus or motor-driven sprinklers or sweepers.

The cost enumerated above for cleaning Savannah's streets covers and includes all labor involved, care of live stock, maintenance of equipment, purchase of all small implements and purchase of other apparatus, sweepers, carts, etc. It also includes the cost of stock, which covers the replacement of necessary live stock. The city operates and maintains its own shop for repair work, horseshoeing, building of carts and wagons and making repairs to harness, etc., and the proper proportion of shop cost is included in the cost of work noted. Interest on investment is not included, but, if added, would not increase the cost more than 1 per cent.

PUMPING STATION AND SEWAGE DISPOSAL PLANT

WARREN, R. I.

PUMP HOUSE.

PUMPING STATION.

The sewage disposal plant at Warren, R. I., consists of concrete sedimentation tanks thru which the sewage passes and is then disinfected by the use of chlorine, the treated effluent finally being discharged into deep water in the Warren river. The object of the plant is to treat the sewage so that it will not be dangerous to shell fish,—the shell fish industry being an important one in Rhode Island.

The plant consists of two tanks about 50 ft. long, 15 ft. wide and 16 ft. deep, with a compartment 14 ft. wide and 38 ft. long which contains the mixing chamber, pump well and a pit in which are located two centrifugal pumps to be driven by electric motors automatically controlled by floats. The settled and treated effluent flows by gravity into the river during the low stages of the tide and is pumped out automatically during the few hours of high tide. The bottom of the disposal tanks is about 12 ft. below high tide. The bottom of a tank is 12 in. thick and the walls are from 27 in. thick at the bottom to 12 in. at the top, all being reinforced with ½-in. steel bars. The tanks are covered with a 6-in. reinforced concrete slab.

In addition to this disposal plant there are 2 small concrete pumping stations consisting of tanks 26 ft. long, 15 ft. wide and 14 ft. deep with a small building on top for motors. The bottoms of these are about 12 ft. below high tide, and they are built in wet marshy ground. The walls of the tanks are 16 in. thick, the bottoms 12 in. thick, all reinforced with ½-in. square rods. In a compartment in each of these tanks there is a duplicate set of automatically operated, motor-driven, centrifugal pumps which lift the sewage from low points in the town to the disposal plant. The concrete for all these tanks was composed of a mixture of 1 of cement, 2 of sand and 4 of broken stone with a proper proportion of Medusa waterproofing powder. The tanks are dry and free from leaks, and in every way satisfactory.

Charles F. Chase, consulting engineer of Providence, R. I., designed this system and was in charge of its construction.

The sewerage system of the town of Warren will consist of 10 to 12 miles of sewers from 8 to 18 in. in diameter and will cost about $125,000. The contract for the work was awarded to Frank A. Gammino, of Providence, R. I., who has had considerable experience in this class of work. James L. Murray as resident engineer supervised the construction of the work with the assistance of Joseph C. Estes.

WEST WALL OF DISPOSAL PLANT.

LIMITING LOADS AND SPEEDS
OF MOTOR VEHICLES

By Eugene W. Stern, Chief Engineer of Highways, Manhattan Boro, New York.

This paper, presented to the American Society of Municipal Improvements, attacks one of the most important problems now before the paving and the motor truck fields, and shows its serious nature.

Most of the questions raised by the author are answered by the report of the New Jersey committee on truck traffic regulation which is appended to it. The latter will undoubtedly result in some form of legislation this winter in New Jersey which will probably be as nearly satisfactory as possible to truck manufacturers, truck owners and operators, and highway authorities and taxpayers, since all are fully represented at the numerous hearings, and the tentative report is being modified in accordance with the results of the discussions.

DURING the past year a great deal of damage has been caused to some of the best pavements in the Boro of Manhattan, City of New York, by heavily loaded steel-tired trailers hauled by motor vehicles. The destruction has been so rapid that it has brought to the attention of the authorities the necessity for limiting the loads on vehicles to be hauled over the city streets.

In recent years there has also developed a greatly increased use of the motor vehicle, with increase in size, so that many of the streets in business sections of the city are becoming congested. Unless some limitation is placed upon the size of vehicles, this condition will continue to become worse.

As the weight and size of the vehicle increases, the question of limiting the speed also must be considered, for it becomes evident that what would be a reasonable speed for an ordinary size vehicle of moderate weight would be detrimental to the public interests in larger and heavier ones.

Damage to City Streets Caused by Vehicles.

The most damage seems to be caused by steel-tired vehicles hauled by motor trucks, or trailers as they are called.

The case in point is here given: A contractor's outfit hauling rock from the subway excavation on Broadway is made up of a tractor and trailer. The latter carries six large buckets, weighing about 15 tons. Its wheels are 41 inches in diameter with 8½-inch wide steel tires. The load per inch width of tire is about 1,400 pounds.

The springs on the front axle are spiral and on the rear, flat. They are very stiff, and this fact has unquestionably contributed towards the destructive effect of the wheel loads of the trailer. The jarring effect of the loaded vehicle is such that people along the route traveled complain about excessive vibration in their buildings.

The route traversed has been along West 42d street from 8th to 10th avenues; north on 10th avenue to 50th street; west on 50th street to the dump dock on the North river.

The age and character of pavements on the route is as follows:

Forty-second street from 8th to 9th avenues: Sheet asphalt on concrete foundation, completed July 22, 1912.

Forty-second street from 9th to 10th avenues: Improved granite on concrete foundation, completed November 14, 1912.

Tenth avenue from 42d to 50th streets: Improved granite on concrete foundation, completed February 26, 1913.

Fiftieth street from 10th to 11th avenues: Sheet asphalt on concrete foundation, completed August 27, 1912.

Fiftieth street from 11th to 12th avenues: Improved granite on concrete foundation, completed May 25, 1912.

It will thus be noted that these pavements are all substantially about four years old. They are considered among our best pavements, and have been laid in conformity with the latest specifications. Up to the time when the damage began to be done by the above mentioned trailers, no appreciable amount of wear had been noticed beyond what ordinarily might be expected on thorofares with as much traffic as have the streets above mentioned.

The mischief has all been done in a very short space of time, about nine months, and has amounted to 5,400 square yards of repairs on granite (equal to 32 per cent. of the total area), costing $6,000, and 1,900 square yards of repairs on sheet asphalt (equal to 30 per cent. of the total area), costing $1,900; whereas, prior to this time, the average cost per year of maintenance on the granite was $150, and on the sheet asphalt $70.

The accompanying photographs show the kind of damage that has been done. On granite pavements the granite blocks have been literally crushed and ground into powder. In many cases the blocks were split. The granite used has given splendid service on other streets of the city. The granite on 42d street, between 9th and 10th avenues, was quarried at North Jay, Me., and has a crushing strength of about 20,000 pounds per square inch. The granite used on 10th avenue from 42d to 50th street, was quarried at Rockport, Mass., and has a crushing strength of 25,000 pounds per square inch. The granite used on 50th street was quarried at Salisbury, N. C., and has a crushing strength of 40,000 pounds per square inch.

On the sheet asphalt, the destructive effect has been equally startling. In some places it has been ground to small bits; in other places the wearing surface has been completely broken and cracked. It shows many depressions, waves and ruts and shoves.

In many places the 6-inch concrete base has been shattered; however, in many other cases where the wearing surface has been damaged, the foundation remains intact.

The speed of these vehicles was about 6 miles per hour in the day time, and at night it was considerably higher—12 and 14 miles per hour, and even 16 at times.

Rubber-Tired Traffic Not Objectionable.

The effect of rubber-tired traffic has been carefully investigated, and practically no damage has been caused by motor vehicles in which all the wheels are covered with rubber, beyond what is reasonable, altho there are some types of heavily loaded trucks in use in the city. Our first-class pavements show practically no additional expense for maintenance beyond a reasonable amount.

The manufacturers of motor vehicles have found by experience, that about 750 pounds per inch width of tire is

about all the load the rubber tire will stand, and this load, together with the resiliency of the rubber and the adequate springs on motor vehicles which good construction demands, seem both together to be the saving features in protecting the pavements against undue wear, even under heavy loads.

The trailer, however, comes in an entirely different class. Not being rigidly connected with the vehicle having the engine of more or less delicate mechanism, it need not have the rubber tires nor the easy springs to prevent damage to the tractor, hence builders of these, who form a distinct class from the motor-vehicle manufacturers, have allowed their fancy no restrictions in the designs of the trailers, their principal object being to provide a vehicle having the greatest tonnage capacity at the least cost, without considering the destructive effect on the pavement caused by the excessive loads, narrow steel tires, small diameter of wheels, and inadequate springs.

It becomes evident, therefore, that immediate action must be taken to protect not only the pavements of the cities and the municipalities immediately surrounding the cities, but also the country highways which are liable to be exposed to such kinds of traffic, or the taxpayers will be called upon to make very heavy payments to maintain their streets and highways, altho these may have been constructed in a thoroly first-class manner and in accordance with the latest ideas.

It goes without saying that a vehicle that would break down the best kinds of city pavements in a few months, will cause much greater damage to even a first-class country highway much more rapidly.

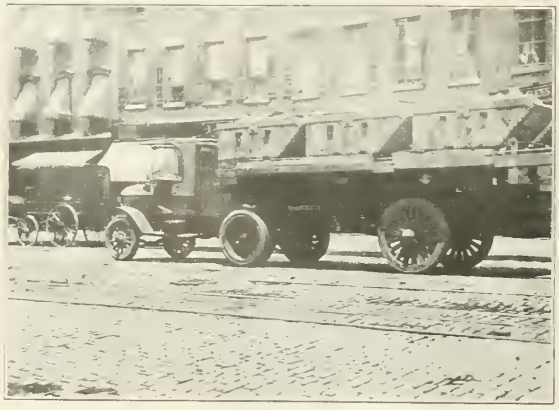
Regulations Should Cover.

It would appear to the speaker that regulations properly framed to protect the pavements against the destructive effects of excessive loading in vehicles, should take into account the following factors:

1. That the wearing or damaging effect of wheel loads on pavements is a function of (a) the load; (b) the diameter of the wheel; (c) the width of tire; (d) whether or not the tire is of a resilient material such as rubber, or of steel; (e) the kind of springs.

2. That speed has considerable to do with the damaging effect of heavy loads.

An investigation of the laws and ordinances governing the weights and loads of vehicles, etc., adopted by eight states and 49 cities in the United States and Europe, goes to show that only a few laws have been drafted in accordance with modern conditions. It is surprising that even today in this country, certain communities require that the width of the tire should depend on the diameter of the axle, regardless of the loading; others make no distinction in the regulations between a wheel large or small in diameter, while still others treat rubber and steel-tired wheels the same.



RUBBER-TIRED TRACTOR HAULING STEEL-TIRED TRAILER WEIGHING WITH LOAD SOME FIFTEEN TONS OVER NEW YORK CITY STREETS.

Ordinances in Force.

Among the most up-to-date ordinances are the following:

Chicago, Ill.:
- Maximum weight of vehicle, 15 tons.
- Maximum load on any one axle, 12 tons.
- Maximum load on the wheel, 6 tons.
- Maximum load per inch width of tire, 1,000 pounds.
- Maximum length, 40 feet.
- Meximum width, 8 feet 6 inches.
- Speed: Compatible with safety, but not to exceed 9 miles per hour. Not to exceed 4 miles per hour when truck has defective tire which would cause injury to pavement.
- Motor trucks must have rubber tires.
- Trailers may have steel tires.

New York State:
- Meximum weight of vehicle, 14 tons.
- Maximum load on any axle, 9 tons.
- Maximum load per inch width, 800 pounds.
- Maximum width, 8 feet 4 inches, except traction engines which may have a width of 9 feet 2 inches.
- Speed: Over 4 tons, 15 miles per hour; over 6 tons, 6 miles per hour, with steel tires, 12 miles per hour with rubber tires.

State of New Jersey:
- Maximum weight of vehicle, 12½ tons.
- Maximum load per inch width of tire, 800 pounds.
- Speed: 3 tons, 12 miles per hour (iron tires); 6 tons, 8 miles per hour (iron tires), 10 miles per hour (rubber tires).

State of Pennsylvania:
- Mixamum weight of vehicle, 12 tons.
- Mixamum load on any one axle, 9 tons.
- Maximum load per inch width of tire, 750 pounds.
- Maximum width, 7 feet 6 inches; for busses in large cities, 8 feet 4 inches.

State of Massachusetts:
- Maximum weight of vehicle, 14 tons.
- Maximum load per inch width of tire, 800 pounds except for hard pavements.
- Speed: 4 tons, 15 miles per hour; 6 tons, 6 miles per hour (iron or steel tires), 12 miles per hour (rubber or similar tires).

Oakland, Cal.:
- Maximum weight of vehicle, 14 tons.
- Maximum load per inch width of tire, 800 pounds (except for hard pavements).
- Speed: 4 tons, 6 miles per hour (iron or steel tires), 12 miles per hour (rubber tires).

England:
- The English have much the most complete and scientific ordinances of any that the speaker has examined.
- Maximum weight of vehicle, 12 tons.
- Maximum load on any one axle, 8 tons (for trailers 4 tons).
- Maximum weight of vehicle without load, 5 tons.
- Combined weight of motor car anu trailer, 6½ tons.
- Weight on axle to be proportioned to diameter of wheel.

The load per inch width of tire (steel) shall be 840 pounds for wheels 3 feet in diameter; and an additional allowance for 9 1/3 pounds for every increase in diameter beyond 3 feet; and for wheels less than 3 feet in diameter, a deduction of 18 2/3 pounds per inch width of tire for every inch less in diameter than 3 feet.

Vehicles for military service limited as follows:

Weight of car unladen, 6 tons.

Weight of car with trailer, 8 tons.

Unit of registered axle weight with tires shod with cross bars, 560 pounds.

Maximum width, 90 inches for 3 tons; 90 inches for trailers.

Speed: Dependent on axle weight for iron tired vehicles, 6 tons, 12 miles per hour for rubber tires; over 6 tons 8 miles per hour for rubber tires.

Should car unladen weigh more than 3 tons, speed is limited to 8 miles per hour.

If motor draws trailer, maximum speed is 5 miles per hour.

Width of Vehicles.

Unless some limitation is placed upon the size of vehicles, the tendency will be to make them larger and larger, until they will become a nuisance and congest the highways. This is now becoming evident in the city of New York, as well as in other cities.

In order to provide reasonable standing room on each side of a street and at the same time allow traffic to proceed in both directions, we are forced to limit the width which vehicles take up.

Many of our streets have roadways only 30 feet between curbs. It thus becomes evident that vehicles over 7 feet in width do not allow for two to pass, even using the utmost care. While it is becoming necessary to widen roadways in this boro, it is very difficult to add more than 2 feet to each side; a 30-foot roadway is thus converted into a 34-foot roadway. In this case, a 7½-foot width for a vehicle would be the limit.

In conclusion, the speaker submits that this subject is one of paramount interest to all cities, and that the time has now arrived when the issues must be squarely faced.

It is hoped, therefore, that a thoro discussion of this matter will ensue, and that the result will be a crystallizing of ideas on this most important subject.

Memoranda Regarding Dimensions, Weight, etc., of Trucks used on the Subway Construction Work to haul Rock from Shafts at 39th, 41st and 43rd Streets, New York, N. Y.

Trailer: Platform over all, 22.2 feet x 8.6 feet.

Wheel Base: 11.5 feet.

Tread Base: 6.55 feet.

Length over all, including tractor and trailer, 33 feet.

Rear wheels of trailer—41 inches diameter, 8½ inches wide steel tires.

Rear wheels on tractor—32 inches diameter, with double 6-inch rubber tires.

Axle of trailer—2¾x5½ inches deep.

Rear springs, flat—53 inches long, having 20 leaves ½ inch thick x 3 1/2 inches.

The trucks carry six skips, which, when loaded with stone, weigh from 2½ to 3 tons each.

There are ten of these trucks in operation. They work 16 hours per day and each make about one round trip every hour. The total number of trips, therefore, for the ten vehicles is 160 per day.

Memoranda Regarding Granite Pavement Repairs.

Location	Quarry.	Crushing Strength
42nd Street, 9th to 10th Ave.,	North Jay, Me.	20,000 lbs. sq. in.

EFFECTS OF NINE-MONTHS USE OF A DOZEN OF THE TRUCKS AND TRAILERS SHOWN IN ANOTHER PHOTOGRAPH, UPON FIRST CLASS GRANITE BLOCK STREETS ON A DEFINITE ROUTE OVER WHICH THEY TRAVELED FROM SUBWAY SHAFT TO DUMP.

Percentage of Repairs.

1915 4

9 months of 1916 .....45.

10th Ave., 42nd to 50th St., Rockport, Mass...25,000 lbs. sq. in.

Percentage of Repairs.

1915 5

9 months of 1916 .....26.

50th Street, 11th to 12th Ave., Salisbury N. C..40,000 lbs. sq. in.

Percentage of Repairs.

1915 6

9 months of 1916 .....36.

Proposed New Jersey Regulations.

In the discussion of this paper it was shown that the State of New Jersey now has under discussion a series of regulations of commercial vehicle and truck traffic which cover all of the points made in Mr. Stern's paper. The report has been prepared by a committee appointed by William L. Dill, commissioner of motor vehicles of the state, and a number of hearings have been and will be held in order to bring the report as near perfection as is possible under present conditions.

The principal points in the report may be summarized as follows, the word "truck" standing in this summary for the words "commercial vehicle or truck."

Maximum dimensions of trucks are 96 in. width if weighing more than 4,000 lbs.; 12 ft. 2 in. height; 23 ft. 6 in. length. Counties having bridges with less than 12 ft. 6 in. headroom must post them, showing clearance. Special permits as to width may be issued where weight is not a material factor of the load. Red flags must be carried if the load extends outside the dimensions of the truck.

No metal of wheels, whether tires, lugs, bobs or other sharp devices can be permitted to touch the road, except chains used in accordance with the motor-vehicle act.

Only one trailer is permitted and it must be equipped with rubber tires.

Special permits must be obtained to use trucks as pleasure vehicles.

Trucks with under-sized tires cannot be licensed.

Schedules of weights allowed on wheels, according to diameters of wheels, sizes of tires and speeds in miles per hour are provided. One-third the total weight of truck and ca-

pacity is the weight assumed for each rear wheel, which must accord with the schedule. The front wheels must accord with the schedule for single tires with the weight remaining for them to carry. Each truck must have a sealed governor with its speed regulated according to the schedule.

The statement was made that the carrying capacity of trucks in use in New Jersey now approximates the carrying capacity of its railroads, showing the importance of legislation on this subject this winter.

New Jersey and the other eastern states are having trouble with their roads of the lighter forms of construction on account of this remarkable development of motor truck transportation. Other states should profit by their experience so that their main roads will be provided with adequately paved surfaces when first improved.

The discussion indicated that the motor truck itself is not seriously troublesome except as to speed and in special cases, but that the major part of the destruction of roads adequately paved is due to the excessive weights on and improper design of trailers, and speed of the trucks whether drawing trailers or running alone.

THE GARBAGE PROBLEM

By Dr. F. E. Young, Canton, Ohio.

Garbage is the refuse of food products derived from the market, kitchen and table. Sanitary engineers calculate on half a pound a day per capita, or one ton of garbage for each four thousand population. It is estimated that one-fifth of the food bought by the average family goes into the garbage can. In the country and villages it is fed to pigs and chickens. In towns it is collected by farmers for the same purpose, but in small cities it is either dumped into the water, buried in the ground or burned. In larger cities the disposal of garbage has been one of the most perplexing and difficult problems to solve, and many methods of destruction are in use. Limits will not permit discussion or even mention of all of these, but it is coming to be a recognized fact that destruction by any method is a mistake and that disposal by reduction, with the recovery of by-products by modern methods, is always the best practice. Recent discoveries and inventions have made it practical to recover more than twice the value in by-products that is usually obtained. The alcohol is worth more than the grease and fertilizer.

Garbage Collection

The cleanest and most sanitary method of collection is to gather the full cans and dump the contents directly into the cooking tanks at the disposal works. The cans are then washed by machine, sterilized with live steam and dried before delivery to patrons. As the full cans are taken up clean ones are left for use until the next collection, when they are again taken up and clean ones left, so that patrons get a clean can at every collection.

This method avoids the use of the unsightly and unsanitary tank wagon, the escape of offensive odors and spilling of garbage while dumping the cans or driving along the street. It takes less time and labor and the cans last much longer. But the greatest advantage is that garbage deposited in the clean can does not decompose as rapidly as if placed in a dirty can from which old garbage has just been dumped. The only valid objection is that it takes more cans to serve a given number of patrons, but this is offset by the advantages mentioned. It will require just as many more cans as will be in daily transit, which for weekly collection will be about one-sixth more, or seven thousand cans for six thousand patrons.

Patrons should not put rubbish in the garbage can. Broken dishes, glass and tin cans belong in the rubbish or ash can. Bulky rags and waste papers should not go into the garbage. Dishrags and a limited amount of paper may be permitted; in fact, the housewife may save a great deal of soap and water, as well as labor, if she will wipe the greasy dishes and pans with paper before washing; for this purpose newspapers may be cut to proper size and kept in a convenient place. If the garbage is wrapped in paper, after draining off the water, it will not decompose so rapidly. As little water as possible should go into the garbage can.

