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HANDLING MATERIALS BY BUCKET CARRIERS

THE "ONE-PIECE" SYSTEM FOR ELEVATING AND CONVEYING—TYPES, CAPACITIES, ECONOMIC SPEEDS, HORSE-POWERS—ADVANTAGES AND DISADVANTAGES*

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ALL conveying and elevating apparatus so far discussed has had one and the same limitation; that is, each particular type of equipment has been destined for practically but one operation, either that of conveying in a more or less horizontal plane or else elevating more or less vertically. From a purely economic standpoint such limitation is actually an advantage, for the use of a separate and distinct equipment for each main operation is frequently advisable, particularly in installations where the various operations of conveying and elevating must of necessity be continuous. A breakdown in an elevator or conveyer would then not necessarily mean a shutdown, for some temporary makeshift—possibly manual handling of the load—could be resorted to for carrying past the damaged conveyer or elevator and the balance of the operations performed as ordinarily. However, one apparatus for performing both operations of elevating and conveying has the advantage of simplicity and, though a breakdown anywhere in such equipment must necessarily mean a complete shutdown of the entire conveying and elevating system while repairs are made, this more flexible outfit is frequently installed in preference to the more reliable but more complex systems in which the various main operations are performed by individual apparatus. The "one-piece" system frequently possesses the advantage of lower initial cost, and further, the advantage that material may be carried in either direction. For elevating, the "one-piece" system necessitates a succession of buckets, somewhat similar to those of the bucket elevator, and the conveying operations must necessarily be performed by the same buckets. The apparatus is commonly designated as a "bucket carrier," both to distinguish it from a bucket elevator and because such equipment can be, and is sometimes, used to carry material only in a horizontal plane or in an inclined plane.

Classification and Construction.—Two distinct types of bucket carriers are in general use—those in which the buckets are rigidly attached to the endless carrying chains so that on horizontal stretches the buckets act as do the flights of flight conveyers and drag the load along a trough; and those in which the buckets are suspended from the carrying chains so that they maintain an upright position in whatever plane they may be advancing. The latter type of bucket carriers, those with pivoted buckets, require discharging devices which tip the buckets so that their load may be discharged at a specified point. This limits the distributing capability of the pivoted bucket carrier, for but one discharge point is all that is possible without greatly complicating the equipment—that is, only one discharge point without shifting the discharging, bucket tipping, device. The annoyance and inconvenience of frequently shifting the discharging device may be somewhat reduced by the installation of systems of distributing chutes, etc. The pivoted bucket construction also complicates the loading of the carriers to some extent, as they are nearly invariably loaded on a horizontal stretch of carrier, in order to avoid the necessity and complication of a receiving receptacle similar to an elevator boot employed for bucket elevators. The carrier's buckets must then be proportioned so that, on horizontal stretches, there may be no gaps between buckets—only possible when the buckets are provided with lips that extend from one bucket over the edge of the succeeding bucket—or else the bucket carrier must be provided with a reciprocating feeder that delivers load to the carrier only when the succeeding buckets are each in the proper position for receiving their load. Rigid bucket carriers, on the other hand, may be loaded as steadily and uniformly as a flight conveyer.

The construction of bucket carriers permits them to run in almost any conceivable path provided the buckets always lie in the same vertical plane. That is, the elevation of the bucket carrier path may be rectangular, a series of steps with the return run of buckets in a series of descending steps or, as is more common, with the buckets brought down vertically from the end of the carrier travel in the first general direction to the plane of the loading point and thence in a more or less horizontal path to the point where the general direction of advance is upward, etc., etc. Bucket carriers traveling in rectangular paths are the more common and are also the more convenient in that one load can be elevated and then carried horizontally to the desired discharge point while a second load can be carried over the lower horizontal run, elevated and discharged where desired. This type of carrier is frequently installed in power houses where coal is elevated and discharged to coal bunkers by the forward run of buckets and the return run of buckets is employed to carry the ashes from under the grates and discharge to an elevated ash bin from which they may be subsequently removed by other means.

Bucket carriers can, of course, be equipped with buckets of almost any conceivable size and shape, but practice has standardized a rectangular shape with a

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depth about equal to the width. Such buckets are referred to in terms of length and width of bucket, so that the carrying capacity of any standard bucket carrier, loaded with any given material, is dependent upon the spacing of the buckets and the speed at which the carrier is run. Table XI. gives the average carrying capacity of certain common sizes of bucket carriers (length of bucket times in width) when handling material weighing 100 pounds per cubic foot at a carrier speed of 50 feet per minute. At equal spacing of buckets, the carrying capacity of bucket carriers handling other material at other speeds is directly proportional to both weight of material carried and speed of carrier. These definite relations and the fact that all standard buckets are similarly proportioned, permits the expression of the carrying capacity of any standard bucket carrier in the form of a convenient equation. (See Formula XXI.).

Table XI.—Capacity of Bucket Carriers in Tons Per Hour. Material Weighing 100 Pounds Per Cubic Foot. Carrier Speed, 50 Feet Per Minute.

Bucket length x width	Spaced 18 in.	24 in.	30 in.	36 in.
12 in. x 12 in.	25.76	19.36	15.41	12.84
16 in. x 12 in.	34.24	25.68	20.55	17.12
16 in. x 15 in.	53.60	40.20	32.15	26.80
18 in. x 15 in.	60.15	45.10	36.10	30.07
20 in. x 15 in.	—	52.40	41.90	33.45
24 in. x 15 in.	—	60.10	48.00	39.60
20 in. x 20 in.	—	88 80	71.00	59.30
24 in. x 20 in.	—	106.70	85.40	70.40
30 in. x 20 in.	—	—	106.70	89.10
36 in. x 20 in.	—	—	128.00	106.70
30 in. x 24 in.	—	—	—	124.60
36 in. x 24 in.	—	—	—	153.72

$$\text{Capacity}: \quad W = \frac{0.00535 \times w^2 \times l \times w'}{S''} \qquad \text{Formula XXI.}$$

Where:
W = Capacity in tons per hour.
w = Width of bucket in inches.
l = Length of bucket in inches,
w' = Weight of material handled in lbs. per cu. ft.
S'' = Spacing of buckets in inches.

Though the average speed of a bucket carrier is about 50 feet per minute, all materials are not most economically carried at that speed. Certain materials permit considerably higher speeds, while others must be handled more slowly, or excessive breakage, etc., is apt to occur. Table XII. gives speeds that have been found to be economic for certain of the common materials usually handled by such equipment. These speeds are by no means fixed, however, and considerable variation is permissible and not infrequently advisable. In fact, some authorities recommend quite different speeds for some of the materials mentioned in Table XII. However, the data of this table has been collected from numerous efficient installations of bucket carriers and may safely be used as a basis of operation.

Table XII.—Economic Speeds of Bucket Carriers for Various Materials.

Material	Advisable Speed
Coke	40 feet per minute
Broken Stone (coarse); Lump Coal—R.M.	50 feet per minute
Ashes, Lime and Cement	60 feet per minute
Ore, Crushed Stone, Sand and Gravel	70 feet per minute
Fine Coal	80 feet per minute

The consumption of power by the rigid bucket and by the pivoted bucket types of bucket carriers naturally differs considerably, but the difference is somewhat equalized by the fact that the pivoted bucket type is nearly invariably furnished with a reciprocating feeder that consumes quite appreciable power. Other than for this special feature of the pivoted bucket carrier, three distinct operations consume power whether the carrier is of the rigid bucket or pivoted bucket construction: 1st, the running of the apparatus itself, which depends upon the total weight of the moving parts—the weight of the endless chains, the buckets and the attachments; 2nd, the carrying of the load horizontally; and 3rd, the operation of elevating the load. Although load may be carried in two general directions by a bucket carrier, such double transfer of load is seldom, if ever, accomplished at the same time, so that it is customary to figure an allowance of power for conveying in one direction only. The elevating operations consume only about the theoretical power required for the load, as the descending buckets and chains compensate for the work of raising these parts and the friction and other unavoidable losses are almost independent of the height of lift, so are allowed for in the power provisions for horizontal travel of load. Standardization of equipment permits the expression of the weight of the moving parts of the carrier in terms of its carrying capacity in tons per hour, for the strength, hence the weight of the chains, attachments and buckets vary very closely with the load that the carrier is capable of handling. In the derivation of Formulæ XXII. and XXII-a, the value of all constants are based on actual results obtained in a number of successful and economic installations of such equipment and, though the results given by such formulæ may be somewhat higher than the claims advanced by certain manufacturers of bucket carriers, dependence upon the use of formulæ for deriving horsepower requirements of bucket carriers that give smaller results is inadvisable, for so many conditions really effect the question of power consumption by such equipment that no theoretical equation can be derived that will fit all cases.