The cost of garbage collection may be paid by the city direct, or collected in whole or in part from the patrons. Probably the best way is to charge a small annual fee for the service, say a dollar a year. Much of this will come from non-taxpayers and all of it from those receiving the service; the city to furnish the cans and keep them clean, collect and dispose of the garbage. The city can buy the cans, keep them clean and in repair, in quantity, much cheaper than patrons can. Cans rust thru at the bottom, and new bottoms can be put on, making them nearly as good as new. The cans should all be of the same shape and size in order to facilitate handling and cleaning. This plan divides the expense nicely and secures greater co-operation on the part of patrons than if the city pays the entire expense. It also furnishes a good means of enforcing the rules regarding the use of the garbage can. When they have paid for the garbage service and know that they will forfeit it and the money they have paid, if they do not keep the can covered or put forbidden things in it, they will be more careful regarding its use.

In order to avoid disputes and controversy the garbage service year should start at a certain date, say the 1st of April. Patrons making application during that month will pay one dollar in advance for the year. Those making application later will pay ten cents a month for each month until the next April, including the month in which the application is made. All old patrons will then pay in April for the next year. If they fail to pay or violate the rules in regard to the garbage can, they forfeit the service and must make application and pay the same as a new patron.

Rules should be formulated and patrons furnished a printed copy when they make application for the service. In fact, the rules should be printed on the receipt given for the money paid for the service. In case of violation of the rules warning should be given that upon further violation the collector will leave no can and the service will be forfeited, together with whatever money they have paid for the balance of the year.

In case of long haul, loads can be quickly transferred from collecting wagons to motor truck, or if cleaning facilities be provided at the loading stations, the garbage may be dumped into tank trucks, cars or boat for transportation to the disposal plant. It is better for large cities to have a number of units than one large central reduction works, with the necessary long transportation.

By this method of collection the odors are confined and by the anaerobic reduction process they are condensed so that there is not the nuisance created that there is by other methods of collection and reduction, besides the by-products are more valuable.

FIRE DEPARTMENT

South Bend Hoosier Pump Tests

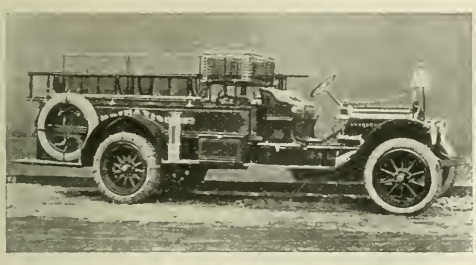
An interesting test of the Hoosier pump was recently made by the South Bend Motor Car Works, South Bend, Ind., Mr. A. C. Mecklenburg, president of the company, conducting the experiments with the assistance of the engineering department. The Hoosier pump has a 95-h.p., 4-cylinder motor, carrying 1,000 feet of standard 2½-in. fire hose and a 40-gal. chemical tank of either the Champion or Halloway type. Among other features it has a geared rotary fire pump, two 4½-in. suction inlets, two 2½-in. quick-closing delivering gates and two 9-ft. lengths of 4½-in. hard suction coupling with a strainer attachment. The tests were as follows:

Test No. 1—Two 2½-in. 300-ft. lines Siamese to 1⅜-in. nozzle, 60 lbs. at nozzle; capacity, 600 gal. per min.

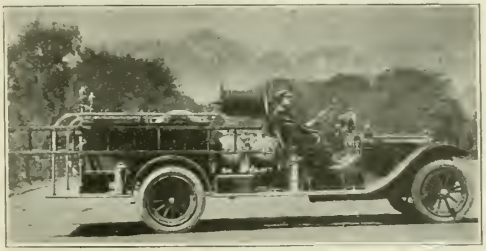
Test No. 2—One 300-ft. line, 2⅜-in., 1-in. nozzle tip, 70 lbs. at nozzle; one 300-ft. line, 2½-in., 1-in. nozzle tip, 100 lbs. at nozzle; capacity, 465 gal. per min.

Test No. 3—One 300-ft. line, 2½-in., 1-in. nozzle tip, 80 lbs. at nozzle; one 300-ft. line, 2½-in., 1⅛-in. nozzle tip, 68 lbs. at nozzle; capacity, 560 gal. per min.

Test No. 4—One 300-ft. 2⅜-in. line, 1¼-in. nozzle, 63 lbs. at the nozzle; one 300-ft. 2½-in. line, 1⅛-in. nozzle, 65 lbs. at the nozzle; capacity, 500 gal. per min. All above tests were made on a basis of one hour each, and the company states that the Hoosier pump has a rated capacity of 250 gal. per min.



WHITE COMBINATION HOSE AND CHEMICAL, AS OPERATED BY THE CITY OF MALDEN, MASS.

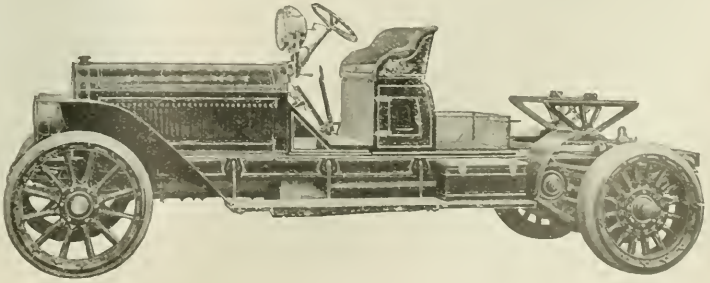


WHITE 5-TON CHEMICAL COMBINATION, AS OPERATED BY THE CITY OF GOLDFIELD, NEV.

Huntington Department Motorizing

Chief Edwin Beard, of the fire department of the city of Huntington, Ind., states that his local equipment consists of one combination hose and chemical, carrying ladders; one hook-and-ladder wagon and two horse-drawn pumpers. His fire limits include about one-third of the city, which has a population of about 15,000.

The Board of Public Safety, which constitutes the local fire committee, only recently issued bonds for $24,000 for a new central station and motor apparatus. It is intended to invest in motor-driven triple combination trucks.

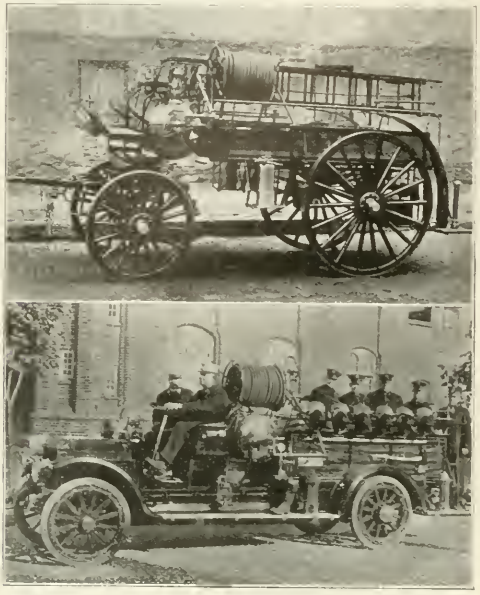


AMERICAN-LA FRANCE TRACTOR, AS OPERATED BY MANY MUNICIPALITIES IN THE MOTORIZATION OF HORSE-DRAWN EQUIPMENT.

How Albany Saved Money

Herewith appear before-and-after photographs showing increased efficiency secured at a merely nominal cost and in a way which should be interesting to every large or small municipality still using horse-drawn fire equipment.

The pictures show how the city of Albany, N. Y., adapted an old combination hose and chemical truck to a newly purchased Federal chassis, giving them a speedier, more reliable, 100 per cent. machine, adequate to modern fire-fighting requirements. Only slight and inexpensive changes were necessary to make the old bodies conform closely to the new motor truck chassis.



It is estimated that this practical adaptation of horse-drawn equipment gave the city of Albany the benefit and economy of motor apparatus that otherwise would possibly have been financially beyond their reach, or at best would have cost them from two to three times as much.

Their other horse-drawn apparatus is being similarly "Federalized."

Fire Department Notes

COTE OF WOONSOCKET

Augustin J. Cote has been chief of the Woonsocket, R. I., fire department since January, 1908. At the time of his taking office there were only twenty permanent men in the department. During 1915 he managed to increase this number to forty-seven, and eight more were added during the current year.

The new Woonsocket station was opened as a headquarters in 1913, and that same year a chief's car, a combination hose and chemical, and a 75-foot Seagrave aerial ladder, with a Christie tractor, were installed. Two additional combination hose and chemicals were added early in 1915.

BRIGHTBILL OF ELKINS

Max H. Brightbill, present chief of the city of Elkins, W. Va., fire department, stands high in the esteem of his community. When the first volunteer fire company was organized in January, 1901, he was elected president, four months later being appointed fire chief by the common council—a position which he has held thruout the ensuing fifteen years.

It is noteworthy that Chief Brightbill himself invented the fire alarm system now used by the city of Elkins. In his time the local department has progressed from hand reel to horse-drawn equipment, and from that to motor-driven apparatus.

STICKNEY, OF VIRGINIA, MINN.

Virginia, Minn., is mentioned in the official reports as one of the cleanest and best constructed cities of its size in the state, for which due credit must be given Fire Chief James Stickney, on whose horizon few "fire traps" have remained for long.

Chief Stickney joined the local volunteer department in 1904 and two years later was appointed assistant chief. The following year the department was put upon a regular paid basis, with a staff of five men and one horse-drawn wagon.

The fire station was built in 1908, and within the next three years three more men were taken on, and three new pieces of horse-drawn equipment and one Waterous motor-driven combination chemical were installed. Mr. Stickney was made chief in 1912, and since then the department has been strengthened by the purchase of a Haynes chief's car, an American-La France combination hose and chemical apparatus, seven more men, and an extensive addition to the headquarters fire station.

MICHAEL OF HANOVER, PA.

Fire Chief A. R. Michael, of the city of Hanover, Pa., owes his original election and continuance for his four consecutive terms in office to ability and popularity with the men serving under him and the subsequent ratification of their choice by the burgess and city council.

Numerous radical improvements have been effected in the local department under his administration, among them being a strictly up-to-date Gamewell fire alarm telegraph system, twenty-four large size fire hydrants, new hose and general equipment, an American-La France motor-driven triple combination apparatus and the new $12,000 fire station, which Hanoverians say gives their city one of the best equipped fire departments of any 9,000-inhabitant community in the state.

BARBER OF DOTHAN

C. J. Barber, chief of the city of Dothan's (Ala.) fire department, has spent seventeen years in battling the flames. He early joined a volunteer department in Columbus, Ga., his native town, and assumed charge of the Dothan, Ala., paid department in January, 1915.

At the time of his appointment to Dothan, the city had no law for building inspection or civic regulations as to storage of oil, gasoline, explosives, motion picture shows, etc. Along with his efficient work in putting the department upon an efficient basis, Chief Barber also put forward vigorous efforts towards adequate protective legislation, and the agitation which he thus fathered today has won for Dothan all that could be wished.

WHITE COMBINATION HOSE AND CHEMICAL, AS OPERATED BY THE CITY OF COCKEYSVILLE, MD.

Statistics of Fire Departments

A—Total for machines of the class. BD—Business district. D—Direct pressure. E—Each machine. F—Streets in fair condition. G—Streets in good condition. R—Reservoir. S—Standpipe.

This table of statistics should be considered with the tables given in the special MOTOR TRUCKS insert to obtain the full information about the departments. This table gives the general statistics of the departments and the names of fire chiefs and members of fire committees. The large table in the MOTOR TRUCKS insert gives full information about the motor-driven apparatus in use, more particularly the motor apparatus installed within the last five years. In the same section will be found a list of the proposed additions of motor apparatus to departments during 1917, which shows that there is plenty of improvement in progress, altho the number of departments which report themselves completely motorized is rapidly increasing. One or two figure references in the column headed "Condition of Streets" are to notes which will be found at the head of the table in the MOTOR TRUCKS section.

City	Pop.	Area Sq. Mi.	Area Fire Limits Sq.m	Mi. Streets	Mi. Paved Streets	Condition of Streets	Water Service	No. Fire Houses	No. Full-time Men	Name of Chief	Members of Fire Committee, Chairman Named First
Alabama—											
Birmingham	.....	....	....	....	....	...	...	..	....	S. A. Middleton, Chf.	
Mobile	57,244	18	18	....	74	...	R	11	63	C. S. McCosker.	Comr. Laz. Schwarz.
Arizona—											
Phoenix	25,000	4.35	0.49	91.28	10.25	G	D	3	24	A. F. Wright.	Robt. A. Craig, Cy. Mgr.; Peter Corpstein, Mayor; Frank Woods, Geo. McBean, J. A. Jones, C. H. Dunlap, Comrs.
Arkansas—											
Ft. Smith	32,000	13.5	¼	187	94	G	SR	4	28	M. J. Brun.	D. F. Singleton, Comr.
Helena	17,000	4	3	30	5	F	D	2	9	L. A. Moorman.	J. B. Coonly, F. E. Ruen.
California—											
Alameda	31,000	23.0	0.2	70	54	G	D	5	24	W. T. Steinmetz.	John H. Walker, E. J. Probst, John Wilkens.
Alhambra	10,000	6.0	0.2	76	69	G	R	3	6	Frank L. Hilton.	Geo. L. Yelland, Com. Pub. Saf.
Bakersfield	20,000	12.0	....	156	50	G	D	4	23	H. R. Shaffint.	W. Morgan, Cy. Mgr.
Berkeley	65,000	10.0	2.0	170	150	F	...	9	74	G. Sydney Rose.	C. Hoff.
Long Beach	40,000	13½	13½	....	....	...	...	4	35	G. C. Craw.	
Los Angeles	600,000	338	....	....	....	GFB	R	43	650	A. J. Eley.	Mayor, F. T. Wordman; A. F. Frankenstein, J. P. Yates.
Oakland	250,000	58	2	527	36	G	R	22	202	Elliott Whitehead.	F. F. Jackson, Comr. P. S.
Pasadena	47,000	13	1	160	135	G	RD	5	50	A. M. Clifford.	W. B. Loughery.
Petaluma	8,000	3.0	1.0	55	20	G	D	3	4	R. S. Adams.	M. O. Torr, G. B. Rodd, O. Cline, E. Sabrance.
Redlands	12,000	16.5	2.0	200	33	G	R	1	3	Ed. Mosbaugh.	E. J. Underwood, A. E. Carter.
Riverside	19,000	40	....	....	112	G	R	2	9	Joseph Schneider.	J. R. Williams, Comr. P. S.
Santa Ana	15,000	9	0.1	132	22	G	D	1	4	W. M. Jackson.	J. W. Tubbs, W. A. Greenleaf.
Santa Cruz	12,000	9	3	110	15	F	R	5	8	R. S. Tevit.	Chas. Canfield.
Stockton	42,500	7½	2½	175	85	G	SRD	7	36	M. D. Murphy.	Mayor O. N. Ford. A. C. Dullahan, F. A. Kenyon.
Colorado—											
Boulder	12,500	4.0	0.7	17	....	F	DR	3	7	E. A. Johnson.	A. E. Chase, J. A. Hunter, T. D. Eberhart, Fred White.
Colorado Springs	33,000	8.5	0.6	125	2¼	G	G	4	36	P. D. McCartin.	Comr. Pub. Safety.
Grand Junction	8,000	1.8	0.3	18	2	...	...	1	4	J. S. Hynes.	C. E. Cherrington, H. F. Verbeck, J. A. Rankin, C. K. Holmberg, L. E. Blacksom.
Greeley	10,000	4	0.4	64	....	G	R	1	8	Floyd Preston.	Louis Baab, B. F. Woodruff, Cottingham.
Pueblo	65,000	13½	2	240	20	F	...	6	53	Sam Christy.	Knox Burton, West, Olin.
Connecticut—											
Bridgeport	150,000	....	11.6	186	100	G	D	12	169	D. E. Johnson.	J. A. Leonard, J. H. Tague, C. C. Lindquist, J. H. Cassidy.
Danbury	24,000	7	4	60	30	G	D	9	15	Peter Beckerle.	Emil Goos, H. E. Meeker, C. Judson.
Greenwich	42,000	9	....	10	2	G	R	2	16	J. M. Sullivan.	Richard Outwater, T. F. Howley.
Hartford	130,000	18	....	111	110	G	R	15	....	J. C. Morean.	H. B. Clark, Wm. McKane, D. Elsner, T. F. Garvan, John Gleason, J. McIntyre.
Middletown	13,000	2½	2½	20	14	G	...	3	8	G. S. Pett.	A. V. McDowell, H. C. F. Howell, E. L. Fcree.
Naugatuck	1,600	....	....	....	....	G	R	2	3	G. W. Hoadley.	H. B. Tuttle, John Fitzgerald,
New Britain	60,000	13	1½	....	....	22	R	5	33	R. M. Dame.	E. G. Babcock, F. L. Moran, H. Steele.
Stamford	33,000	7½	6	62	7	G	R	3	36	H. W. Parker.	W. F. Joyce, W. F. Cressy, F. C. Orfinger.
Torrington	25,000	....	1¼	....	4	G	RD	1	5	E. J. Kelley.	W. A. Gleeson, E. J. Kelley, J. M. Cluxton, J. A. Woodhead.
Willimantic	14,000	....	1	30	1	F	R	3	....	T. P. Foley.	G. M. Graves, C. M. Holbrook, W. J. Jenkens.
Delaware—											
Wilmington	.....	....	....	....	....	...	...	..	....		Geo. Taylor, Secretary.
Florida—											
Gainesville	11,030	4	4	96	60	G	SD	1	2	E. W. McCreary.	R. B. Bush, J. H. Colson, J. A. Goodwin.
Key West	18,000	2½	½	20	5	F	SD	3	14	T. E. Reedy.	D. L. Cash, B. B. Warren, A. B. Cleare.
Miami	25,000	....	....	....	....	...	D	3	30	H. R. Chase.	Casper Hefty.
W. Tampa	12,000	2½	½	70	17½	F	DS	1	10	L. L. Moan.	J. M. Rey, P. Rey, G. N. Benjamin.
Georgia—											
Americus	13,500	4.9	0.2	52	10	G	D	1	8	J. B. Parker.	I. J. Kalmon, H. O Jones, R. H. Horton.
Athens	20,000	7.5	0.5	110	7.5	F	SD	2	19	G. W. McDonnan.	E. K. Lumpkin, Jr., J. Z. Hoke, H. R. Palmer.
Brunswick	15,000	6	1	20	14	F	SR	1	10	J. H. Harrison.	M. B. McKimon, B. F. Jones, J. Sidney Roberts.
Rome	20,000	3.4	0.2	75	5.5	F	R	4	21	J. A. Sharp.	C. S. Pruden, A. B. Arrington, E. E. Lindsey, F B. Holbrook, J. P. Jones.
Idaho—											
Boise	25,000	2.5	0.7	110	14	F	D	4	32	C. F. Lindsay.	J. A. Davis.
Pocatello	15,000	5	1.5	....	7	F	R	2	9	A. B. Canfield.	J. W. Hopkins, Willard Green, W. S. Hudson.