Horsepower:—

W = Weight of load handled in tons per hour.
L = Length (total) of horizontal stretches of Carrier in one general direction in feet.
H = Height (total) or distance through which load is elevated in feet.
V = Velocity (speed) of Carrier in feet per minute.
W_c = Weight of moving parts of Carrier in lbs. per foot.
= 0.608 W—Carriers with rigid buckets.
= 0.756 W—Carriers with pivoted buckets.
W' = Weight of load handled in lbs. per minute.
= 33 W

$$\frac{W'}{V} = \frac{33\,W}{V} = \text{weight of load handled in lbs. per minute per foot.}$$

f_s = Speed factor = 0.18 —Carriers with rigid buckets.
= 0.035—Carriers with pivoted buckets.

f_l = load factor = 0.70—Carriers with rigid buckets.
= 0.20—Carriers with pivoted buckets.

Horsepower required to run empty carrier:—

Carriers with rigid buckets.

Total weight of moving parts = $2\,(H + L)W_c$
Average velocity of Carrier (V) = 50 feet per minute.

$$HP = \frac{2(H + L)W_c \times V \times f_s}{33000} = \frac{2(H + L) \times 0.608\,W \times 50 \times 0.18}{33000}$$

$$= \frac{33\,(H + L)W}{100,000}$$

Carriers with pivoted buckets.

Total weight of moving parts = $2(H + L)W_c$
Average velocity of Carrier (V) = 50 feet per minute.

$$HP = \frac{2(H + L)W_c \times V \times f_s}{33000} = \frac{2(H + L) \times 0.756\,W \times 50 \times 0.35}{33000}$$

$$= \frac{8(H + L)W}{100000}$$

Horsepower required for handling load on horizontal travel:—

Carriers with rigid buckets.

$$HP = \frac{W' \times f_1 \times V \times L}{33000 \times V} = \frac{33\,W \times 0.70 \times L}{33000} = \frac{70\,WL}{100{,}000}$$

Carriers with pivoted buckets.

$$HP = \frac{W' \times f_1 \times V \times L}{33000 \times V} = \frac{33\,W \times 0.20 \times L}{33000} = \frac{20\,WL}{100{,}000}$$

Horsepower required for elevating load:

All types of Bucket Carriers.

$$HP = \frac{33\,W \times H \times V}{33000 \times V} = \frac{100\,WH}{100{,}000}$$

Horsepower required for Reciprocating Feeder:—

Carriers with pivoted buckets only.

$$HP = \frac{9\,W}{100} \text{ (from experiment).}$$

Total horsepower required:—

Carriers with rigid buckets.

$$HP = \frac{(103\,L + 133\,H)W}{100000} \qquad \text{Formula XXII.}$$

Carriers with pivoted buckets

$$HP = \frac{(28\,L + 108\,H)W}{100000} + \frac{9\,W}{100} \qquad \text{Formula XXII-a}$$

The average bucket carrier is now pretty well standardized as to cost as well as in design, so that unless the buckets are of abnormal proportions or very complicated in design and the carrier chains are efficiently economical such a close relationship exists between the cost of the component parts of such a system and its size and length that an equation may be derived that will closely approximate the cost of any ordinary installation. As far as cost is concerned, the component parts naturally fall into four general groups: 1st, the chains which depend upon the total length of the bucket carrier and the weight of the load to be carried; 2nd, the buckets and attachments which also depend upon the total length of the carrier and the weight of the load; 3rd, the trough, gates, etc., for carriers with rigid buckets, or the rails, discharging devices, etc., for carriers with pivoted buckets, all of which depend upon the size of the buckets and the horizontal travel of the carrier in one direction; and 4th, the sprockets, drive, etc., which depend upon the size of the buckets, or size of carrier—to which must be added the cost of the reciprocating feeder for bucket carriers with pivoted buckets, which latter varies directly in cost with the square root of the product of the width and length of the buckets. As the weight of the load to be carried depends upon the size of the buckets and their spacing, it is possible to derive an equation for ascertaining the approximate cost of any system in which the variable factors are those of total length of bucket carrier, size of bucket and weight of material to be handled. Such an equation follows as Formulæ XXIII. and XXIII.-a, the results attained from the use of which will give very close approximations of the cost of any average standard type of bucket carrier equipment, including an allowance sufficient to cover the cost of a simple installation.

Initial Cost:—

C = Cost of Bucket Carrier equipment in dollars.
wl = Size of buckets in square inches = width x length.
H = Height (total) to which load is elevated in feet.
L = Horizontal travel (total) of buckets in one direction in feet.
S = Spacing of buckets in inches.
w' = Weight of material to be handled in lbs. per cubic foot.

Carriers with rigid buckets.

Average cost of chains ...... $\dfrac{0.024\,wl(H + L)}{S} \times w'$

buckets .... $\dfrac{0.026\,wl(H + L)}{S} \times w'$

Average cost of trough, gates, etc. .... $0.005\,wl\,L$

sprockets, drive, etc. .... $15.25\sqrt{wl}$

$$C = \frac{0.05\,wl(H + L)}{S} \times w' + 0.005\,wl\,L + 15.25\sqrt{wl} \qquad \text{Formula XXIII.}$$

Carrters wiih pivoted buckets.

Average cost of chains .... $\dfrac{0.025\,wl(H + L)}{S} \times w'$

buckets .... $\dfrac{0.045\,wl(H + L)}{S} \times w'$

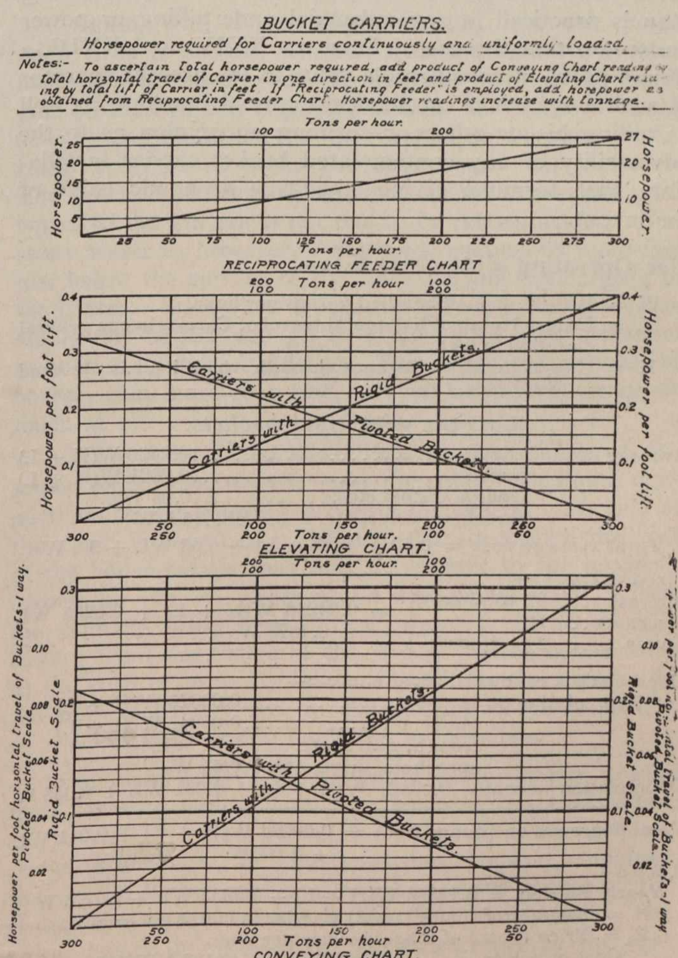
rails, discharging device, etc. $0.05\sqrt{wl}\,L$

sprockets, drive, etc. .... $15.25\sqrt{wl}$

reciprocating feeder .... $0.75\sqrt{wl}$

$$C = \frac{0.07\,wl(H + L)}{S} \times w' + 0.05\sqrt{wl}\,L + 16\sqrt{wl} \qquad \text{Formula XXIII-a.}$$

The close relationship that exists between the carrying capacity of a bucket carrier and the size of its buckets (spacing of buckets depending almost entirely