City	Pop.	Area Sq. Mi.	Area Fire Limits Sq.m	Mi. Streets	Mi. Paved Streets	Condition of Streets	Water Service	No. Fire Houses	No. Full-time Men	Name of Chief	Members of Fire Committee, Chairman Named First
Illinois—											
Alton	25,000	....	....	....	....	G	SD	5	....	Wm. Feldwisch.	H. B. Herb, Joe Grosham, Moses Rubinstein.
Aurora	38,000	7	2.5	100	45	GF	SD	5	29	G. J. Rang.	P. H. Jungles, Harvey Rockmeyer, Fred Butke.
Beardstown	7,453	1.5	0.1	32	6	G	SD	2	2	Claude Miller.	E. E. Angier, Wm. Scullion, Harry Knippenberg, C. H. Davis.
Belleville	25,000	6	....	....	....	G	D	2	18	H. C. Kunz.	Henry Baumgarten, Peter Jung, Chas. Hassel.
Belvidere	8,000	2	0.2	50	14	F	D	2	8	Frank Clark.	W. L. Rairdin, J. F. Meyers, W. H. Robinson.
Bloomington	30,000	4	1	115	46	F	SD	5	34	Henry Mayer.	A. G. Ereckson, Comr.
Cairo	18,000	25	10	50	15	F	RD	2	17	Peter Lind.	Chas. Feuchter, F. D. Nellis, M. J. Holley, Dan Kelly, Mayor, Walter Wood.
Canton	12,500	....	0.3	....	12.5	F	D	1	....	C. H. Totten.	Jos. Schuler, G. C. Sandburg, H. E. Mannahan.
Centralia	10,000	....	....	....	....	F	...	1	2	Ray Hoffman.	John Hopkins.
Charleston	8,000	4	0.3	79	14	G	D	1	2	C. W. Roberts.	Palmer Stoner, Jas. Dunifer, Theo. Nickels.
Chicago Heights	20,000	2.6	0.3	43	19	...	S	2	14	M. S. Philip.	L. C. Miller, F. W. DeBolt, Elsa Miller.
Cicero	40,000	6	....	2.5	100	F	...	5	48	A. F. Hede.	J. S. Ryland, Hart Sunek, Bachman.
Decatur	41,000	....	....	....	41	G	D	4	39	G. W. Devore.	J. F. Mattes.
DeKalb	9,000	2.5	0.15	35	11	F	D	1	7	M. H. McEvoy.	W. P. Hiland, P. Seaholm, A. Nelson.
Dixon	10,000	12	....	....	8	F	D	1	5	T. B. Coffey.	J. D. Vanbibber.
E. St. Louis	80,000	14	....	....	....	F	D	7	78	M. J. Tobin.	Edw. Cunningham, G. Janner, Phil. Minuette, J. Haggerty, S. J. Fowler, A. Murphy, W. McNary, W. B. Crawford.
Edwardsville	7,500	2	0.5	30	15	G	S	1	3	C. H. Fiegenbaum.	J. J. Watson, F. W. Schulze, E. J. Horning, J. P. Borman.
Elgin	27,000	7	1½	110	23	F	SD	5	27	Wm. Haible.	C. L. Kohn, Comr. P. S.
Galesburg	25,000	9	0.2	110	34	G	RD	3	18	J. E. Cater.	J. P. Evans, J. F. Dolan, J. E. Anderson.
Granite City	17,000	25	2	126	12	F	D	1	6	Fred Stegelmeyer.	C. Schwartz, Hodges, Jerdon.
Jacksonville	18,000	16	¼	84	28	F	R	1	11	Samuel Hunt.	J. Edgar Martin.
Joliet	55,000	4	2	180	55	G	D	5	38	C. W. Royce.	Thos. Gorey.
Kewanee	15,000	3	½	....	7	F	R	1	6	D. W. Hawthorne.	W. S. Buckingham.
Mattoon	15,000	3	0.3	60	24	F	S	2	8	J. C. Weaver.	Wm. Byers, Wm. Haskell, Osborne.
Monmouth	10,000	4	0.2	....	28	G	D	2	5	T. A. Wilson.	W. E. Loftus, John Strand, Jas. Costello.
Murphysboro	12,000	3.5	3.5	64	14	F	...	1	4	Alb. Herring.	D. M. Anderson.
Oak Park	35,000	4½	1	94	85	G	D	3	21	H. J. Schoff.	G. W. Hales, B. B. Dutton, D. Nelson.
Paris	9,500	4.5	1	45	14	G	S	1	5	C. H. Ulrich.	Frank Clinton.
Pana	8,000	4	0.1	35	6	F	SD	1	....	G. W. Searles.	Grover Clements, Chas. Hill, J. L. Haynes.
Pekin	12,500	6½	0.1	80	19½	G	SD	1	5	J. F. Jaeckel.	J. W. Zuckwiler.
Springfield	63,000	8.6	1	167	73	F	R	8	77	Peter Jacobs.	R. R. Reece, Comr.
Urbana	11,000	....	....	....	....	G	D	1	....	W. H. Roughton.	J. B. Bennett, Roger Tyrell, Elmer Johnson.
Indiana—											
Anderson	32,000	7	¾	50	25	G	D	4	25	C. G. Alford.	H. Urban, E. Station, S. Heavlin.
Brazil	12,000	4	1	60	15	G	R	1	6	Oscar Todd.	Frank Crawford, John Row, Will Treagor.
Crawfordsville	12,000	16	2½	25	14	G	D	2	10	J. W. Hurley.	H. T. Schenck, Carlton Snyder, M. U. Borroughs.
Elkhart	23,000	6	0.1	100	21	F	D	4	25	Alex Dotson.	J. B. Davidson, F. E. Hughes, Eli Coleman.
Elwood	13,000	....	....	....	....	G	D	1	....	Herman Barber.	Charles Meisley, James Bradley, W. E. Hare.
Frankfort	10,000	3	0.1	46	14	G	D	1	6	Roy Henderson.	I. E. Scripture, Q. A. Kennedy, H. F. White.
Gary	45,000	3	....	....	120	G	S	4	49	Wilfred Grant.	K. M. Burr, Albert Carlson.
Goshen	10,000	4	4	40	10	G	SD	2	6	John Snobarger.	Wm. Collins, N. W. Monroe, Edw. Nymeyer.
Huntington	15,000	2.7	....	51	17	G	S	2	12	Edwin Beard.	Fred Bowers, Jacob La Monte, John Kenower.
Indianapolis	300,000	46	....	....	....	G	D	31	335	J. H. Johnson.	Albert Gall, A. H. Wahl, Robt. Metzger.
Kokomo	20,000	3½	0.4	80	52	F	D	3	17	Ed. Shauman.	Wm. Helmich, Wm. Webb, T. F. Lynn, B. P. W.
Logansport	21,000	11	9	58	5	F	...	5	24	John Griffin.	Adrian Beale, Mayor; F. V. Guthrie, St. Comr.; Thos. Flinn, Cy. Engr.; Harry Thompson.
Michigan City	23,000	25	3	....	35	G	D	3	16	I. C. Bauman.	A. W. Voss, Ohms, Bennett, Bates.
Muncie	29,000	4	0.2	75	14	G	D	3	24	J. E. Casey.	P. W. Goebel.
Portland	6,000	6	1	40	6	F	D	1	3	A. O. Ball.	Frank Wilt, Harvey Humphries, W. H. Hutchins.
Richmond	30,000	4½	2	69	13	G	D	5	26	E. E. Miller.	Chas. Marlatt, Alfred Bavis, John McMinn.
Shelbyville	10,000	2	1	28	2	G	D	1	16	J. H. Briggs.	Chas. Jackson, Joseph Pearson, Edward Burkher.
South Bend	70,000	15	....	198	71	G	SD	9	66	I. W. Sibrel.	B. F. Augustine, A. Hibbard, Clement Smogor.
Terre Haute	75,000	10	1	220	53	F	D	10	81	Harry Bledsoe.	Jacob Frisz, I. F. Mehegan, Oscar Kantmann.
Vincennes	20,000	....	....	....	26	G	S	3	14	G. L. Snyder.	
Whiting	7,500	1½	½	13	12½	G	D	1	8	C. C. Lampman.	J. W. Burton, R. Spurrier, A. Hulaska.
Iowa—											
Burlington	25,000	10	4	....	50	G	D	6	17	L. F. Blank.	Ed. Matsch.
Cedar Rapids	45,000	13	2	....	52	G	D	6	38	W. A. Mohrbacher.	Martin Evans, Comr. P. S.
Council Bluffs	32,000	16	0.2	....	....	G	RD	5	27	W. A. Williamson.	F. M. Williams, Gus Clausen, W. A. Williamson.
Davenport	50,000	10½	2	....	90	G	RD	8	55	Peter Denger.	Wm. H. Gosch, B. Raben, W. Moeller.
Des Moines	105,568	54	1	185	135	G	D	16	127	Will Burnett.	Ben Woolgar, Comr. P. S.
Dubuque	45,000	12½	....	....	....	G	R	6	52	J. R. Reinfried.	G. Ragatz, J. Drexler, J. McEvoy.
Ft. Dodge	20,000	6¾	0.4	90	36	G	SD	1	9	F. B. Trusty.	C. H. Smith, J. F. Ford, F. W. Collins.

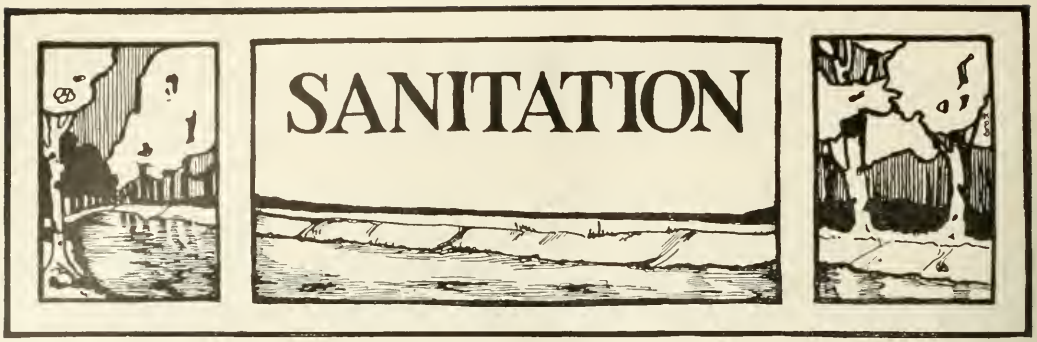
City	Pop.	Area Sq. Mi.	Area Fire Limits Sq.m	Mi. Streets	Mi. Paved Streets	Condition of Streets	Water Service	No. Fire Houses	No. Full-time Men	Name of Chief	Members of Fire Committee, Chairman Named First
Iowa City	12,000	....	....	....	....	F	...	2	....	J. J. Clark.	John Breese.
Keokuk	15,175	20	20	300	100	F	D	3	12	John Anderson.	Fred Hilpert, Jr., Comr. P. S.
Marshalltown	16.065	8.6	2	89	22	G	D	2	10	A. T. Anderson.	Ed. T. Austin, Dir. P. S.
Mason City	31,000	12	0.8	130	40	F	D	1	15	Thos. Conner.	C. A. Codwise.
Muscatine	16,178	....	....	....	....	...	SRD	3	13	J. J. Brown.	John Deircks.
Oskaloosa	11,000	4	4	....	15	G	D	1	5	I. H. McCracken.	Al. Mendenhall, Lee Fansher, J. H. Pickett.
Ottumwa	25,000	12	6	....	35	F	R	2	....	C. W. Slvan.	Fritz Ehrman, Comr. P. S.
Sioux City	62,000	44	....	....	....	F	...	8	51	G. M. Kellogg.	Geo. E. Ward.
Waterloo	33,000	13	0.4	192	52	G	D	2	24	A. A. Dunham.	M. J. Morgan, J. W. Reckert, E. G. Rath.
Kansas—											
Atchison	18,000	6	1	90	29	G	SRD	2	15	John Compton.	C. A. Brown, Frank Bracke, L. J. Ham, Fayet Kested, H. M. Ernst.
Chanute	10,000	2¼	0.1	235	21	G	D	1	4	N. E. Barker.	Mayor, J. L. Marrison; W. M. Barber, W. T. Sams, N. E. Barker.
Ft. Scott	13,000	2	½	106	50	G	SD	1	8	M. W. Smith.	P. C. Hesser.
Independence	13,500	6	0.4	....	42	...	D	1	6	Roy Pitts.	Mayor, R. R. Bettman.
Kansas City	100,000	18	...	297	140	G	D	9	112	John McNarrey.	Commisioners.
Leavenworth	22,000	7.4	7.4	....	....	G	RD	0	17	M. Bahler.	Mayor, Ed. Crancer.
Manhattan	7,000	4	....	35	28	G	R	1	2	W. P. Coudray.	S. F. Goheen.
Newton	9,000	4	0.2	35	20	F	SD	1	4	Guy Kemper.	Mayor, A. J. Duff; G. C. Cook, A. B. Gilbert.
Parsons	20,730	2.5	0.1	50	34	F	SD	2	10	W. A. Buel.	Mayor.
Pittsburg	22,000	4¾	¼	90	25	G	D	2	14	T. W. Howe.	A. L. Wolff, J. V. Osberg, John Mishler.
Salina	12,000	7	1	40	19	G	...	1	6	B. N. Camp.	Mayor.
Topeka	53,000	8½	1	175	90	F	D	6	77	Joseph Hanlon.	Mayor, O. H. Bently.
Wichita	65,000	28	1	450	82	G	D	5	50	A. G. Walden.	
Kentucky—											
Ashland	12,000	2.5	1	35	35	G	R	1	8	H. H. Davenport.	J. H. McCleary, Howard Collins, R. O. Poague.
Hopkinsville	12,000	4	4	80	56	GF	S	1	4	E. P. Fears.	Frank Bassett.
Lexington	41,500	8	3	40	30	G	D	5	43	W. A. Jesse.	Geo. Laud, H. M. Schoonmaker.
Newport	32,500	1¼	....	25	19	F	R	3	16	Sam'l Rardin.	C. Ebert, Comr. P. S.
Louisiana—											
Morgan City	6,000	1	1	15	6	F	SD	1	3	T. G. Thorgesen.	Dancy Winchester, Thos. Shannon.
Shreveport	42,000	10	5½	....	49	G	S	6	44	Chris O'Brien.	Geo. Thurber.
Maine—											
Bath	9,000	15	15	50	....	F	D	5	3	C. E. Parks.	Ralph Conel, Henry Leeman, Chas. Hooper, Harry Bonire, Geo. Barker, Alex Mason.
Lewiston	30,000	35	6	140	12	F	R	4	10	M. J. Moriarty.	G. S. Libby, Mayor; L. J. Braun.
Portland	62,000	22	¾	153	44	G	D	13	97	A. D. Butler.	S. F. Brogan, J. E. Scott, F. M. Langley. Mayor, W. G. Chapman; C. B. Clarke, J. P. McCarthy, S. O. Symonds, C. E. Files, M. J. Bowen.
Skowhegan	5,500	4	4	....	0	F	S	1	1	Mark Sarage.	E. C. Butler, R. T. Patten, M. C. Viles.
Maryland—											
Baltimore	.....	....	...	....	....	...	R	48	797	August Emrich.	Richard H. Johns, Albert Diggs, S. T. Manning.
Cumberland	28,000	....	3	25	17	G	R	3	17	R. C. Hoenicka.	Oscar A. Eyerman, Comr.
Massachusetts—											
Adams	14,000	25	8	40	20	G	...	3	....	H. A. Jones.	G. B. Adams, F. M. Waters, P. P. Smith.
Attleboro	18,000	....	....	90	0	G	S	5	19	H. R. Packard.	H. R. Packard.
Beverly	23,000	15	....	76	16	G	R	6	20	R. H. Grant.	T. D. Connolly, Paul Eaton, Edward Thompson.
Boston	.....	....	....	....	....	...	...	..	....		
Brockton	65,000	22	22	152	44	F	S	6	74	W. F. Daley.	W. E. Johnson, W. L. Gleason, O. E. Peterson, H. D. Bent, F. D. Rowe.
Brookline	.....	....	....	....	....	...	...	..	....		
Chelsea	43,426	2½	1¼	....	....	...	R	5	45	D. M. Hudson.	R. A. Voke, W. A. Morse, J. E. Wholley.
Chicopee	30,138	....	....	....	....	...	...	6	32	J. E. Pomphret.	
Dedham	10,000	20	....	40	....	G	S	3	6	H. J. Harrigan.	
Easthampton	11,000	14½	14½	58	8	F	D	2	4	A. J. Krenle.	
Fitchburg	41,000	28	1	141	8	G	RD	6	45	T. F. Murnane.	J. H. Delaney, J. B. Fellows, G. H. Gibson, W. G. Hayes, T. H. Powers.
Franklin	7,000	9	9	84	0	F	S	4	0	E. L. Metcalf.	H. E. Ruggles, A. J. Gallison, G E. Emerson, F. P. Chapman.
Gardner	17,000	23	1	....	....	G	R	3	6	G. S. Hodgman.	J. W. Davis, W. J. Littaker, Ellsworth Brown.
Lawrence	90,000	6	....	114	19	G	RS	9	71	D. E. Carey.	J. W. Cadogan, Dir. P. S.
Lowell	116,000	14	....	215	69	F	R	14	134	E. F. Saunders.	N. P. Putnam, Comr.
Lynn	100,000	11	3	....	....	G	R	10	97	E. E. Chase.	Mayor, G. H. Newhall.
Malden	50,000	4¾	½	65	5	F	RD	6	51	J. T. Nichols, Actg.	J. H. Hannan.
Marblehead	7,500	5	...	50	1	G	SR	2	5	J. T. Adams.	J. T. Adams, W. H. H. Atkins, J. T. High, T. H. Rhoades, C. A. Goodwin.
Maynard	6,500	1½	1	12	0	G	R	1	2	G. H. Gutteridge.	T. H. Gilman.
Melrose	17,314	....	0.1	62	1	G	R	3	11	Joseph Edwards.	E. J. Burke, Norman Adams, J. E. Higgeston.
Milford	14,000	14	....	85	0	F	SD	5	1	E. J. Burke.	
Milton	8,800	....	....	55	....	G	D	3	13	J. Harry Holmes.	S. A. Goodfellow, S. E. Bentley, G. D. LaCroix, P. Andette.
New Bedford	112,000	19	....	....	....	G	RD	11	108	E. F. Dahill.	W. S. McKay, Edw. Perkins, Bamford, Jos. Blood, Phllip Weare, Herbert Patten.
Newburyport	16,000	....	1	38	5	F	S	5	2	J. L. Lewis.	C. A. Bingham, Cy. Mgr.
Norwood	12,500	11	3	55	12	G	SD	2	3	J. F. Boyden.	B. P. Gallagher, Palmer Boleteo, Griffin, Geary.
Peabody	18,000	6	1	75	0	G	RD	5	11	J. F. Barrett.	Mayor, A. B. Curtis, H. J. Harding.
Quincy	40,600	17	....	91	10	F	D	6	34	Faxon Billings.	
Revere	30,000	6	....	....	....	F	...	5	25	A. L. Kimball.	

City	Pop	Area Sq. Mi.	Area Fire Limits Sq.m	Mi. Streets	Mi. Paved Streets	Condition of Streets	Water Service	No. Fire Houses	No. Full-time Men	Name of Chief	Members of Fire Committee Chairman Named First
Salem	4,300	8	...	....	....	F	D	6	43	H. C. Kimball.	F. W. Broadhead, J. L. Sheehan, J. H. Gruley.
Spencer	6,000			8	1/4	G	SR	2		J. W. Rogan.	
Taunton	36,161	50	50	150	....	F	SD	5	36	F. A. Leonard.	J. P. Carr.
Wakefield	13,000	8	0	18	12	G	....	4	6	W. E. Cade.	John Meloney.
Waltham	31,000	11	0.1	95	0	G	S	5	23	G. L. Johnson.	
Watertown	19,000	1	1	66	66	F	R	2	12	J. W. O'Hearn.	A. W. Bixby.
Wellesley	7,500	14	14	200	200	G	R	4	7	J. P. Doyle.	Board of Selectmen.
Winthrop	12,288	2	....	33	....	G	RS	3	8	F. W. Woollcott.	H. N. Bangs, F. G. Smith.
Woburn	16,410	10	...	55	....	F	...	3	12	F. E. Tracy.	W. R. Merchant, E. H. Marshall, J. F. McGovern, Lewis Menchin, J. P. Lynch.
Worcester	170,000	35	...	....	....	F	GD	18	212	W. N. Avery.	H. A. Cooke, E. W. Jenkins, C. W. Corbett, F. S. Clark, W. W. Lassey, H. A. Nash, J. V. Rafferty.
Michigan—											
Adrian	11,000	4	1/4	42	8 1/2	G	D	2	4	L. L. Knowles.	Mayor, A. D. Billings; F. T. Older, L. L. Knowles.
Albion	8,000	4	0.1	50	5	F	S	1	4	F. W. Griswold.	Cy. Mgr., Slocum.
Alpena	14,000	7 1/2	...	47	15	G	D	3	12	R. E. Wilson.	H. G. Robey, Cy. Mgr.
Battle Creek	35,000	6	1/2	....	....	G	SD	4	35	W. P. Weeks.	J. B. MacGregor.
Benton Harbor	11,000	2 1/2	3/4	45	12	G	D	1	6	Irving Clauser.	Wm. Jewell, Ed. Warner, Morse Hall.
Cadillac	10,000	7	1	50	18	F	D	1	4	J. T. Maxwell.	T. V. Stephens, Cy. Mgr.
Flint	75,000	6	....	325	32	F	D	3	42	E. H. Price.	F. R. Armstrong, Geo. Streat, John Collins, Frank Torrey, Homer Vetts, E. G. Frazer.
Grand Rapids	125,000	19	1	305	54	G	SRD	12	187	Geo. Boughner.	Wm. E. Elliott.
Hillsdale	5,001	5 1/2	1 1/2	38	5	G	D	1	2	R. H. Morlock.	David Gould, C. H. Tiller, Frank Johnson.
Holland	12,000	1	....	40	4	G	RD	2	2	C. Blom, Jr.	B. Mulder, Fred Jackson, John Schouten, H Brusee, D. M. Coak.
Iron Mountain	9,500	6	0.1	40	10	...	R	2	8	Lee Lalonde.	Potter Rule, J. Landercock, A. Bant.
Ironwood	19,000	....	....	....	....	F	SD	1	8	Will Boyer.	Adolph Mueller, Patrick Mullen, Gust Swanson.
Jackson	45,000	9	....	....	....	GF	D	5	41	B. F. King.	City Manager.
Lansing	55,000	8	1/2	150	19	GFB	S	5	45	H. R. Delfs.	C. M. Watson, H. T. Thomas, Homer Luse, C. Bennett, Lewis Imes, Geo. Walt.
Marquette	12,000	....	....	33	....	G	D	2	5	W. J. Johnston.	J. P. Werner.
Menominee	14,000	....	....	....	....	F	D	3	14	L. C. Collins.	Simon Bolin, Bruno Schultz.
Muskegon	35,000	6	1	115	43	G	D	6	27	Napoleon Belfy.	Mitchell Brown, Wm. Cayo, Peter Kemp.
Pontiac	25,000	8 3/4	....	....	15	F	D	1	15	J. B. Austin.	R. J. Lounsbury.
Saginaw	70,000	12	....	220	74	...	D	10	58	R. B. Hudson.	Mayor H. F. Paddock, Comr.
St. Joseph	6,000	....	....	....	....	G	D	1	....	H. G. Hughson.	J. J. Miller.
Traverse City	12,000	7	2	....	6	G	D	4	8	T. C. Murray.	G. W. Lardie, Comr.
Minnesota—											
Cloquet	7,031	3	0.8	19	1	G	S	1	8	Geo. Mayhan.	Frank Yetka, Andrew Norman.
Duluth	90,000	60	....	....	....	F	...	9	111	Joseph Randall.	B. Silberstein, Com. P. S.
Hibbing	15,000	1 3/4	1/2	22	5 1/2	G	DS	3	28	C. Mellhargey.	John Curren, D. D. Haley & Chief.
Minneapolis	354,000	53 1/2	9	882	250	G	R	30	425	C. W. Ringer.	L. N. Ritten, E. W. Hawley, E. J. Swerney, John Peterson, T. O. Dahl.
St. Paul	285,000	54	4 1/2	821	70	21	RD	23	312	Henry Devlin.	Henry McColl, Comr. P. S.
Stillwater	10,189	3	0.2	....	2	F	SD	1	8	Jas. McGann.	Mayor, J. R. Kollmer; M. L. Murphy, Ernest Torinna, Hugh Campbell, Roble Woerz.
Winona	25,000	9	0.4	....	....	G	S	4	31	W. C. Norton.	H. J. McConnon, J. R. Schooth, H. J. Willis, F. J. Buchholz, J. W. Jeneczek.
Mississippi—											
Greenville	12,500	4	1	....	1 1/2	F	...	4	18	E. V. Donovan.	J. E. Leppert, J. N. Croch, Joe Milzinski.
Vicksburg	22,000	10	0.2	45	12	G	S	6	25	J. W. Wilks.	W. H. Miller, W. J. Hossley, Mayor, J. J. Hayes.
Missouri—											
Carthage	12,000	4	1/4	....	2	F	D	1	7	S. S. Mathews.	L. S. Dunham, J. W. Rodd.
Columbia	15,000	6	1/2	96	25	G	D	1	4	E. N. Kurtz.	Percy Klass, E. B. McDonald, W. D. Shaw.
Hannibal	22,000	3 1/2	1	20	10	...	R	3	11	T. B. Parks.	John Snitzer, Comr.
Kansas City	350,000	60	10	1,100	450	G	D	26	396	J. C. Egner.	W. W. Harnden.
Moberly	15,000	3 3/4	1/4	100	28	G	R	1	4	J. D. Crews.	W. R. Butler, E. P. Hutchinson, O. R. Nise.
Poplar Bluff	11,000	8	0.1	20	7	F	SD	1	2	C. E. Langley.	I. D. DeLapp, C. E. Langley, Ed Patton, W. T. Morris.
St. Charles	10,000	2 1/2	3/4	30	2	F	D	2	4	Henry Hatchmeyer, Jr.	Henry Brocker, Herman Feldman, Ford Hallbruegge.
St. Joseph	80,000	13	7	200	110	G	R	16	100	P. P. Kane.	
St. Louis	.....	....	....	....	....	...	...	49	819	F. E. Henderson.	
Springfield	50,000	7 1/2	3	300	150	G	SD	4	43	W. R. Price.	Mayor Gideon.
Trenton	7,500	6	2	80	7	F	SD	1	1	G. Himen.	M. A. Christopher, Ben Hall, G. H. Titcomb.
Webb City	15,000	6	1	12	1 1/2	F	D	2	7	G. C. Wilson.	Ben Reynolds, Ed. James, M. Westerman, E. Culver, J. Schwartz, G. W. Crocker.
Webster Groves	10,000	4	0.1	70	50	G	D	2	7	R. M. Odien.	John Nolan, H. C. Ryan, E. Booth.
Montana—											
Anaconda	18,000	4	1	18	3	F	R	1	7	Chas. Collins.	Emery Kell, Jas. McCavitt, John Tierney.
Bozeman	7,500	4	1/4	43	8	F	R	1	3	W. G. Alexander.	E. J. Hines, M. J. O'Connell, J. N. Pratt.
Kalispell	5,000	2	0.2	17	2	F	R	1	3	C. D. O'Neil.	W. P. Twining, G. A. Brinkman, Jno. Fishel.
Missoula	20,000	6	6	....	4	F	R	1	9	P. F. Loffner.	T. E. Kemp.

City	Pop.	Area Sq. Mi.	Area Fire Limits Sq. m	Mi. Streets	Mi. Paved Streets	Condition of Streets	Water Service	No. Fire Houses	No. Full-time Men	Name of Chief	Members of Fire Committee, Chairman Named First
Nebraska—											
Columbus	6,000	1½	....	50	½	F	SD	3	0	A. J. Galley.	Frank Rudat, L. F. Rector.
Grand Island	15,000	4	4	200	8	F	D	4	5	T. M. Dillon.	J. E. Hanna.
Nebraska City	6,200	8	0.1	25	5	G	D	1	2	H. H. Bartling.	Bert Ryder, O. A. Roos, Herman Schomerus.
Norfolk	9,500	5	4½	45	10	F	S	3	2	V. A. Nenow.	E. Bruggeman, M. C. Fraser, Matt Shaffer, Jr.
Nevada—											
Reno	13,500	....	½	....	....	G	R	2	20	R. B. Hewcroft.	Robt. Nelson, P. Steffas, E. Twaddle.
New Hampshire—											
Concord	21,497	63	1	....	....	G	R	6	13	W. C. Green.	F. M. Dodge, G. O. Robinson, Roy Fraser.
Laconia	14,000	10	3	36	0	G	R	3	5	A. W. Spring.	C. E. Rowe, C. J. Avery, C. R. Davis.
Manchester	80,000	33	33	....	....	F	...	10	....	T. W. Lane.	H. R. Bennett, A. L. Garmon, H. L. Clough.
Nashua	30,000	27	7	....	....	G	D	4	28	C. H. Whitney.	H. C. Lintott, C. H. Austin, E. W. Duncklee.
Portsmouth	13,000	....	...	....	....	G	S	4	7	W. F. Woods.	Valentine Hitt, Clarence Smart, John Sullivan.
New Jersey—											
Elizabeth	85,000	10	4	128	64	G	D	10	75	Aug. Gerstung.	R. L. Patterson, Frederick Kurtz, Frederick Bender, C. Schandler, Otto Wagner.
Irvington	21,000	3	0	50	15	F	...	3	13	H. J. Groom.	Leonard Setaro.
Jersey City	271,000	19	19	203	142	G	D	27	350	Roger Boyle.	Frank Hoyne, Dir. P. S.
Passaic	65,000	3½	....	....	....	....	...	6	54	R. H. Bowker.	Jno. H. Kehoe, Comr. P. S.
Plainfield	30,000	5	1	30	30	F	...	4	5	T. O. Doane.	John Core.
Rutherford	8,500	....	....	....	2	G	SD	4	2	E. O. Farnum.	E. J. Kennedy, F. W. Sheaf, T. J. Johnson.
Trenton	106,000	....	....	....	....	G	RS	12	....	J. W. Bennett.	G. B. LaBarre, Dir. P. S.
New Mexico—											
Albuquerque	15,000	2	0.4	53	2	F	R	2	11	J. W. Burnett.	W. F. Switzer, S. S. Gilbert, C. G. Gibson.
Roswell	8,500	8	...	....	3½	F	D	1	6	Chas. Whiteman.	A. L. Whiteman.
New York—											
Albany	110,000	19	....	150	110	G	D	14	188	W. W. Bridgeford.	W. G. Knapp, Jno. Hawkins, M. Fisher.
Amsterdam	35,000	4½	2½	78	7	G	R	6	33	Wm. Stichel.	F. J. Blood, Jos. Nadler, John Hungerschafer.
Auburn	36,000	9	1	70	13	G	D	7	47	E. J. Jewhurst.	D. P. Swerney, Comr.
Batavia	14,000	....	....	....	7	G	D	2	7	W. H. McBride.	Geo. Winters, Hartley, Ware.
Binghamton	53,688	10	½	120	27	F	D	8	81	A. H. Lyon.	F. W. Spaulding, Comr. P. S.
Cohoes	24,000	5	1¾	31	13	G	...	5	22	T. C. Collin.	J. H. Mitchell, Comr. P. S.
Corning	15,000	....	....	....	....	G	R	2	10	J. W. McCarthy.	Mayor, G. W. Lane; V. L. Cole, H. J. Millspaugh.
Cortland	13,500	4½	1	57	25	G	SD	1	5	E. M. Eastman.	Edward Alley, C. E. Thompson, W. H. Gilbert.
Elmira	.....	7½	....	....	....	G	...	..	47	J. H. Espey.	H. N. Hoffman, Wm. Ufford, W. E. Sheive.
Fulton	12,400	....	3	40	10	F	SD	1	8	H. L. Waugh.	L. A. Richardson, John Cavanaugh, M. E. Mead.
Jamestown	38,000	10	BD	106	32½	G	R	6	40	H. S. Rodgers.	R. Y. Eden, Gust. Hultquist, Gust. Anderson.
Little Falls	15,000	26	....	25	15	...	...	2	5	E. J. Cooney.	Robert Nolan, T. L. Rogers, W. B. Shepardson, D. F. Cunningham.
Newburg	30,000	4	....	....	....	G	RD	9	....	Michael O'Brien.	John Sloan.
New Rochelle	31,758	12	12	....	....	G	...	6	28	James Ross.	J. P. Nestler, J. S. Adams, T. E. Winter.
Oswego	26,000	8	2	85	16	F	DR	4	18	R. G. Blackburn.	F. A. Schentgow, E. J. Andefinger, F. Gallagher, T. J. Kehoe.
Plattsburg	12,000	5	0.4	22	2	G	D	1	6	E. Seymour.	P. K. Knowles, R. H. Nash.
Rochester	250,000	....	....	....	....	G	GD	26	....	Charles Little.	R. A. Hamilton, Comr. P. S.
Rome	24,000	72	4	....	....	G	R	3	21	G. M. Bower.	H. C. Wiggins, E. S. Williams, E. D. Besley, N. H. Jones.
Schenectady	90,000	9½	9½	175	165	G	D	11	100	H. R. Yates.	J. E. Cole, Comr. P. S.
Solvay	5,500	....	....	....	....	G	R	3	0	R. R. Blair.	W. P. Kanar, Vil. Pres.
Syracuse	150,000	18	18	300	98	F	SR	17	215	T. F. Ryan.	W. W. Nicholson, Comr. P. S.
Tonawanda	10,000	....	....	....	....	F	D	4	6	C. R. Rech.	Alb. Lozo, Christ. Ackerman, Herman Licht.
Troy	80,000	10	...	160	75	G	R	17	85	Patrick Byron.	J. F. Cahill, Comr. P. S.
White Plains	20,000	10	10	74	5.6	F	SD	6	0	F. J. Keefe.	J. H. Calhoun, Comr. P. S.
Yonkers	95,000	21	....	145	114	G	R	10	126	J. J. Mulcahey.	Chas. Miller, J. S. Davis, F. H. Stillwell.
North Carolina—											
Asheville	26,000	6.7	0.5	105	37	G	R	1	7	J. H. Wood.	D. H. Ramsey, Comr. P. S.
Durham	23,000	4	½	....	....	F	D	4	26	D. C. Christian.	L. S. Christian, C. P. Norris, A. W. Sorrell.
Elizabeth City	12,000	4	0.3	25	12	G	D	..	2	J. B. Floro, Jr.	J. C. Commander, Cy. Mgr.
Greensboro	23,000	4	1	50	20	GF	R	4	14	F. N. Taylor.	R. M Reese.
High Point	13,000	4	¼	20	¼	B	S	3	6	E. K. Ingram.	A. Lyon.
New Bern	16,000	4	2	25	5	G	SD	2	6	S. H. Coward.	S. H. Scott, A. T. Dill, J. Crabtree.
Raleigh	30,000	4	½	60	20	G	SD	..	28	C. D. Farmer.	O. G. King, Comr.
North Dakota—											
Jamestown	.....	2	0.1	12	0	F	SD	..	1	J. G. Bensch.	Wm. Hall, W. R. Hilton, Wm. Noel.
Ohio—											
Alliance	20,000	4	0.1	58	35	F	D	3	15	J. E. Held.	J. H. Patton.
Ashland	10,000	5	4	55	14	G	S	1	2	Nathan Strauss.	Lloyd Mathews, Chas. Clark.
Bellaire	15,000	3	....	35	25	F	R	3	4	Jas. R. Fitton.	T. B. Phillips, Dir. P. S.
Bellefontaine	9,000	4	0.03	50	4½	F	R	2	7	H. S. Blair.	J. C. Brooks, J. C. Reinhart, Fred Spittle.
Canton	65,200	9	4	275	65	G	D	8	58	R. O. Mesnar.	R. J. Kunkel.
Conneaut	12,000	4	1	24	12	G	RD	3	11	T. J. Gough.	Martin, Risley, Fredericks.
Delaware	10,000	4	...	20	8	F	D	2	5	C. W. Keiser.	Chas. Owens, John White, Patrick Foley.
E. Cleveland	12,200	3	0	....	....	G	D	2	22	E. T. Woolway.	Jas. Sanborn, W. Merrick, Wm. Cowen.
Elyria	22,000	7	¼	60	44	G	D	3	24	W. N. Bates.	R. F. Vandemark, Dir. P. S.; Asaph Jones, John Carson, F. R. Cantle.
Gallipolis	7,000	1½	...	....	5	G	DR	1	2	W. R. White.	J. W. Miller, Dir. P. S.
Hamilton	40,000	5½	5½	60	30	G	RD	7	41	W. C. Dowty.	A. E. Egry, Dir. P. S.

City	Pop.	Area Sq. Mi.	Area Fire Limits Sq.m	Mi. Streets	Mi. Paved Streets	Condition of Streets	Water Service	No. Fire Houses	No. Full-time Men	Name of Chief	Members of Fire Committee, Chairman Named First
Lancaster	16,000	5	0.4	50	15	G	R	1	7	C. A. Landerfelt.	Joshua Clark.
Lima	43,523	7	1	125	45	G	D	4	35	J. C. Mack.	E. C. Rohm, Dir. P. S.
Lorain	35,000	10	2	84	35	F	D	8	31	D. E. Hatt.	M. J. Lesher, M. N. Walker, David Kelly.
Marietta	16,000	5	5	35	24	G	R	2	12	G. B. Holst.	T. E. Sayler, Dir. P. S.; J. Schultheis, L. A. Dickinson, Geo. Bonnell.
Marion	25,000	6	1.5	50	35	F	SD	3	21	T. J. McFarland.	
Newark	30,000	5	0.1	52	25	F	RD	4	22	Louis Bausch.	C. A. Bigbee, Dir. P. S.
Norwood	23,000	3	....	44	....	F	S	3	21	J. A. Geller.	L. O. Saur, Dir. P. S.
Painesville	8,000	3	0.4	25	16	G	...	1	3	T. W. Morgan.	D. J. Connell, Dir. P. S.
Portsmouth	32,000	2	....	40	39	G	R	3	26	G. L. Koerner.	W. S. Crummer, C. W. Wilson, Harold Rise.
Salem	10,000	2½	....	30	15	15	...	3	2	Wm. Bolen.	D. E. Sheehan, Dir. P. S.
Tiffin	15,000	5	0.1	50	25	...	D	2	13	A. D. Harris.	A. Litzenberger, Welter Fox.
Toledo	240,000	32	3.3	442	241	G	D	17	234	L. H. Elling.	J. C. Newton, Dir. P. S.
Wooster	8,500	3	0.1	33	15	F	RD	2	4	Ed. Snavely.	Wm. Long, Geo. Fisher, H. Rhodes, F. L. Steinmetz.
Youngstown	110,000	25	½	....	....	G	DS	10	92	J. Wallace.	Wm. Harrison, Wm. Reese, A. Shale.
Oklahoma—											
Guthrie	1,400	....	0.3	150	25	G	SD	..	12	Theo. Barnthouse.	R. N. Dunham.
McAlester	15,000	5.7	0.16	125	12	F	S	2	13	I. L. Holbrook.	J. I. Woods.
Oklahoma City	85,000	17	5	425	130	G	D	10	76	R. M. Brooks.	Ed. Overholser, Mayor; J. T. Highby, Comr. P. S.
Sapulpa	14,500	3½	3½	41	7	F	D	1	8	A. W. Smalley.	Don McMasters.
Shawnee	18,000	2	....	35	23	G	SD	3	10	L. A. Brown.	A. J. Cammack, Tom Adams, Dick Richards.
Oregon—											
Medford	10,000	4	1	40	20	G	D	1	6	J. W. Lawton.	John Mann, J. M. Keene, Frank Amy.
Pennsylvania—											
Altoona	52,127	....	....	63	41	F	R	9	58	T. W. Allemann.	W. C. Myton, Dir. P. S.
Berwick	5,000	1	1	25	1.5	B	RD	3	....	G. W. Brownson.	Herman Legevira, James Lee, E. A. Glenn.
Butler	25,000	3	3	40	30	F	R	2	12	J. W. Lefevre.	Jas. Orr, Jas. Green, Donald McDonald, Geo. Varnum, Henry Miller.
Carnegie	11,430	2	2	13	11	G	R	1	6	Robt. Edwards.	I. N. Dushane, J. L. Wright, D. B. Johns.
Coaldale	5,151	....	....	....	0	F	D	1	....	James Bynon.	John Willing, Sr., John Maguire, Fred Fudge.
Coatesville	15,000	5	....	30	½	F	RD	3	4	F. E. Soule.	H. M. Zook, Comr.
Connellsville	16,000	2	1½	29	12	F	RD	1	8	W. E. DeBolt.	M. B. Pryce, Comr.
Easton	32,000	3½	¾	60	8	F	RD	5	25	T. P. Ricker.	W. P. Strickland, Comr. P. S.
Erie	92,000	7	1½	130	67	G	S	9	106	J. M. Duerner.	Henry Kissler, Dir. P. S.
Franklin	10,000	7½	½	14	9½	F	...	1	2	F. D. Grimm.	Theodore Clulow, Dir. P. S.
Greensburg	20,000	3	3	27½	19½	G	...	6	0	O. F. Myers.	H. J. Hensell, Geo. Weightman, Robert Feightner, Harry Orr, Saml. McCrady, W. T. Dun, John Temble, W. G. Conners.
Hazleton	32,000	6	....	....	7½	F	R	3	7	L. J. Kepping.	W. J. Cullen, Jacob Martin, Chas. Bittenbender, Wm. Gerlach.
Homestead	25,000	1	¾	....	A	F	R	3	9	C. R. Bryce.	John Eicholtz, Frank Fulton, Wm. Hawley, George Milton, Thos. McGeven.
Jeannette	10,000	0.9	0.1	162	7	GF	R	3	4	P. C. Schlingmann.	E. M. Gaughan, J. Hart, G. W. Whiteman, Ed. Egan, Dr. Ringer.
Latrobe	10,000	1	1	....	....	G	...	5	0	J. L. Ackeman.	James Weimer, Geo. Creteau, S. J. Cennow.
Lewistown	10,000	....	...	....	....	G	...	4	0	Tim S. Johnson.	F. W. Sills.
Meadville	15,000	....	1½	33	26	G	R	4	5	Howard Dowdell.	Geo. Maxwell, Dir.
Munhall	6,000	....	....	20	15	G	D	3	2	E. M. Cox.	Chas. Menk, A. J. Tiley, Jas. Gifford.
New Castle	50,000	10½	0.05	112	45	G	S	7	27	F. J. Connery.	J. M. Hamilton.
Philadelphia	1,700,000	129½	129½	1,655	1,467	G	R	75	1,047	W. H. Murphy.	
Pittsburg	575,000	41	....	983	550	G	R	63	905	J. F. Richards.	J. P. Kerr, Pres. Council.
Pottsville	28,000	3½	3½	47	0.5	G	R	7	1	W. L. Stevenson.	J. O. Bearstler.
Rankin	9,000	¾	0	13	5	F	D	1	1	H. N. Fritzius.	Harry Johns, Wm. Watkins, J. K. Milligan.
Uniontown	19,990	21	½	30	16	F	R	2	6	G. H. Litman.	Robert Hogsett, Dir. P. S.
West Chester	13,250	....	1½	....	....	G	R	3	0	H. J. Griffith.	S. B. Darlington, H. R. Guss, E. S. Darlington.
Wilkes-Barre	75,000	4.8	2	100	500	G	R	7	67	Frank Hochreiter.	J. G. Schuler, Supt.
Windber	10,000	....	....	15	2	G	R	1	1	S. H. Mills.	Banks Eakins, G. Butterbaugh, John Hartman, Dan Mills, Harry Deitz, R. M. Gouchnor.
Rhode Island—											
Central Falls	22,000	1¼	1¼	17	1¼	F	RD	2	16	C. A. Wilbur.	F. D. Frerman, R. C. Simmons, Peter Clare.
East Providence	20,000	15	3	200	2	F	...	2	5	C. H. Simmons.	H. T. Ray, H. R. Adams, R. G. McMeehan, F. E. White, W. Van Arsdell.
Newport	30,000	7¾	2¾	....	....	...	...	5	36	A. J. Kirwin.	
Woonsocket	40,000	8.3	....	....	....	G	R	5	50	A. J. Cote.	Frank Girard, Chmn.; Fred Burton, L. J. Archambault, J. F. Carroll.
South Carolina—											
Columbia	4,000	4.7	2	123	11	...	SD	3	44	W. J. May.	F. S. Earl.
Spartanburg	22,578	7	0.2	120	14	F	D	1	15	W. D. Mitchell.	J. F. Hudson.
South Dakota—											
Aberdeen	12,000	4	½	125	6	G	D	2	12	E. I. Kingsley.	S. H. Lynch, Comr.
Tennessee—											
Chattanooga	75,000	7	....	....	....	...	...	8	73	Wm. Toomey.	T. C. Betterton, Comr.
Clarksville	12,000	4	3	....	0	GF	S	1	3	W. E. Bates.	Chas. Perkins, Sam Hodgson, C. D. Runyon.

City	Pop.	Area Sq. Mi.	Area Fire Limits Sq.m	Mi. Streets	Mi. Paved Streets	Condition of Streets	Water Service	No. Fire Houses	No. Full-time Men	Name of Chief	Members of Fire Committee, Chairman Named First
Jackson	20,000	5½	0.2	....	3	F	D	1	10	B. L. Warlick.	Lawrence Taylor, H. M. Harris, Z. K. Griffin.
Johnson City	13,000	32	5	50	26	F	RD	2	3	Berry Wilson.	Frank Thomas, P. M. Ward, Albert Miller.
Nashville	125,000	18	9	342	204	G	R	17	121	A. A. Rozetta.	Geo. J. Tompkins, Comr.
Texas—											
Abilene	15,000	....	0.2	165	56	G	SD	1	2	J. J. Clinton.	J. N. Fergison.
Amarillo	17,000	8½	½	65	4	G	D	2	7	H. B. Jones.	W. H. Hardin, Cy. Mgr.; J. N. Beasley, Lee Bivins, W. E. Cazzell.
Austin	40,000	16	½	270	13	F	DR	8	33	C. L. Woodward.	W. B. Anthony, Dir. P. S.
Beaumont	35,000	6	0.6	81	34	G	D	5	40	E. E. Eastham.	J. J. Hogan, J. T. Booth, S. W. Pipkin.
Dallas	135,000	20	1½	342	153	G	D	14	176	H. F. Magee.	R. I. Winfrey, Comr.
Denison	20,000	4	1	....	20	G	SD	2	9	J. C. Cooper.	
El Paso	62,000	10	....	....	....	G	R	5	55	J. W. Wray.	W. G. Jolly, J. W. Fischer, J. P. O'Connor.
Galveston	48,000	6½	5½	155	18	GF	...	9	81	J. H. Gernand.	A. P. Norman, Comr.
Houston Heights	13,808	....	....	....	....	F	S	1	....	Hugh Montgomery.	M. L. O. Andrews, Mayor J. B. Marmion.
Laredo	22,000	....	....	....	....	F	D	2	3	C. C. Biggio.	J. P. Leyendecker, J. F. Westbrook, J. Maher.
Marshall	15,000	9	¼	...	16	G	SD	3	6	T. S. Coleman.	N. O. Sawyer, Comr.
San Angelo	15,000	7	....	150	2¼	F	SD	1	5	John Parker.	Eli Wells, Jr., Cy. Mgr.
Sherman	14,480	4	0.4	42	12	F	S	2	16	G. R. Hamblen.	City Manager.
Texarkana	20,000	5	1½	50	40	F	D	3	19	W. J. Springer.	W. K. Grim, A. W. Kennedy, J. D. Sanderson, R. P. Deerough, Gene Cook.
Wichita	17,000	9	....	87	9	G	DS	2	6	J. L. McClure.	M. J. Gardner, A. J. Richolt.
Utah—											
Ogden	30,000	16½	3	....	....	G	G	3	24	G. A. Graves.	A. R. Heywood.
Vermont—											
Burlington	22,000	6	6	65	....	G	R	5	27	C. D. Stockwell.	F. E. Perkins, N. Laury, E. F. Nash.
Montpelier	8,000	8	8	59	10	G	R	1	5	W. A. Pattee.	P. H. Ryan, H. C. Shurlteff, R. H. Standish.
St. Johnsbury	8,000	....	4	40	0	G	R	4	4	H. J. Marden.	
Virginia—											
Charlottesville	10,000	8	6	10	6	G	R	1	3	T. I. Williams.	Mayor.
Roanoke	52,000	7	....	....	....	F	D	6	57	Jas. McFall.	J. H. Stuart, J. F. Turner, Jr., A. Seubert, G. T. Kesler, A. W. Howard, T. D. Maslow, Wm. McDermott, S. O. Porter.
Staunton	15,000	....	....	48	12	G	R	1	12	J. M. Bratton.	L. C. Ware, G. W. Fretwell, S. P. Sillings, G. A. Cottrell.
Washington—											
Bellingham	36,000	23	1	165	40	G	D	3	14	J. J. Marsh.	Otto Hagen, E. C. Harshman, C. B. Wight.
Everett	12,000	....	0.2	....	6	G	RD	2	9	W. E. Crawford.	J. S. McKee.
N. Yakima	18,000	3½	1	90	12	G	D	2	18	E. G. Dawson.	J. F. Barton, Harry Coonse, Wilbur Crocker.
Olympia	10,000	6	½	20	8	G	RD	1	6	B. H. Barnes.	L. C. Ramberg, Geo. Talcott, A. Yauger.
Spokane	125,000	40	1¼	465	69	G	RD	14	146	A. L. Weeks.	Mayor, C. A. Fleming.
Tacoma	104,179	43	6¾	299	104	G	RD	12	112	C. E. Carlson.	F. H. Pettit, Comr. P. S.
Vancouver	12,000	20	20	....	....	...	RD	1	17	C. E. McCall.	J. J. Padden, G. R. Percival, E. H. Mackey.
Walla Walla	20,000	3.7	0.6	65	20	G	D	2	22	Wm. Metz.	Mayor, M. Toner.
West Virginia—											
Martinsburg	12,000	2½	1	30	1	F	D	4	5	Martin Quinn.	J. T. Wolford, T. M. Dunn, G. B. Wiltshire.
Moundsville	12,000	4	4	27	18	F	R	1	2	H. B. Haddox.	F. T. Moore.
Wheeling	.....	....	....	....	....	...	...	..	....		Lee Hedges, J. H. Zink, Jas. Richards, Thos. Fox, Edw. Vaas, J. J. Kenney, D. A. Morgan, Wm. Kieldsing.
Wisconsin—											
Antigo	8,000	1	0.1	....	....	B	D	1	7	E. Billings.	Mayor Calhoun.
Chippewa Falls	10,000	9	¼	65	3	F	R	1	7	Joseph Meuli.	Otto Detthoff, Erick Myrman, Joseph Sokap, A. H. Jasper, J. M. Morris.
Eau Claire	20,000	12	1	60	10	F	D	4	20	J. P. Webb.	Mayor John Barron.
Fond du Lac	20,000	6	0.1	80	25	20	D	3	25	Chas. Doll.	John F. Hohensee, J. J. Breister, L. P. Peake, and Mayor.
LaCrosse	32,000	10	1	....	13	G	RD	5	51	F. C. McGlachlin.	Frank Kohn, Paul Mahoney, H. Roth.
Menomonee	5,500	12	3	30	3	F	S	2	3	J. E. Johnson.	J. R. Mathews, F. W. Rowe.
Merrill	9,000	5½	0.1	50	5	F	D	2	9	Andrew Milspaugh.	Richard Kamke, John Moe, Chas. Canfield.
Milwaukee	448,000	26	8 1-3	600	400	G	SR	36	567	Thos. A. Clancy.	Aldermen Meisenheimer, Campbell, Baumann, O'Connor, Bohn.
Portage	6,500	....	....	20	2	F	...	1	4	C. L. Niemeyer.	M. J. Downey, F. F. Goss, John Studemeyer.
Sheboygan	30,000	6	2½	85	28	G	D	4	28	W. R. Trotter.	Edw. Fisher, J. C. Meyer, Oscar Schnelderwand.
Wausau	18,000	6¾	1	120	19½	F	D	4	23	F. F. Zeilsdorf.	F. J. Gaetzman, A. V. Gearhart, Louis Garske.



Mechanical Agitation and Aeration and Trade Wastes in the Activated Sludge Process

In connection with the presentation of the American experiments on activated sludge process of sewage purification at the October convention of the American Society of Municipal Improvements, the following account of recent English experiments will be of great interest. It is from a paper presented at the recent meeting of the Association of Managers of Sewage Disposal Works at Sheffield, England, by John Haworth, F. S. C., manager and chemist of the Sheffield sewage works.

These experiments, carried on at Sheffield, are by no means complete, and have been retarded on account of shortage of staff and pressure of work due to the war.

While the primary effluents from the contact beds are usually incapable of putrefaction, at times colloidal solids separate out on standing, and they are particularly liable to this effect on account of the large volume of trade wastes, containing iron and other metallic salts, hydroxides and mineral acids discharged into the sewers and present in the sewage at the outfall works. Experiments were, therefore, commenced about four years ago in order to determine the most suitable and economical methods by which these primary effluents from the contact beds might be rendered at all times satisfactory. The experimental plant consists of tanks, pump, motor, etc.

Aeration—It was found that, on standing in contact with air, opalescent and cloudy effluents became quite clear after about twenty-four hours. Experiments were, therefore, made to bring about, if possible, the rapid deposition of colloidal and other solid matters with subsequent clarification. These experiments consisted of (1) Aeration by jets of air, (2) Aeration by forcing air thru porous substances, such as land tiles and silica bricks. (3) Aeration by causing the liquids to fall in sprays. (4) Aeration by rapid treatment on percolating filters of varying depths. (5) Sand filtration. (6) Precipitation by chemicals. All these methods produced the effects desired to a greater or less extent, but by no means of the percolating filter effluents of high purity, clear and free from colloidal matters, were obtained. Primary effluents have been regularly treated in this manner at the rapid rate of 800 to 900 gallons per day per cubic yard of material with satisfactory results over a period of at least four years.

The following chemical results may be taken as typical:

	Parts per 100,000. Sprinkler effluent.
Oxygen absorbed, four hours' test*	0.68
Nitric nitrogen	0.72
Dissolved oxygen test. Oxygen absorbed in five days at 18.3 deg. Cent.	0.63
Suspended solids	Traces only

*Liquid treated, 2.5:1.

The effluent, when diluted with tap water in the proportion of four effluent plus five tap water and the mixture aerated at 14.5 deg. Cent. (equal to two parts dissolved oxygen per 100,000) and then incubated for five days at 18.3 deg. Cent. invariably absorbed less than two parts of oxygen per 100,000, and was, therefore, well within the Royal Commission standard.

Whilst the early experiments which were made by forcing air thru porous substances, such as land tiles and silica bricks, did not yield such hopeful results, there was an incentive to continue the experiments, inasmuch as attention had then been drawn to the use of activated sludge in combination with aeration. Consequently, it was thought that useful information might be obtained by applying activated sludge to the treatment of primary effluents. In two of the experimental tanks, fitted with diffusers, sludge was activated by the usual method. In one tank primary effluents and mixtures of these effluents with settled sewage were dealt with, and in the other settled sewage was treated. The results have proved both interesting and instructive. In the case of the tank treating primary effluents with settled sewage, deposition of colloidal matters is obtained, but bearing in mind the large volumes of this liquid which can be dealt with on the percolating filter and the greater simplicity of the process, no advantage would be gained by adopting the former.

Briefly, the following are the results arrived at: (1) Well-clarified effluents are usually obtained which are within the commonly accepted limits of impurity allowable. (2) It is found that discharges of acid trade wastes, such as occur in the Sheffield sewage, destroy the efficiency of the sludge for a time. On one occasion a particularly strong discharge resulted in the activity being destroyed, and aeration for several weeks was required before clarified effluents could again be obtained. This inhibitory action is more or less pronounced, and, consequently, great care is necessary to render such abnormal discharges neutral in character and to equalize their flow so as to render such sewage amenable to purification by this process. A still more important point must be considered, namely, the effects of discharges of trade effluents containing and consisting essentially of chemical solids of heterogeneous composition upon the activated sludge. (3) The porous tiles became choked after a few months' use, owing to dust and grease in the compressed air, and also by bacterial masses growing thru the pores of the tiles. This latter fact has also been proved in connection with the Pasteur-Chamberland porous porcelain tube filter. (4) Uneven aeration occurs by reason of unequal porosity of the tiles. (5) Tiles have cracked, with the result that the air escapes at one place, and the tank has had to be stopped for repairs. This unsatisfactory feature in the use of porous tiles requires serious consideration. These unsatisfactory features lead one to the conclusion that, while sewage may be purified by means

of activated sludge, the mode of application leaves room for much investigation and improvement before its practical utility is proved. Experiments have, therefore, been made in connection with devices for the aeration of liquids without the use of porous media, and in this direction some of the latest experiments will now be described.

During a discussion on this question with Mr. F. Scudder, F. I. C., F. C. S., of Manchester, he described to me a series of experiments on the aeration of crude sewage which were made by him in 1881, in collaboration with the late Dr. Angus Smith, and called my attention to an apparatus designed for the oxidation of oils, etc., devised in the year 1880 by Dr. Storer, and which was used in Angus Smith's experiments. As a result of this, and with the aid of valuable suggestions by Mr. Scudder, apparatus has been constructed which promises satisfactory results, of which several small types may be seen in operation. The apparatus consists essentially of a narrow cylindrical tube placed vertically and fitted with a central spindle, bearing either an archimedean screw or a series of suitably shaped propeller blades. A number of the blades are within and others projecting below the lower end of the tube. The top of the cylindrical tube is placed at a suitable depth beneath the surface of the liquid to be aerated. On rotating the spindle at a rapid rate the liquid is merely circulated down the cylindrical tube, but on the insertion of a small air pipe within the edge of the cylindrical tube a large volume of air is sucked in and distributed into the liquid at the lower end of the cylinder. The mixed water and air rise up on the outer side of the tube ready to flow in again, and thus the aeration is continuous. The apparatus is at present experimental in character, but, as a mechanical means for circulating the sludge and at the same time giving abundant aeration, has so far proved to be simple and effective without many of the disadvantages to which aeration by forcing of compressed air thru porous slabs, etc., is liable.

It should be observed that two functions are performed by the air in the activated sludge process as now operated, viz., primarily, the supply of oxygen for maintaining the bacteriological and chemical action and efficiency of the sludge; and, secondly, the agitation of the sludge with the liquid. As only a small proportion of the air is used for oxidation, and the larger proportion for circulation, it becomes questionable whether it is economical to use compressed air for purposes of agitation, or if mechanical agitation, which would carry in probably the minimum amount of air necessary, would work as efficiently as the more expensive compressed air plant.

With this aim two further experiments were devised: (1) A series of perforated ordinary steam pipes was laid at the bottom of a small tank and connected to the compressed air supply. Over the pipes approximately 2 feet of clean clinker or slag broken into approximately ¾-inch cubes was laid. The tank was then filled with settled sewage and air bubbled thru for about five hours. The resulting effluent was found to be clarified, non-putrescible, and in all respects a satisfactory one. A partially septic and black tank liquor treated by this method becomes bright and clear after one hour's aeration, and after four or five hours is amply purified. One of the tanks has been in daily operation for about nine months and continues to give good results.

	Parts per 100,000. Effluent.
Oxygen absorbed, four hours' test*	0.92
Nitric oxygen	1.15
Dissolved oxygen test. Oxygen absorbed in five days at 18.3 deg. Cent.	1.89
Suspended solids too small to estimate in 250 c. c. of liquid.	

*Liquid treated, 4.97.

The effluents when diluted with tap water in the proportion of four effluent to five tap water, aerated at 14.5 deg. Cent. and then incubated for five days at 18.3 deg. Cent., with a few exceptions absorbed less than two parts of oxygen per 100,000, thus being within the Royal Commission standard.

(2) The second experiment consisted of a small iron tank having a semi-circular section at the bottom. A shaft was fixed lengthwise thru the tank, and to it were attached two hollow paddles of special shape, so arranged that in the lowest position the paddle nearly touches the bottom of the tank, and in the upper position it is approximately at the top of the tank. The tank was charged with humus washed from material taken from a contact bed together with sewage, the proportionate volume of humus being 25 per cent. of the sewage. When the paddle is rotated the blades leave the liquid at the surface and trap a small volume of air, which is carried into the liquid and discharged therein. Thus the mixture of humus and sewage is kept continuously in motion and a definite quantity of air is discharged into it by each revolution of the paddle. The paddle is revolved fifteen times per minute. After several weeks' operation the humus was found to become fully activated, and during the last six months crude sewage has been treated daily with satisfactory results, as the analytical table indicates:

	Parts per 100,000. Effluent.
Oxygen absorbed, four hours' test*	1.17
Nitric nitrogen	0.66
Dissolved oxygen test. Oxygen absorbed in five days at 18.3 deg. Cent	0.57
Suspended solids too small to estimate in 250 c. c. of liquid.	

*Liquid treated, 4.81.

The effluents, when diluted with tap water in the proportion of four effluent to five tap water, aerated at 14.5 deg. Cent., and then incubated for five days at 18.3 deg. Cent., invariably absorbed less than two parts of oxygen per 100,000, thus being with the Royal Commission standard.

The results of these two experiments show that the aeration by minute bubbles of air, such as thru porous tiles, is unnecessary, and that the mechanical circulation, combined with minimum aeration, is efficient. Both these experiments are still in operation.

The general conclusions drawn from the experiments which have been described may be summarized thus: (1) That a normal sewage may be purified by the activated sludge process. (2) That trade wastes may interfere seriously with the process. (3) That further investigation is needed with respect to modes of application of the sludge to the sewage, periodical removal of the surplus sludge and the effect of such removal on the continuing results of purification methods of aeration, costs of plant and upkeep, before older plants and methods can be abandoned. (4) That skilled control of the process will be essential. (5) That while the resulting sludge is undoubtedly richer in nitrogenous organic matter than ordinary sewage sludge, it remains to be proved by actual agricultural trials that such nitrogen is in a form suitable for the ready assimilation by plant life, and that as a fertilizer its superiority over humus can be established, as up to the present humus sludge derived from sprinkler filters, which is also richer in nitrogenous organic matter than ordinary sewage sludge, has not been appreciated by the agriculturist as a fertilizer, in spite of its availability in large quantities at many sewage works in this country during recent years.

ROADS AND PAVEMENTS

Efficiency and Economy in Road Construction

By W. H. Recd.

The main highways of a county should be paved first. The paving of any feeders before the main arteries are paved means the sacrifice of the welfare of the many for the benefit of the few. Therein is vested the essence of good or bad government. Wherefore, a board of county commissioners should not permit themselves to be swerved by any group pressure or "my district's interest" or vote promises or vote threats from first paving the main highways. Very few are seeking the general welfare at a sacrifice of their individual, selfish interests. Otherwise good government would not be so remote.

The township system for road construction is a most serious obstacle to the paving of the main highways first. I consider it bad from every viewpoint: Self-centered, multiplies supervisory powers, which makes for greater cost and inferior work; increases nepotism and favoritism in the construction crew. Fortunately, Spokane and Whatcom counties are the only ones in the State of Washington having the township system. It's a relic—primitive. The district plan prevailing in Washington is bad enough.

Efficient Officers of First Importance.

The annual outlay for pavements by five states in 1915—not counting county and city expenditures for pavements—was, approximately, $26,000,000. Complete figures for all the states are not obtainable. In such enormous expenditures there is an opportunity for great loss. There is such loss. Why? Inefficiency; lack of thoroness. All standard types of pavement are good if properly constructed. All are bad if improperly constructed. Any standard type of pavement, thoroly well maintained, should last twenty years or more. If thru faulty materials, specifications or workmanship such life is reduced one-half, as frequently occurs, as does occur on the average, then the public loss in the United States is no less than $50,000,000 per annum.

Hence, obviously, the thing to do of first importance to avoid such misfortune is to elect officers who are to have supervision of the paving work on the basis of efficiency. If you of Oregon put your men in office on that basis, you vote on a different basis from that of any other state in this Union. I know that when I was elected county commissioner of Pierce county, Washington, I displayed a lack of ability in certain directions amounting almost to genius. In my statements to you Oregonians I wish to avoid being too realistic, but the truth is, my ignorance on some questions did, because of my chagrin, make me perspire.

Our Intelligent Method of Selecting Officials.

In Washington we vote for the candidate on the following basis: First, because he belongs to "our party," which may be, fortuitously, a Republican, Democratic, Bull Moose, Moonshine or Evergreen party. Second, and commonly a close second, too, we vote for the candidate because he belongs to or will favor our church, or because he is anti-church; or will favor our lodge, or grange, or union, or Spanish war veteran organization, or "is good looking," or "speaks to our baby." The surprising part in it all to me is not that the result is so bad, but that it is not much worse. If railroad companies, manufacturing plants or any other business organizations chose their managing men on a similar basis, they would "go broke" in short order. You may think I have strayed from the pavement part of my subject. I haven't. In your public officer exists an essential, the necessary foundation, for good pavements. It may be futile to order water to run uphill, but it is no more so than to expect the uninformed to intelligently direct.

Trained Consideration of Paving Types.

If you have selected your officials, engineers, county judges and commissioners, on the basis of efficiency, such officers will consider the paving question somewhat along the following lines:

First: Creosoted wood blocks and brick pavements cost most. Does the country road traffic warrant such expenditure? Next in cost come, in the following order, bitulithic or warrenite, sheet asphalt, bitucrete, cement concrete. Does the traffic census, taken on the proposed highway, warrant the construction of any one of these pavements?

Second: Which of these pavements is the most durable and would have the lowest maintenance cost? These officials would know, having been elected on the basis of efficiency, that brick pavements, properly constructed with first-class paving brick, will last, because they have lasted, twenty-five years; and that the yearly maintenance expenditure on such type of pavement for country traffic would be about $100 per mile.

Sheet asphalt: They would know by service test that a properly built sheet asphalt road is good for twenty-five years' wear, with a maintenance cost of about $100 per mile per year; that in every way it is a first-class pavement for country roads if properly built, with but one drawback—that of slipperiness under a light rainfall. This defect we have remedied in Pierce county at an additional expense of 6½ cents per square yard, by covering it with "roadamite," ¼ gallon to the square yard, heavily sanded with coarse torpedo sand.

Warrenite or bitulithic: This patent was issued in 1903, and, therefore, there is no service proof that it would last twenty-five years; but these officials would be able to reach a fairly well-founded conclusion on the basis of performance of various well-constructed examples of this type, to the effect that it would probably last twenty-five years, their chief doubt arising from its tendency to disintegrate by reason of bleeding, its volatile oils being drawn to the surface by capillary attraction of the sun. Its annual maintenance cost would be $100 per mile.

Bitucrete: This type of pavement has not been construct-

ed long enough to afford a reasonably fair basis for a conclusion as to the life of its wearing surface. Its cement concrete base is certain, if properly constructed, to be good for many more than twenty-five years, which should also be said of a bitulithic or warrenite pavement having a cement concrete base.

Cement concrete: With the exception of the concrete pavement, 10 feet wide and 220 feet long, built in Bellefontaine, Ohio, in 1893-4, which I do not consider adequate evidence, there has not been built any cement concrete pavement for a sufficient number of years to enable any one to know that its surface wear is good for twenty-five years. In my opinion it isn't, no matter how well constructed, so long as there is any considerable number of iron-shod wheels used on vehicles. We know that cement concrete becomes gradually harder with age, extending on for many years, very slowly after the first thirty days, with a gradual increase in the slowness of additional hardness. When the surface wear by abrasion requires a covering of sheet asphalt, bitulithic or warrenite, bitucrete or a blanket coat, then we have in the cement concrete pavement, without additional cost, the best known base. The maintenance cost of a cement concrete pavement without asphaltic surfacing would be about $50 per year per mile. Tho, in Pierce county our best built cement concrete pavements have had a maintenance cost, on one of six miles, of $22 per mile per year, and on another, a six-mile extension of the same road, of less than $9 per mile per year so far. The first-named six miles was built in 1913; the second-named, better specifications and a little better workmanship, in 1914.

Third: These capable commissioners, having reached this point in their reasoning on the pavement problem, will begin to figure interest on the investment in each, with the above basic factors before them, in about this way: If one type costs two and a half times more than another, the interest on the more expensive type will be two and a half times greater; hence the lower cost pavement, if it is certain to last half as long and its maintenance cost has proven to be no greater than that of the more costly type, would undoubtedly be the better investment. If the lowest cost pavement is certain to have a surface wear one-half as long as a type costing one-half more to construct and its yearly maintenance cost is about one-half that of the other, and it is known in addition that when the lower cost type should require an asphaltic wearing surface there is in hand the best-known base for such surfacing, then, logically, these officials will at this point, ask themselves: Why not save the interest on the cost of the asphaltic surfacing for all these years up to the date when such surfacing is required?

You will notice that I have not mentioned for consideration the water-bound macadam type; nor the type bound by asphalt under the penetration method. My reason for overlooking these types was that I am reasonably sure your commissioners, whom you have elected on an efficiency basis, would know that with the advent of the automobile with its speed suction these types were no longer to be considered; that their construction cost, 16 feet in width, would be $7,000 to $9,000 per mile, with a *maximum* life, if properly constructed, of three years; whereas, a cement concrete pavement, properly constructed of same width would cost but from $9,000 to $12,000 per mile, have a minimum wearing-surface life of seven years by service test and would afford a base good for 100 or more years and a maintenance cost of seven-eighths less than any type of macadam.

Are Constructing Pavements Fast Enough.

When the hard-surfaced roads now under construction in Pierce county, Washington, are finished, we will have 62.44 miles of paved roads; being 22 miles of cement concrete pavements, 17.14 miles of bitulithic, 8.47 miles of sheet asphalt, 8 miles of granitoid, 6.06 miles of bitucrete, 0.75 miles of brick. These pavements are all 16 feet wide. The bitulithic average cost, exclusive of subgrade, was $12,918 per mile; sheet asphalt, $12,251; bitucrete, $12,101; granitoid, $13,143; brick (No. 2), $16,791; cement concrete, $8,026.

Pierce county hasn't any road bonded indebtedness. Nor has the state of Washington—Thank God, and Governor Lister!—nevertheless, Washington is fourth in the Union in country pavement mileage, with California third. In my opinion, we are building our pavements fast enough. We will all know better how to construct pavements within the next five years. There is much yet to be learned in pavement construction. We will know far more of the chemistry of materials within the next five years. On pavement construction, we are just waking up. I believe we will make progress faster by going slower.

The people of Washington are now and have for several years been taxed about $7,000,000 per year for state and county highway construction and maintenance in addition to an aggregate of approximately $5,000,000 in county road-bond issues.

The state of Oregon expends, approximately $235,000 each year, from the state fund, on road surveys and construction. The counties of Oregon spend on roads, per year, about $4,000,000, not figuring the bond issues of $400,000 for Clatsop county; $375,000 for Columbia county; Hood River, $75,000; Multnomah, $1,250,000; Jackson, $400,000, and $362,000 for Coos county; all these voted for within the last three years, and all these funds expended in construction, excepting those of Coos county, which were but recently authorized.

Standard Form for Making Traffic Counts

The importance of the traffic census in the design of street pavements is now generally recognized. The report upon a standard form, made to the American Society of Municipal Improvements by a committee of which J. C. Hallock, of Newark, N. J., is chairman, is therefore very timely. The standard form was adopted after a careful study of the methods and forms of report used in the eight or ten cities which make traffic counts and represent the best practice at the present time.

Newark makes regular census counts once in 3 years, Baltimore, Brooklyn, Buffalo and St. Louis make them annually and Philadelphia every 3 months. The count is made for 3 days at each point in Buffalo and for 4 days, Friday to Monday, in Philadelphia.

The form of blank for keeping count which is adopted by the American Society of Municipal Improvements is headed "Traffic Census Observation Report, ——— City, ——— department; with spaces for statement of direction of travel, street on which count is made and between which it is passing; date; weather; name of observer; kind of pavement; and condition of pavement, whether clean or dirty, damp or dry, slippery or safe. The columns are headed for the hours from 8 a. m. to 7 p. m., with two blank columns for later observations if desired.

The traffic is divided into classes with one line for each subdivision:

1. Iron tired vehicles; 1-horse vehicles, light and heavy, 2-horse vehicles, light and heavy, 3 or more horse vehicles, and total.
2. Street cars.
3. Rubber tired vehicles; motorcycles or bicycles; passenger vehicles, 2-passenger, 3 or more passenger; freight vehicles, large loaded or empty, small loaded or empty, and total; and grand total.

The blank thus has 16 lines for making records and 13 columns.

For card records a form is provided for each street on

which count is made and each pair of streets between which the traffic passes which is counted.

All the counts made at a given point are entered on one of these cards so that the traffic at different dates can be counted directly. The columns are headed: Date, Kind of Pavement, Date Laid, Width of Road, Wet or Dry, No. of Hours; the vehicle data are given in Total per day for Horse, Motor and Total; Average per hour for Horse, Motor and Total; Maximum per hour in Number and Hour; Average per minute per foot width of pavement for Traveled Width and Total Width; the tonnage data are given in Total per Day, Average for Vehicle, Average per minute per Foot Width of Pavement, and Total per year per Foot Width of Road; there are columns also for per cent. of traffic Horse and Motor, for Number of Street Cars, and for Traffic Units per Minute per Foot Width of Road.

Good Roads Notes

New Jersey is considering the passage of a law authorizing the issue of $7,000,000 to pay for the construction of thirteen main thru highways and proposes to pay off the principal and interest out of the fees for motor vehicles. These amount now to $1,500,000 a year and increase about 25 per cent. each year. This novel plan for paying for this reconstruction seems equitable, especially so far as truck travel is concerned, since it is made necessary by the enormous increase in number and weight of such vehicles using the main roads.

New Paving Scheme in Georgia

By J. B. Ansley, City Engineer and Supt. Water Works, Americus, Ga.

The city street force, composed of convict labor, under the direction of the writer, is laying considerable concrete street pavement in the residence section of the city of Americus, Ga.

As an inducement the mayor and City Council have agreed to do the grading, hauling, mixing and laying of pavement free of cost to the propertyholders on condition that the property owners pay for the material constituting the pavement. As a result several residence streets are being paved. It is stipulated that 60 per cent. of the property owners must petition the mayor and City Council to pave the street upon which their property abuts before any street can be paved, and, upon the compliance with this rule, an ordinance is passed granting the request and work of paving commenced within thirty days.

The class of pavement is a 1-2-3 mix, one course concrete pavement; 5 in. thick at the curb line and 7 in. thick in the center, with a crown of 6 in., reinforced with American Steel & Wire Company 29R triangular mesh wire. ½x5-in. Elastite for expansion joint along curb and two thicknesses of one-ply tar paper (left ½ in. under surface) for transverse joints spaced 35 ft. apart, street widths varying from 35 to 40 ft.

The concrete is being mixed and placed with a No. 16 Koehring paver equipped with 20-ft. boom and bucket and gasoline engine, owned by the city. The surface of the pavement is finished by rolling while green with a light hand roller and dragging off with ¾-in. rubber hose. An average of 500 sq. yds. per day is the progress made. As stated, the city is doing the work of grading, preparing of the sub-base, hauling off all the material and mixing and placing concrete with its regular street force of teams and convict labor, free of cost to the property owner; but the entire cost of the material for the pavement is paid for by the property owners abutting, one-half being assessed against owners on either side of the street paved, the city itself paying for all street intersections. The city is not put to any extra expense for this work, regarding it as an actual economy in that every street so paved relieves the force of the maintenance of that street as a sand-clay proposition. Besides that, the residences along the paved thorofare are relieved of the dust nuisance from automobile and other vehicle traffic. The approximate cost to the property owner is $1.00 and to the city 25c per sq. yd.

We find that the convict labor employed in street paving and other work is more efficient than ordinary free labor, inasmuch as the convicts are more careful to carry out instructions and more interested in the work than is usually the case with free laborers.

The accompanying photos give a fairly clear idea of the methods employed in the placing and finishing of the pavement.

MISCELLANEOUS

Meetings of Organizations

Dec. 11-13, at New York. Portland Cement Association.

Dec. 14, 15, at Syracuse, N. Y. Conference for Better County Government in the State of New York. O. E. Cartwright, 15 Court street, White Plains, N. Y.

Dec. 26-28, at New Haven, Conn. Society of American Bacteriologists. Dr. A. P. Hitchens, secretary, Glen Olden, Pa.

Dec. 26-31, at New York. American Association for the Advancement of Science. L. O. Howard, secretary, Smithsonian Institute, Washington, D. C.

Dec. 27, 28, at Tulsa, Okla. Oklahoma Society of Engineers. H. G. Hinckley, secretary, Oklahoma City.

Dec. 27-29, at Columbus, O. American Statistical Association, American Economic Association and American Sociological Society. Prof. Carl E. Perry, Ohio State University, Columbus, O., chairman of local committee on arrangements for the joint meeting.

Dec. 27-29, at Chicago, Ill. American Society of Agricultural Engineers. D. K. Shedd, secretary, Ames, Ia.

Dec. 28-31, at Cincinnati, O. American Political Science Association. C. L. Jones, secretary, University of Wisconsin, Madison.

Dec. 29, in assembly hall of the Automobile Club of America, New York City. Conference on road engineering education, under auspices of the Society for Engineering Education, American Association for the Advancement of Science, National Automobile Chamber of Commerce, Automobile Club of America and National Highway Association.

Jan. 20, 1917, at Kansas City, Mo. Western Paving Brick Manufacturers' Association. G. W. Thurston, secretary, 416 Dwight building, Kansas City, Mo.

Jan. 23-25, 1917, at New York. American Wood Preservers' Association. F. J. Angier, secretary, Mt. Royal Sta., Baltimore, Md.

Feb. 7-19, 1917, at the Coliseum, Chicago, Ill. Tenth Cement Show.

Feb. 8-10, at La Salle Hotel, Chicago. American Concrete Institute. H. D. Hynds, secretary, 30 Broad street, New York.

Feb. 12, 13, at Sherman Hotel, Chicago, Ill. National Builders' Supply Association. L. F. Desmond, secretary, 1211 Chamber of Commerce, Chicago, Ill.

Municipal Bond Market

The sales of municipal bonds in October were four million dollars greater than in any previous October, being $37,898,233. The next highest sales figure was in 1913, and this class has now fully recovered from the effects of the war. This is true as to price as well as volume of sales, and bonds are now getting back toward the level of 1905, when the 3½ per cent. bonds of the larger cities sold at a premium. The net income basis now is well below 4 per cent. *The Bond Buyer* is the authority for these statements, and that periodical pays special attention to municipal bonds of all kinds, as they are now the most popular form of long-time investments.

American Steel Pipe

A recent article in an English paper devoted to the iron trade goes into considerable detail in comparison of American and English welded steel pipe used in pipe lines in Egypt, very much to the credit of American pipe. The points of advantage of American pipe are the standardization of sizes in the smallest number possible, the larger threads by which joints are joined together, the better protection of these threads in shipment, the better design of these junctions, all of which result in better pipe, pipe more easily and safely handled, and a very material reduction in cost, notwithstanding the much higher cost of American labor. One very material advantage as to cost of pipe in place is found in the American system of using one class of pipe for all uses, whether gas, steam or liquid under pressure, the only differences being for differences in pressure to which the pipe is to be subjected, and none being made for differences in material carried.

Modern methods of welding add enormously to the availability and applicability of steel and wrought-iron pipe, since now any sort of connection can be made successfully and any kind of bends or twists, without fear of leaky joints. Electric, blowpipe and thermit welding are all used, and the welded pipes can be made quite as flexible and strong as the original short lengths of pipe, 20 feet each, approximately.

Some very interesting examples of pipe welding by the various processes are shown and described in Bulletin 26 of the National Tube Company, of Pittsburg. The processes are applicable to the joints of pipe laid in water, gas or steam lines in trenches or conduits.

To protect the pipes from corrosion they are very carefully coated. The pipes are made of a special soft steel having a very high degree of uniformity, and are Spellerized by a process of hot forging during manufacture, which makes the surfaces more uniformly dense and resistant to pitting. This steel pipe, cleaned and dried and still above the boiling point of water in temperature, is dipped into a special refined bituminous compound and kept there until its temperature is brought up to that of the bath. Then the enamel-like surface is wrapped with a strip of fabric, thoroly saturated with the hot compound, being wound round spirally with about an inch overlap on each turn, the thickness of one-ply coating being about 3 64 inch, as compared with 0.01 inch or less thickness of the ordinary bituminous coating. For special difficulties in transportation, handling or use the coating can be applied in as many thicknesses as may be desired. The machinery for wrapping the pipe makes a very ingenious application of mechanical principles. It is shown in another booklet of the National Tube Company.

Outline for the Study of Bitumens

Arranged in convenient question and answer form with space for additional memoranda, The Barber Asphalt Paving Company has published an "Outline for the Study of Bitumens." While the whole subject of bitumens is covered, the Outline has been prepared with especial reference to the asphaltic materials used in highway construction. In addition to the answers provided in the Outline itself, there are references to most of the standard text books on highway engineering. While prepared especially for school use, the Outline is a convenient means of reference for anyone who finds it necessary to investigate the differentiation and characteristics of bitumens.

Commission-Manager at St. Augustine

In 1915 the new charter of St. Augustine, providing the commission-manager form of city government, was adopted by a majority of but 18 votes. Since that time there has been much criticism of the form of government by those interested in retaining the former system, but notwithstanding much activity of this sort, the candidates for the city board pledged to the present form, with slight modifications, were elected by a vote of more than 2 to 1, the average majority of the candidates being 329. The present commissioners, up for re-election, led the ticket, showing that the criticisms were not those of the people at large.

Civil Service Examinations

The U. S. Civil Service Commission will hold examinations at the usual places as follows:

Dec. 5: Associate ceramic chemist in the Bureau of Standards, Pittsburg, Pa., at $2,000 to $2,500 a year.

Dec. 11: Designing engineers in Bureau of Yards and Docks, Navy Department, Washington, D. C., at $10 to $15 a day.

Dec. 13, 14: Assistant inspector of weights and measures, in Bureau of Standards, Department of Commerce, for field work, at $1,000 to $1,600 a year. Assistant engineer, inspector of weights and measures, same office, same salary. Laboratory apprentice, same office, at $480. Structural engineer and draftsman, supervising architect's office, Treasury Department, at $1,600 to $1,800 a year.

Personal Notes

Charles L. Pillsbury Company, consulting engineers, of 805 Metropolitan Life building, Minneapolis, Minn., and 716 Capital Bank building, St. Paul, Minn., are now associated with Vaughn & Meyer, consulting engineers, 1007 Majestic building, Milwaukee, Wis., and together cover a wide range of engineering activities. Mr. Vaughn will have his headquarters in Milwaukee, and Mr. Pillsbury and Mr. Meyer will have headquarters in Minneapolis. There are no changes in designations of firms.

Manley Osgood, city engineer, Ann Arbor, Mich., has formed the Washtenaw Engineering Company, of which he is president, which will devote itself to the various lines of municipal engineering and accounting and surveying, with offices at 408 First National Bank building, Ann Arbor.

Sanford E. Thompson, consulting engineer, especially in reinforced concrete, steel, and economical plant operation, has combined his offices at Newton Highlands and Milk street in one which he has located in the Federal Street building, Boston, Mass. Mr. Thompson has full laboratory facilities.

Technical Schools

By a co-operative arrangement with the International Railway Fuel Association the United States Bureau of Mines and the Railway Engineering Experiment Station of the University of Illinois, a series of tests of various sizes and grades of coal for fuel is in progress and the Baltimore & Ohio Railroad has loaned a new Mikado type locomotive for testing the fuels under conditions of actual use of Illinois coal from 2 by 6 lump to impalpable powder, one study being of the relative smokelessness of the methods of burning the coal.

The fourth annual short course in highway engineering at the University of Illinois will be held January 8 to 19, 1917. The program will include men well known in the field of highway engineering. There will be courses in continuation of the work of last year, as well as for those coming for the first time. No fees and no examinations.

Association Notes

At the annual meeting of the American Road Builders' Association, held in New York November 3, announcement was made of the election of Arthur W. Dean, chief engineer Massachusetts State Highway Commission, as president; W. H. Connell, A. B. Fletcher, A. H. Blanchard, vice-presidents; E. L. Powers, secretary; W. W. Crosby, treasurer; T. R. Agg, W. E. Atkinson, F. E. Ellis, R. H. Gillespie, B. Michaud, Paul D. Sargent, directors for three years. At the following dinner about 100 members and guests were present.

Publications Received

Bulletin 90 of the Engineering Experiment Station, University of Illinois is on "Some Graphical Solutions of Electric Railway Problems" and is by O. M. Buck.

Clifford Richardson's paper before the Western Society of Engineers at Chicago, November 20, 1916, on the "Importance of the Relation of Solid Surfaces and Liquid Films in Some Types of Engineering Construction," has been issued in an 8-page pamphlet.

Progress reports of experiments in dust prevention and road preservation in 1915 are printed in Bulletin 407 of the U. S. Department of Agriculture, being a professional paper from the office of Public Roads and Rural Engineering.

The first number of *The County Commissioners' Magazine*, published at Milwaukee, Wis., has been received.

Reprint from Journal of Agricultural Research of paper by Charles S. Reeve and Fred P. Pritchard on a new penetration needle for use in testing bituminous materials.

Glimpses of our National Parks are given in a booklet with that title published by the U. S. Department of the Interior, Washington, D. C.

Elements of Highway Engineering, by A. H. Blanchard, professor of highway engineering, Columbia University. John Wiley & Sons, New York.

Engineering as a Career, a series of papers by eminent engineers, edited by F. H. Newell and C. E. Drayer. Cloth, 226 pp., $1. D. Van Nostrand Co., 25 Park Place, New York.

City Planning; a series of papers presenting the essential elements of a city plan, edited by John Nolen. Cloth, 447 pp., $2. National Municipal League Series, Appletons, New York.

Regulation of Railroads and Public Utilities in Wisconsin, by Fred L. Holmes. Cloth, 375 pp., $2.16 by mail. Appleton's Railroad Series, D. Appleton & Co., 35 West 32d street, New York.

The Carnegie Library of Pittsburg has issued a 42-page booklet, giving a bibliography of books and magazine articles on "Road Dust Prevention."

A paper on the concrete road by Edward N. Hines, chairman of the board of county road commissioners of Wayne county, Mich., read before the Portland Cement Association meeting at Detroit is in one of the series of booklets issued by the Portland Cement Association, 111 West Washington street, Chicago, Ill.

MACHINERY AND SUPPLIES

Self-Propelling Grab-Bucket Crane, Excavator and Unloader

The "auto crane" shown in the accompanying illustrations has been built for adaptation to a wide variety of construction purposes, including excavation, ditch-digging, back-filling and the loading and unloading of gravel and similar bulk material at a time-saving over hand methods. For road work the machine has a notable use in transferring stone from cars to bin as is shown by the photograph, which was taken on a Vermillion county, Illinois, job, for which the P. M. Johnston Company, of St. Elmo, Ill., was the contractor.

The other illustration shows how F. C. Theselius, big Chicago contractor, uses the "auto crane," which he says is "the only unloading machine allowed by railroads here on public team tracks."

The total weight of this traction derrick is 19,500 lbs. It has a lifting capacity of 4,000 lbs. and dimensions that bring it well within highway and railway clearances, so that it may travel almost anywhere that a motor truck can go. The boom can easily be lowered and the stack removed for close clearances.

LOADING MOTOR TRUCK ON RAILROAD'S PUBLIC TEAM TRACK.

UNLOADING GRAVEL FOR VERMILLION COUNTY, ILLINOIS, ROAD WORK.

The 4-wheel car body is 17 ft. 4 in. long by 6½ ft. wide, with a 15-ft. 4-in. wheel base and a height from ground to top of A-frame of 12 ft. Either a ½-yd. clamshell or a 12-ft. orangepeel bucket can be used at the end of the 20-ft. boom.

The forward or propelling wheels are 39 in. in diameter, with 10-in. face and ¾-in. tires. On these wheels are sprockets driven by a heavy steel pintle chain. There is also a differential. The steering wheels are 30 in. in diameter and are mounted on a pivoted axle and steer by handwheel and worm. An emergency hand brake is provided. The wheels are drilled for attaching spuds, if desired. The propelling speed forward or reverse is 200 ft. per min.

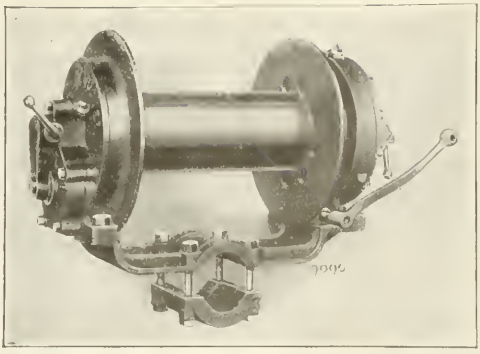
The machine is built with three power friction-drums for use with clamshell or orangepeel. Where the outfit is used only as a derrick, the same frame is employed with but two power drums, space being provided for a third drum, so that the extra drum can be added in the field, if desired. Housing is provided in the form of an all-steel cab.

The boom is an 8 by 10 stick having a three-rod steel truss the full length. For sand, gravel, screenings and similar loose material almost any light standard bucket is satisfactory, but with crushed rock, slag or other large or heavy materials it is important to have a high-powered bucket, in some cases fitted with teeth. The John F. Byers Machine Company, of Ravenna, Ohio, manufacturers, guarantee one round trip of boom and bucket per minute.

New Model Hoist

A new model Little Tugger hoist has been brought out for the use of those who prefer manila to wire rope for light hoisting and hauling. This is designated as No. 11 by the Ingersoll-Rand Company, New York City manufacturers, and is essentially similar to the No. 1 model in its square piston, reversible driving engine, automatic lubrication, enclosed gearing, drum-release clutch and worm-operated band brake. The most noteworthy variations are in the diameter and length of the drum, the width of the flanges and, of course, the main frame and over-all dimensions.

The new model Little Tugger has a hoisting drum 7 in. in diameter by 17 in. long, with 5-in. flanges, thus accommodating 300 ft. of ⅞-in. manila rope. Conservatively estimated, the maximum capacity of this hoist is about 600 lbs. The hoist is 21 in. long, 31¼ in. wide, 23 in. high and weighs 358 lbs.



It is built for operation by either steam or compressed air. The standard clamps fit a 4½-in. diameter column or pipe, and by removing the clamp the hoist can readily be bolted direct to any convenient support, timber or flooring. Altho designed primarily for underground work, it can be used for general hoisting work, hauling and manipulation in tunnels, pits, quarries or industrial plants.

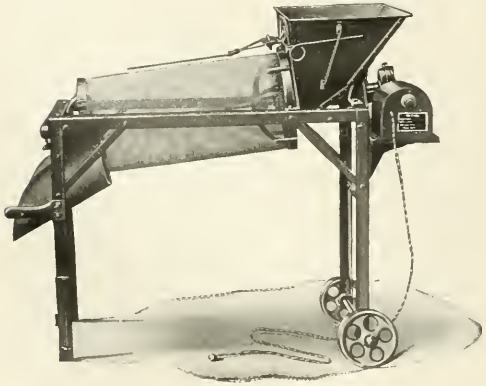
Grand Rotary Sand Riddle

Increased efficiency in sand sifting work is claimed for the Grand rotary riddle, which has several new and interesting features. The most significant of these are (1) the use of interchangeable screens, which enable sifting in various sizes according to the needs of various machines; (2) a special tapping device for keeping the screen clear and thus allowing the handling of wet and dry material with equal ease.

Construction is wholly of iron and steel. The frame is made of heavy angle-iron, securely braced, and is square so as to permit wheelbarrows being run under it. The hopper is of heavy-gage steel, reinforced with a round rod rolled in the top of it and rigidly held in place by heavy iron brackets. The hopper is low to shovel into, yet the drum is high enough above the ground to permit of screening into a wheelbarrow. An auger in the hopper makes the machine a force-feed, so as to handle very wet and sticky core sand.

The rear end of the machine is mounted on large iron wheels and the front end is equipped with two handles so that one man can easily wheel the riddle to any part of the work.

The front legs of the machine are adjustable and may be lowered to give any pitch desired for the best handling of the material. This is a great advantage in screening and mixing core sand that has just been mixed with oil, as all lumps are broken up before reaching end of drum.



The drum is mounted on tubing, which easily slides over the main shaft and engages the clutch to revolve same. This drum is 14 in. in diameter and 36 in. long, giving 10½ sq. ft. of screening surface at one revolution of drum. It revolves 37 r.p.m., giving a large screening capacity and it only requires two minutes to remove one drum and replace it with another of different mesh wire cloth, thus giving the machine a wide range of work. The wire cloth on these drums can also be changed by loosening the steel spring bands at each end of the drum.

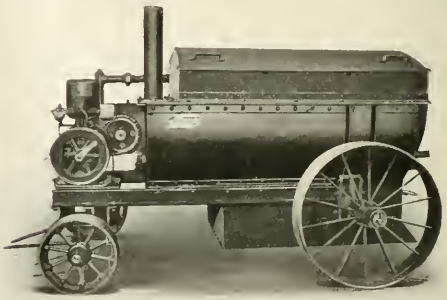
The patent automatic tapping device keeps the screen clean at all times, no matter whether materials are wet or dry. This tapper is quickly adjusted to strike a heavy, medium or light blow, or can be thrown out of operation entirely when screening dry material. Owing to the manner in which the materials are handled in the screen, it is claimed there is practically no wear to the wire cloth.

The machine can be operated either with a crank for hand power or with a pulley, which can be connected by belt power to a regular line shaft. The Hall-Holmes Manufacturing Company, of Jackson, Mich., are the makers.

Handy Heater and Sprayer for Bituminous Materials

Considerable difficulty is often experienced in handling heated bituminous materials on a small scale, largely because of the more or less inferior and improperly constructed appliances so often used for the purpose. The accompanying illustration is that of an improved heater and sprayer especially designed to overcome existing difficulties.

The machine is similar in construction to many forms of tar kettles now in use, being a steel tank of capacity ranging from 300 to 600 gallons; the tank being equipped with a



large-sized fire-box underneath, adapted for burning wood, coal or coke. The tank is jacketed by a heating chamber, which is extended on the front so as to receive and enclose a Kinney pump, which is driven by gasoline engine, as shown in the cut, or may be driven by hand power, as desired. The important advantage of the heating chamber is that the pump is kept heated at all times, thus preventing the hardening of material within the pump and so preventing its operation.

The pump is adapted to take the material from the tank thru proper screens or strainers, passing it thru the discharge pipes, equipped with proper valves extending to the rear end, where it is adapted for connection with the spraying hose and nozzles for the application of bituminous material thru the nozzles. The discharge pipe also is so made that the stream may be diverted into the tank, thus establishing a circulating system, which facilitates the heating and at the same time

prevents the material from hardening or coking to the bottom of the tank.

The machine is mounted upon steel wheels with broad tires and can be drawn by hand, steam roller or tractor. It may be furnished with attachments for hoisting barrels, also with a warming closet for warming barrels of heavy material for easy dumping into the heater.

It is made by the Kinney Manufacturing Company, Boston, Mass.

No Repair Bills Except for Bridge

The big Federal motor-driven street flusher operated by the city of Vicksburg, Miss., recently started out to deliver 850 gal. of good drinking water to the State troops, which are encamped a few miles out of town. Just as the truck crossed

a bridge on the outskirts the heavy planking gave way and the truck went thru, resting on the worm axle, as illustrated herewith.

No injury was done to the truck except the loss of a little paint.

Pneumatic Concrete Mixing and Placing

Pneumatic mixing and placing of concrete has demonstrated its adaptability, efficiency and economy on big jobs of many different kinds. Several prominent engineers already concede that this method will supersede all others for certain types of construction, such as tunnel work, subways, etc. It is said that the pneumatic mixing and placing machine can effect a saving of approximately from $1.50 to $2.50 per cubic yard over the old method.

This efficiency, of course, depends largely on the proper

DISCHARGE PIPE FROM A RANSOME-CANNIFF PLACER CONVEYING CONCRETE FOR CONSTRUCTION OF A COAL PIER. PIPE LAID IN CENTER OF FALSE WORK.

RANSOME-CANNIFF PNEUMATIC MIXER AND PLACER WITH A SPOUTING SYSTEM IN BRIDGE CONSTRUCTION.

designing and co-ordinating of the entire construction equipment, particularly that part of the plant which can be made to utilize compressed air. The pneumatic mixer and placer requires a compressor of large capacity, and it is essential that the compressor be used for other power functions than concrete mixing. It is often advisable to install a sufficiently large compressor to run the entire auxiliary equipment in daylight hours and then place concrete in a few hours during the night. Then, by use of the excess compressed air available, the output can be greatly increased.

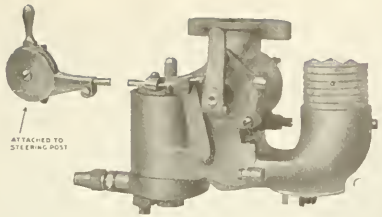
The accompanying photographs are illustrative of certain large jobs upon which pneumatic machines were recently used. The chief engineer for the Degnon Contracting Company, New York—now operating two pneumatic mixers and placers—reports that they have proven "highly satisfactory in performance." "Our first machine," he says, "has been in use on our 59th street subway contract in New York City and has placed all the concrete lining in some 800 ft. of double-track subway, most of which was rock tunnel, and the balance open cut construction. It has worked successfully on both classes of work. The machine is most valuable in placing concrete that would otherwise have to be hand-shoveled, particularly in the arch of the tunnel. We find there is a large saving in mixing and placing with it."

Similarly favorable comment is made by A. A. Brewer, engineer for the Flinn-O'Rourke Company, Inc., big New York City contractors, who now are using three pneumatic mixing and placing machines. Like testimony from the big engineering firm of T. A. Gillespie Company, High Falls, N. Y., and the Pennsylvania Water and Power Company, Baltimore, Md., seems to establish the enthusiastic assertions of the Ransome Concrete Machinery Company, Dunellen, N. J., for their machines and methods.

Carburetor for Fire Apparatus

Motor fire apparatus is regularly called upon to meet sudden and strenuous exigencies which the ordinary contractor's truck rarely meets. It must do all that is expected of the ordinary truck at a greater speed and with complete reliability. It has to snake at top speed thru dense traffic; to be unaffected alike by bad roads and weather conditions.

The fire-truck driver should realize how much of his truck dependability depends upon its carburetion. The accompanying illustration is of the "Master" carburetor, which is said to be specially adapted for fire apparatus service. Its two most salient features are the control and the device for distributing fuel, both designed to give perfect vaporization and so eliminate the possibility of frequent adjustments.



SHOWING ALL HOT VERTICAL AIR INTAKE.

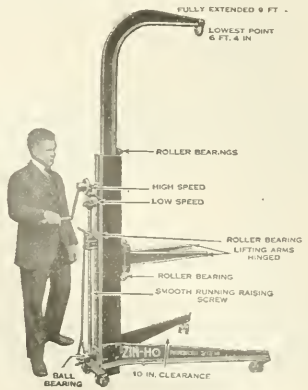
Fuel is fed into the combustion chamber thru a series of 14 to 21 tiny holes, their exact number depending upon the size of the carburetor. They are said to break up the fuel more thoroly than can be done by ordinary nozzles or jets. At the top of the fuel distributer there is a rotary throttle. When this is closed only one little hole is exposed, permitting the escape of only enough "gas" for idling or very low speed. The gas supply is augmented proportionately as the throttle is opened wider and more of the tiny holes are exposed. When left wide open the gas is let out in the form of a minutely broken-up spray, which makes for perfect combustion.

Control of the live mixture is vested in a small lever located near the driver on either the steering post or dashboard. Variable conditions of speed, grade or weather cannot influence the mix adversely and the operation of this lever is even more simple than that of the spark lever, inasmuch as there is no necessity of changing the control so frequently. The lever's central position affords a normal running mixture and a mere shove to one side or the other will give either a rare mixture for high speed or a rich one for quick starting in cold weather.

The Master carbureter originated in California, where the varying atmospheric conditions from foggy sea level to the rarified air of mountain tops demand the highest carbureter efficiency. It has already been installed on the machines of the fire department of Boston, Rochester, San Francisco, Oklahoma City, Grand Rapids, New York City, Detroit, Los Angeles, Spokane, Denver, Phoenix, Atlanta and many others, according to the Master Carbureter Corporation, of Detroit, Mich., its manufacturers.

Zin-Ho Portable Crane

Herewith is illustrated the Zin-Ho portable crane, which is especially adapted for use in general construction work and in utility plants, municipal stores or yards and in central fire stations operating motor-driven apparatus. Portability and easy one-man operative features make it convenient under all conditions. Its work can be regulated with exactitude by means of its raising screw. The entire outfit weighs only 350 lbs. and is capable of hoisting 4,000 lbs.



ZIN-HO PORTABLE CRANE.

The crane is equipped with a telescope mast with a davit type head. A smooth-running vertical head screw, driven by a crank handle thru gears giving either high or low speed, raises the mast to a height of 9 ft. 3 in. It can be lowered to 6 ft. 4 in. The thread of the lifting screw is so fine that the crane can be manipulated to a fraction of an inch. The value of this feature is readily apparent where machinery is to be handled.

Lower down on the vertical support there are two hinged arms for jacking or lifting. When it is desirable to use only the boom these arms can be swung out of the way. The base comprises two supporting beams, under the ends of which and also beneath the bottom of the mast are casters. The bases of the swinging arms and the boom are equipped with ball bearings.

The crane is made by the Zin-Ho Manufacturing Company, of Chicago, Ill.

Motor Truck Salesmanship

Mr. Lynn B. Dudley has been appointed advertising manager of the Federal Motor Truck Company to succeed Mr. Geo. W. Cushing, who recently resigned to take a position in the advertising department of the Hudson Motor Car Company. Mr. Dudley is well qualified to take up his new work, having had 12 years' experience in the editorial and advertising departments of newspapers, and for 3 years has been connected with Campbell-Ewald Company, advertising agents. He has specialized in automobile, gas-engine and motor truck accounts, and for some time past has had supervision of the agency account of the Federal Motor Truck Company. Owing to his close association with the Federal organization, Mr Dudley was selected for the position.

Trade Publications

The Construction of Roads and Pavements, by T. R. Agg, professor of highway engineering, Iowa State College. Cloth, 432 pp. McGraw-Hill Book Co., 239 West Thirty-ninth street, New York City.

Copies of specifications for waterproofing mass concrete, cement, stucco, walks and floors with a thin coat, issued by The Aquabar Co., have been received from P. R. Baker, their Indianapolis representative, 2255 Talbot avenue. They are accompanied by a reproduction of blue prints showing the methods of making the applications.

The fourth volume of "Motor Trucks of America," for 1916, has been issued by The B. F. Goodrich Co., Akron, Ohio, and gives descriptions and photographs of 103 American motor trucks, all of which use Goodrich tires. It is a very valuable publication for anyone interested in motor trucks or becoming

interested in their use, which is the state of mind of very many who use means of transportation in their business, whether for collection and delivery of materials and products or in the numerous ways of the contractor.

Kansas City's Pumping Engine

Herewith is illustrated a latest design horizontal cross compound crank-and-flywheel pumping engine recently installed in the city of Kansas City, Kas., which Mr. L. H. Chapman, water and light commissioner, states has been giving perfect satisfaction in practically continuous operation under governor control ever since being placed in service.

The pump is of the duplex double-action type, with outside center-packed plungers and is fitted with rubber pump valves arranged in easily removable cages. The main pump chambers are said to be especially effective owing to their close proximity to the suction valves. The steam pistons and pump plungers are connected thru cross-heads and double distance rods.

The steam cylinders are fitted thruout with Corliss releasing valves, having separate eccentrics for the steam and exhaust valves on each cylinder, thereby allowing an economical adjustment and giving great flexibility with large variations in water and steam pressures.

The condenser is usually of the surface type, located in the main suction line to the pumps. This arrangement insures an abundance of cooling water at all times, with no expense for circulating pumps or loss due to wasting water for condensing purposes.

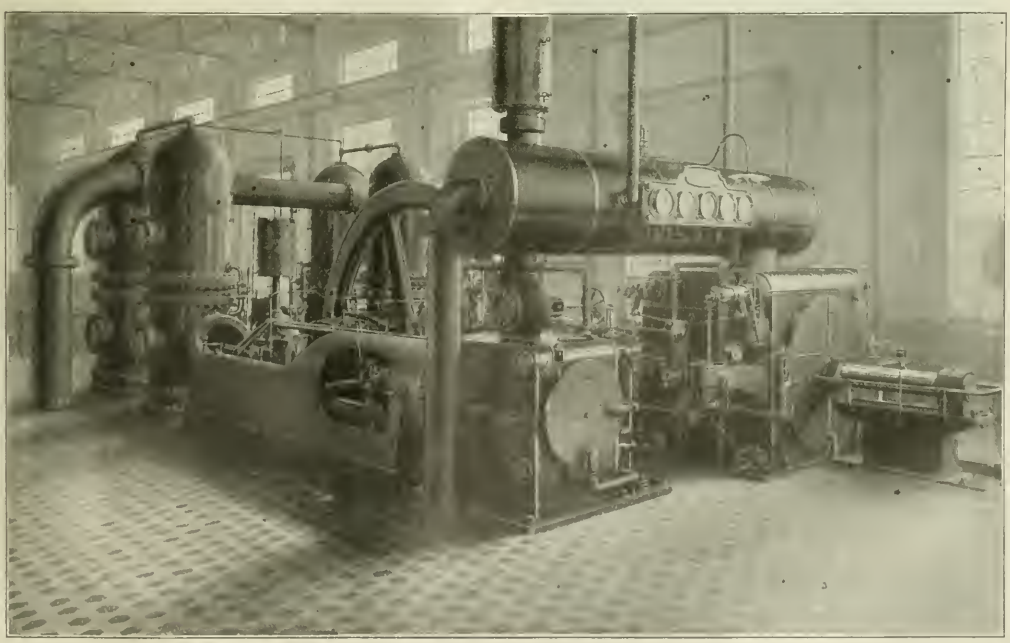
The receiver, located between the high and low-pressure cylinders, is of large size and forms an ample reservoir for the low-pressure cylinder to draw upon. This receiver can be located either above or below the cylinders, to suit local conditions. The exhaust pipe leads from the low-pressure cylinder to the steam inlet of the condenser, and from this point the exhaust steam makes two complete passes thru the condenser tubes to the suction pipe of the air pump. The condensed steam drains by gravity to the air pump, which is driven by a special eccentric on the main shaft of the engine. In this way the air pump is operated at the same steam economy as the main unit and, owing to the small power required and the ample cooling water available, a very high vacuum is obtained at practically no cost.

In addition to the air chambers formed in the two suction boxes an air chamber of liberal proportions is furnished and located at some convenient point on the suction line near the pumping engine.

Very liberal discharge air chambers are located immediately over the discharge valve decks and insure easy operation with a uniform flow of water and freedom from jars or knocks. All working parts are accessible for the convenient making of adjustments.

The pumping engine operates under the following conditions, which speak for themselves:

Capacity, 12,000,000 U. S. gallons per 24 hours.
Total head, 324 feet to 393 feet.
Steam pressure, 150 lbs. per sq. in.
Revolutions per minute, 42.85.
High pressure cylinder, 27½ in.
Low pressure cylinder, 52 in.
Plunger, 19 in.
Stroke, 42 in.
Flywheel, 16 ft. diam., 35,000 lbs.
Condenser, surface type of the Allis-Chalmers manufacture, located in main suction line.
Cooling surface, 1,500 sq. ft.
Air pump, attached type-double, 17 in. diameter by 14 in. stroke.
Attached feed pump, 3¾ in. by 14 in. stroke.
Valve area of each quarter of suction and discharge deck 661.5 sq. in.
Number of cages in each quarter, or for each deck, 7.
Percentage of valve area to plunger area, 240 per cent.



Duty guaranteed, 148,000,000 foot pounds of work per 1,000 pounds of dry steam.

Duty obtained on official test, 160,040,000 foot pounds of work per 1,000 pounds of dry steam.

The unit is a product of the Allis-Chalmers Manufacturing Company, Milwaukee, Wis.

Steam Shovels and Trucks Work Together

Carlin Brothers, of San Francisco, Cal., recently secured the contract for the removal of 9,000 cu. yds. of material from the basement of a large apartment building on a hillside at the corner of Post and Leavenworth streets. Their first procedure was to install the most modern equipment they could find, which in their case comprised a fleet of eight motor trucks and a Bucyrus revolving steam shovel.

No unusual problems were encountered on the job, the feature being, of course, the extremely hard material to be handled. It was thought at first that blasting would be necessary before it could be loaded economically by the small shovel, but a trial soon convinced them that the machine could handle it without any trouble. On this job, the material consisting of hard shale, earth and boulders, the shovel averaged 265 cu. yds. per day. Its makers, The Bucyrus Company, South Milwaukee, Wis., say that this is no unusual record for it.

Dynamite in Road Building

In going through a cut in light soil dynamite helps in loosening up the dirt if charges of a half cartridge of 20 per cent. Red Cross are fired in holes to the required depth, five or six feet apart each way. Then the scrapers can handle it with ease, doing away with a great amount of hand-picking and shoveling. In a hard clay soil charges of one to two cartridges of 20 per cent. dynamite may be used in holes four to six feet deep, and spaced about six feet apart, and will be found satisfactory for loosening the soil for the scrapers.

Outcrops of rocks are frequently met with in road construction and, of course, require to be drilled either by hand or machine drill for the economical use of explosives. Where it is not possible to drill these outcrops, they may sometimes be mudcapped, but this takes several times as much dynamite to do the work under most favorable conditions as compared with that required in a drill hole, and, frequently, is absolutely impractical. Boulders may sometimes be blasted by firing charges in holes driven beneath them with a bar, or they may be drilled and fired, or, if very hard and brittle, it is most economical to mudcap them.

Stumps may be taken out economically and quickly by firing charges of dynamite under them, placed far enough below the surface of the ground so that the crater produced will include the greatest proportion of the roots.

Ditching is frequently necessary and may be done in two ways, depending on the character of the soil. In a dry, sandy soil single cartridges, 1¼ by 8 inches, of dynamite are placed in holes two to three feet apart and two to two and one-half feet deep, with an electric blasting cap in each hole and the entire line connected up in a series and fired with a blasting machine. In very wet, heavy soil or swampy muck, the ditch may be made by firing charges of one cartridge of 50 per cent. straight dynamite in each hole spaced 18 inches apart and two to two and one-half feet deep. In this case it is not necessary to use an electric blasting cap for each hole. One extra cartridge placed in a hole near the center of the line of holes and fired by either an electric blasting cap or a blasting cap will detonate the entire line by influence. Ditches have been dug over a thousand feet long by this method. A hand-dug ditch usually costs just about twice as much as a dynamited ditch.

Sink-holes, mud holes, bog and miry spots in low-lying portions of country roads are often effectually and permanently drained by firing charges of dynamite in holes driven into the impervious stratum of soil, usually clay or hard-pan, which forms the basin and prevents the water from running down into the earth. These charges should be fired fifteen or twenty feet apart each way, the depth depending upon the nature of the soil. Wet spots in roads have been permanently cured at very little expense by this method.

Dynamite is one of the handiest and most reliable helps the road-builder can have in his equipment. It can be used for felling trees, making post holes for fences or planting trees, and for digging and loosening up the soil for telegraph and telephone pole holes.

Road builders as yet have not exhausted the possibilities of its usefulness, but those who have carried it in stock and used it intelligently would no more dispense with it in any operation than they would with their equipment of picks and shovels.

A Durable Pump

A remarkable performance of the Atlantic diaphragm pumping engine of the Harold L. Bond Company of Boston is reported from Alaska, where the city of Skagway used one for three years in sand and gravel at all times and it is still on the job all the time and has never failed to give entire satisfaction.

Trade Notes

The Cleveland Brick and Clay Company, of Cleveland, O., has been added to the list of licensees of the Dunn Wire-Cut Lug Brick Company, of Conneaut, O., and henceforth will make wire-cut lug paving brick. The company is one of the most prominent paving brick manufacturing concerns in northern Ohio, and it has a daily productive capacity of 60,000 blocks. J. L. Higley is president of the company, and A. L. Hendershot is secretary.

The Buffalo Steam Roller Company, Buffalo, N. Y., and the Kelly-Springfield Road Roller Company, Springfield, O., have been combined into the Buffalo-Springfield Roller Company, with main offices and factory at Springfield, O. The entire sales organization of the Buffalo company, as well as the full line of Buffalo-Pitts rollers, will be taken over by the new company. With the tandem and macadam types, the steam and gasoline rollers of both companies, the list will be complete in styles and in sizes from 2½ to 20 tons.

The Jamestown Shale Paving Brick Company, of Jamestown, N. Y., has become a licensee of the Dunn Wire-Cut Lug Brick Company, of Conneaut, O., and will make wire-cut lug paving brick. This company has been making paving brick for more than thirty years and has rebuilt its plants so they are modern, up-to-date and fireproof. It has a daily capacity of 65,000 blocks. It operates five rectangular kilns, with a daily capacity of 25,000, and a continuous kiln, with daily capacity of 40,000. The company has seventy-five acres of workable shale bed from 75 to 100 feet, within the city limits of Jamestown. The officers of the company are: A. N. Broadhead, pres.; Thomas Mahoney, vice pres.; John Mahoney, treas.; J. B. Fisher, sec.; R. F. Fisher, mgr.; A. B. Green, supt.

The Purington Paving Brick Company, of Galesburg, Ill., has become a licensee of the Dunn Wire-Cut Lug Brick Company, of Conneaut, O., and will engage extensively in the manufacture of wire-cut lug brick. The Purington company is one of the biggest paving brick concerns in the United States, with a daily output capacity of about 350,000 brick. The Purington organization consists of F. G. Matteson, president and treasurer; George C. Prussing, vice president; C. D. B. Howell, vice president; W. H. Terwilliger, secretary; W. G. D. Orr, general manager.

The Citizens' Company, B. N. Brennan, president, Baltimore, Md., finances corporations, engages in underwriting, and handles for its own account complete issues of securities.

Fred E. Boylan has resigned his position as manager of the Detroit branch of the Swinehart Tire and Rubber Company, and has been appointed factory representative of the Sewell Cushion Wheel Company. With a view of working the territory more intensively, Mr. Boylan will divide his time with their branches in Cleveland, Buffalo, Rochester, Boston, New York, Philadelphia, Baltimore, Pittsburg, Cincinnati, St. Louis, Chicago and Minneapolis.

The patent on the Ferguson reinforced concrete dock or pier, now constructed by the Cleveland Dock Engineering Company, Cleveland, O., has been sustained in a decision of the United States Circuit Court of Appeals, in the case of James D. Carey, president of the company, against the Detroit Steel and Iron Company.

Rural contractors specializing in concrete work, especially those building silos and other far mstructures, also contractors or others who would like to specialize on such work, will be interested in knowing of a co-operative plan now being carried out by the Extension Division of the Portland Cement Association. Any one interested in concrete contracting work or in taking up such work, is urged to address a letter to the director, Extension Division, Portland Cement Association, 111 West Washington street, Chicago, for some information that will prove valuable, and that can be obtained without cost or other obligation.

The Chain Belt Company of Milwaukee, Wis., has appointed Mr. C. F. Messinger manager of their Concrete Mixer Department. Mr. Messinger has for years managed the Advertising Department and is thoroughly acquainted with the mixer business. He will take charge at once and will augment the service feature which has always accompanied chain belt mixers. Mr. Messinger is a graduate of the Sheffield Scientific School of Yale University and is well known by mixer men thruout the country.

Two additional licensees have been added to the family of the Dunn Wire-Cut Lug Brick Company, of Conneaut, Ohio. These are the Streator Clay Manufacturing Company, Streator, Ill., which has recently completed a new plant with a daily capacity of 60,000 paving block; R. H. Green, president; James A. Green, vice president, and John Connelly, secretary; also the Martinsville Brick Company, of Martinsville, Ind., with a daily productive capacity of 30,000; E. J. Poston, president; B. C. Poston, vice president; O. E. Sweet, secretary.

Trade Publications

A handsomely illustrated booklet of the National Concrete Company of Indianapolis, Ind., shows the construction of the West Washington street bridge in that city by this company.

The Ideal Mortar for Brick Masonry, Mortar No. 5, produces maximum strength with minimum expense, as demonstrated in Bulletin J of the Hydrated Lime Bureau of the National Lime Manufacturers' Association, Arrott Bldg., Pittsburg, Pa.

Economic Brick Mortar and Permanently Dry Basements are the titles of 2 circulars of the Hydrated Lime Bureau, Arrott Bldg., Pittsburg, Pa.

Concrete Houses and Why to Build Them, Concreting in Cold Weather and That Alley of Yours are 3 interesting bulletins of the Portland Concrete Association, 111 West Washington street, Chicago, Ill.

Novalux street lighting units for Mazda series lamps and street lighting brackets and center span fixtures for Mazda lamps are shown in full detail in two booklets of the General Electric Co., Schenectady, N. Y.

Dynamite in fish culture is the subject of a paper by E. V. Gardner, C. E., Goshen, N. Y., which is republished by E. I. du Pont de Nemours & Co., Wilmington, Del.

Standard pumping units for water supply are shown in detail in a catalog of The Standard Pump and Engine Co., Akron, Ohio, using handpower, gas or gasoline engines or electric drive, suction or deep well pumps, compressed air tanks for delivery of water when pump is not running; also combined pump and electric light plants. Plans for foundations for engines and pumps are also given. Capacities run up to 4,000 gallons an hour.

Wallace & Freman Co., New York, issue a booklet comparing the cost of sterilization of water and sewage by the use of hypochlorites and of liquid chlorine.

The Domestic Engine and Pump Company, Shippensburg, Pa., is distributing a new 28-page 6x9 illustrated bulletin, describing their line of gas-engine-driven contractors' machinery, which includes diaphragm, centrifugal, combination and force pumps, geared and chain-driven hoists and special hoisting outfits for applying power to hand derricks. A number of new electric-motor-driven pumping outfits are also shown. A copy of this bulletin may be obtained by application to the Domestic Engine and Pump Company.

A reprint from the *Oregon Voter* of June 12, 1915, gives the extensive quotations from the report of the paving committee of the Portland Chamber of Commerce on the public contracts then to be let under the bond issue passed for good roads. It is handsomely illustrated and goes into some detail regarding the life of concrete, Hassam, Warrenite and Topeka specification pavements, and the patents involved. The conclusions are fully stated, recommending Warrenite for all the roads except under certain conditions of grade, where Belgian blocks are recommended, using Oregon stone. Experiments with wood block, also an Oregon product, are recommended.

"Better Roads" and "Highway Maintenance" are the subjects of two folders on Howe's road combinations and methods of road treatment, issued by the S. G. H. Rubber-Stone Co., Detroit, Mich.

Contracting News

AUTOMOBILE FIRE APPARATUS AND MOTOR EQUIPMENT.

BIDS REQUESTED.

Atlantic Highlands, N. J.—Until Jan. 9, on motor-driven apparatus.

Harrison, N. J.—Until Dec. 5, for furnishing 2,000 ft. of fire hose.

LaCrosse, Wis.—Until Dec. 5, for furnishing city with 1,000 ft. fire hose and two city service trucks. Add. Bd. of Pub. Wks.

Lakefield, Minn.—Until Dec. 5, for 60-gal. chemical engine. Add. L. W. Rue, Vil. Clk.

CONTEMPLATED WORK.

Alameda, Cal.—Fire Comm. has purchased plans and specifications for two pieces of motor equipment.

Alliance, Ohio—Ord. No. 2241 passed, providing to issue bonds of $1,000 for purchase of motor equipment for fire chief. Chas. O. Silver, City Audr.

Baldwinsville, N. Y.—City contemplates purchasing piece of motor apparatus.

Baltimore, Md.—The purchase of four steamers and seven trucks, three motor combination cars and other equipment, has been taken under consideration for 1917.

Bristol, Pa.—Cornwells Fire Dept., Cornwells, reported as considering purchase of fire apparatus. Funds now being appropriated.

Chattanooga, Tenn.—The purchase of combination chemical and hose car at an early date, has been recommended. Est. cost $4,500. T. C. Betterton, Fire and Police Commr.

Coopertown, N. D.—City of Bismarck is to motorize their fire department and are about to purchase a fire truck. A street flusher probably will be purchased, too.

East Milltown, Pa.—Considering the purchase of motor fire apparatus in the near future.

Evanston, Ill.—Council Comm., Mr. H. E. Chandler, chairman, has been requested to make appropriation for purchase of five more pieces of motor-driven fire apparatus.

Garfield, N. J.—The purchase of a piece of motor apparatus for Fire Co. No. 1 is contemplated. Bids will be advertised shortly.

Great Falls, Mont.—City Engr. prepared specifications for purchase of one motor-driven comb. pumping, chemical and hose truck. Six cylinder, 60-h.p. engr., centrifugal pump, chemical tank and three ladders.

Harrisburg, Pa.—Ordinance introduced to city council requesting city to loan $60,000 to appropriate for motorization of fire dept. Chas. A. Miller, Clk. of City Council.

Hartford, Conn.—The Fire Commrs. of Windsor District have been authorized to advertise for bids for purchase of 600 feet of fire hose.

Hewett, L. I.—Fire Commrs. have decided to purchase a new motor apparatus, which is to be combination chemical engine and hose truck with junior pump.

Hinsdale, Mont.—Bd. of Commrs., Valley Co., have approved of purchase of fire apparatus. Est. cost, $1,200.

Huntington, Ind.—Bids will be requested for purchase of motor apparatus.

Lockport, N. Y.—Voters have approved the issuance of bond issue of $12,000 for purchase of several pieces of motor apparatus.

Manchester, N. H.—Bond issue of $25,000 for purchase of two motor pumping engines and two motor hose cars, has been approved.

McPherson, Kans.—Petitions being circulated requesting city council to purchase fire apparatus.

Newburgh, N. Y.—Vil. of Deacon are to install fire alarm system at est. cost of $3,000 from $186,655, which is to be appropriated for improvements.

New Castle, Ind.—City Council voted and approved of the advertising for bids for furnishing automobile for fire chief.

Piedmont, Cal.—Bond issue of $25,000 approved for fire department improvements.

Quincy, Mass.—An ordinance presented to Fire Committee requesting an appropriation of $6,000 for three motor hose cars.

Sacramento, Cal.—An appropriation of $16,000 has been decided for purchase of motor-driven apparatus.

BRIDGES.

BIDS REQUESTED.

Americus, Ga.—Until Dec. 11, for construction of bridge over Flint River at Murray's Ferry. Est. length, 1,300 feet long, of concrete or steel. Address City Clerk.

Ann Arbor, Mich.—About January 1, for construction of rein. concrete bridge 620 feet long across Huron River. Est. cost., $45,000. Add. John C. Cox, State Highway Commr.

Barbourville, Ky.—Until Dec. 9, for construction of two bridges, one over Little Richmond Creek, one over Stinking Creek, and 12 smaller bridges. Add. Read P. Black, Clk., Knox Co., Crt.

Chillicothe, Mo.—Until Dec. 9 (12 noon), for construction of seven reinforced concrete bridges; also grading of Haynes Hill Add. Joe Broaddus, Bridge Commr.

Crown Point, Ind.—Until Dec. 8 (10 a. m.), for construction of concrete culvert. Edw. Simon, Audr. Add. bids to Commrs. of Lake Co.

Gastonia, N. C.—Until Dec. 6, for construction of steel bridge, two spans, over Long Creek, 2 miles from Gastonia. Add. O. B. Carpenter, Clk. Co. Commrs.

Litchfield, Minn.—Until Dec. 13 (2 p. m.), for construction of pile trestle bridge, 112 feet long over Lake Koronis, Sec. 2, Union Grove. Add. A. O. Palmquist, Meeker, Co. Audr.

Lisbon, Ohio.—Until Dec. 11 (1 p. m.), for construction of Bridge No. 846, known as Canton Bridge, in Center Tp. Certified check $250. Add. H. R. Dickey, Clk.

Molino, Fla.—Until Dec. 12, for construction of bridge and approaches over Escanaba River. Add. M. C. Barrineau, Chrmn. Escanaba Co. Commrs., at Pensacola. Plans with Geo. Rommel, Engr., Pensacola.

New Castle, Pa.—Until Jan. 1, for construction of bridge over Neshannock Creek on Gardner Ave. Est. cost $35,000. Bids recd. by Co. Commrs. of Lawrence Co. T. A. Gilkey, Engr.

Newton, Iowa.—Until January 1, for construction of concrete culverts and bridges. Est. expenditure $25,000. Add. Mr. C. O. Edge, Co. Audr.

Potter, Wis.—Until Dec. 15, for construction of concrete bridge, 5 piers, two abutments on 50-ft. piles, six 40-ft. spans, 20-ft. roadway and concrete floors. Est. cost, $20,000. Add. bids to Wm. Heinig, Brillion, Wis. All above is a report. Not official.

Springfield, Ill.—Until Dec. 5 (2 p. m.), bids will be recd. at Farmers Natl. Bk. in in Genesco, for construction of two rein. concrete bridges in Edford Tp., Henry Co., known as Gotthardt and Newman bridges. Spans 18 and 20 ft., roadways 18 ft. Est. cost $2030 and $1490 respectively. Jas H. Reed, Co. Supt. of Highways, Cambridge, Ill.

Seale, Ala.—Until Dec. 7, for construction of bridge over Brush Creek on Tuskegee and Columbus Rd., including concrete piers. Add. bids to Russell Co. Plans with W. S. Keller, St. Hgwy. Engr., Montgomery.

Vienna, Ga.—Until Dec. 11, for construction of bridge over Flint River at Murrays Ferry. Add. Co. Clk.

CONTEMPLATED WORK.

Abingdon, Va.—Ch. Engr., Holston River Lbr. Co., preparing plans for construction of 200-ft. steel bridge.

Aurora, Ill.—To construct concrete bridge bridge with roadway 24 ft. wide and 50 ft. long over Ferson's Creek on west road north of St. Charles.

Canadian City, Okla.—Plans being prepared by city for construction of bridge over So. Canadian River on Jefferson Highway. Est. cost, $12,000.

Chicago, Ill.—Considering construction of bridge over Chicago River at 12th St., consisting of 2,500 tons steel and 2,100 sq. yds. creosote blocks. Est. expenditure, $600,000. Add. Dept. Pub. Wks. and San. Dist. of Chicago. Thos. G. Philfeldt, Cty. Bridge Engr.

Clearwater, Fla.—Pinellas Co. Commrs. to vote on $70,000 bond issue for construction of bridge over Boca Ceiga Bay to Island where Pass-a-Grille is located.

Columbia, Tenn.—Plans prepared for construction of bridges and culverts in Maury Co. Add. Co. Clk. Columbia. Est. cost, $10,818.

Covington, Ky.—Bond issue of $500,000 voted for improvements, including traffic bridge over Licking River, $40,000; other steel constructions, $95,000. Add. The Mayor.

Elizabeth, N. J.—Bd. Freeholders contemplated constructing 135 ft. span with 40 ft. roadway, known as Strauss bascule life bridge; also, wood block pavement at South Front St. J. L. Bauer, Co. Engr.

Flint, Mich.—Council planning to construct bridge across Flint River near Saginaw St. C. E. Shoecraft, Cty. Engr.

Gainesville, Tex.—Chamber of Commerce reports city is having plans prepared for constructing of bridge. Est. cost bet. $50,000 and $60,000.

Highlands, N. J.—Monmouth Co. preparing plans for construction of bridge over Shewsbury River. Est. cost $90,000. Add. Co. Clk.

Kansas City, Mo.—Plans prepared and approved by Bd. of Pub. Wks. for construction of bridge over Bush Creek on Elmwood Ave. Est. cost $11,000. Curtis Hill, Cty. Engr.

Kansas City, Mo.—Planning to construct bridge with proposed Chestnut Ave. through N. Terrace Pk. Est. cost $40,000. Add. Pk. Bd.

Mankato, Minn.—J. H. A. Brahtz, Supr. Engr., looking over the site on which concrete bridge known as Grand Ave. bridge, is to be constructed. Est. cost $185,000.

Marquette, Mich.—An appropriation of $9,000 has been made for construction of bridge in county during 1917. Add. Bd. of Supvrs.

Monroe, La.—L. N. Larche, Chrmn. Brdg. Comm., reports city is planning for construction of bridge across Ouachita River. Est. cost $300,000.

Montgomery, Ala.—County voted $50,000 bonds for construction of bridge across Tallapoosa River at Judkins Ferry, with concrete; also $50,000 for one across Tallapoosa River connecting Elmore and Montgomery Counties. R. H. Jones, Pres. Bd. of Revenue.

New Haven, Conn.—Edw. Gagel, Chf. Engr., New York, New Haven, & Hartford R. R., will furnish information with regard to construction of bridges calling for expenditure of $1,000,000.

Philadelphia, Pa.—Plans have been revised for new county bridge across Salem River. Est. cost $65,000.

Pond Creek, Okla.—Estimate submitted for construction of bridge over Salt Creek, for Chicago, R. I. & Pac. Ry., of $150,000. C. A. Morse, Chf. Engr., Chicago, Ill.

Rio Vista, Cal.—Plans being prepared for construction of Solano-Sacramento bridge. Est. length 2,400 ft., cost $170,000. Add. F. A. Steger, Vallejo, for further information.

Rison, Ark.—The expenditure of $10,000 for construction of bridge over Saline River is contemplated by Cleveland Co. Commrs. Contract will be awarded early next year (1917).

Rock Rapids, Iowa.—County Clk. will adv. for bids shortly for construction of sixteen bridges. Est. cost $80,000.

Santa Ana, Cal.—Contemplating issuing bond for $20,000 to construct Hanna Street bridge which was destroyed year ago.

Utica, N. Y.—New York Central R. R. planning construction of rein. concr. bridge over their tracks. Est. cost $30,000. C. W. Kittredge, Ch. Engr., Grand Central Term., N. Y.

Waco, Tex.—Bond issue of $25,000 approved for construction of bridges and culverts. Add. Mayor.

Woodbine, Ga.—Wm. M. Torrance, Civil Engr., Savannah, instructed to prepare plans for construction of bridge across Satilla River in Camden Co. Est. cost $20,000.

York, S. C.—York Co. contemplates constructing bridge over Catawba River in Fort Mill Tp.

LIGHTING.

Huntington, Ind.—Until Dec. 6 (10 a. m.), for construction of system of ornamental lighting for Huntington St. Bridge, Wabash, Ind. Add. Bd. of Commrs., Wabash Co. Frank P. Kircher, Audr.

Fergus Falls, Minn.—Contract awarded to Sterling Electric Co., St. Paul, for in-