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upon their size and hence not varying greatly comparatively) allows the expression of cost of equipment in terms of tonnage handled (capacity) suitable for use when considering the factors that enter into the net operating cost. An error enters the initial cost of equipment as ascertained by such means, because the initial cost of an equipment for handling material of any given weight does not really vary directly with the weight, although it does increase somewhat as the weight of the material to be handled increases, but this error is greatly discounted by the comparatively small proportions of the initial cost of equipment that actually enters into the question of net operating cost, being in fact only the fixed charges represented by interest on investment, taxes, insurance, etc. Depreciation, on the other hand, usually increases more rapidly than the increase in initial cost apparent when handling heavier materials, so that, being figured as a percentage of the initial cost, the inaccuracy of figuring a fixed rate of depreciation is compensated for by unduly high initial cost upon which it is figured. Power costs entering into net operating cost are, of course, directly dependent upon the tonnage handled, so that no error is apparent that is due to the high initial cost as expressed in terms of tonnage the carrier is capable of handling. In fact, the only error that appears at all is in figuring the fixed burden of interest, etc., which is but a relatively small percentage of the total net operating cost. Hence, Formulæ XXIV. and XXIV.-a, expressing the net operating cost of handling a ton of material over any bucket carrier system, may be considered conservatively accurate. More accurate results would be unattainable without most careful and complicated bookkeeping—far more systematic and painstaking than is practiced in any indsutrial undertaking or power house—so that the use of Formulæ XXIV. and XXIV.-a should prove of considerable value to the present operator of such a system of mechanical material handling as well as aiding his or others in forming an opinion as to the advisability of any contemplated bucket carrier installation, such formulæ giving the true economic value of the layout.

Net Operating Cost (N.O.C.):—

W = Weight of load handled in tons per hour.
L = Length (total) of horizontal travel of Carrier in one general direction in feet.
H = Height (total) or distance through which load is elevated in feet.

Carriers with rigid buckets.

Average cost of chain .... 0.2420 W(H + L)
buckets .... 0.2621 W(H + L)
trough, gates, etc. .... 0.03 WL.
sprockets, drive, etc. .... 5.5 W
Total average cost = 0.5041 W(H + L) + 0.03 WL + 5.5 W

Fixed charges:—
Interest .. 6% total cost
Insurance .. 1%
Taxes .... 2%—¾ cost
} = 0.04286 W(H + L) + 0.0255 WL + 0.4675 W

Depreciation, renewals, repairs, etc.:—
Depreciation on chains .... 0.03025 W(H + L)
buckets .... 0.05242 W(H + L)
trough, gates, etc. .... 0.01 WL
sprockets, drive, etc. .. 0.55 W
Depreciation account—0.00827 W(H + L) + 0.001 WL + 0.055 W

Total depreciation (summation) = 0.09094 W(H + L) + 0.011 WL + 0.605W

Then:—
Yearly Burden = 0.13380 W(H + L) + 0.0365 WL + 1.0725 W
N = Number of hours (total) Carrier is in use per year.
P_c = Price (cost) of a horsepower per hour.
Cost of power .... (0.00103 L + 0.00133 H)WNP_c
attendance .... (0.0000145 L + 0.000075 H)WN
supplies ...... (0.0000455 L + 0.000045 H)WN

Burden depending upon use of Carrier:—
= (0.00103 L + 0.00133 H)WNP_c + (0.00006 L + 0.00012 H)WN

$$\text{N.O.C.} = \frac{13380(H + L) + 3650\,L + (103\,LP_c + 133\,HP_c + 6L + 12H)N + 107250}{100{,}000\,N}$$

Formula XXIV.

Carriers with pivoted buckets.

Average cost of chain .... 0.2520 W(H + L)
buckets .... 0.4504 W(H + L)
rails, etc. .... 0.0180 WL
sprockets, drive, etc. .. 5.5 W
reciprocating feeder .... 0.25 W
Total average cost = 0.7024 W(H + L) + 0.018 WL + 5.75 W

Fixed charges:—
Interest.... 6% total cost
Insurance.. 1%
Taxes .... 2%—¾ cost
} = 0.05970 W(H + L) + 0.0153 WL + 0.4888 W

Depreciation, renewals, repairs, etc.:—
Depreciation on chains .... 0.0315 W(H + L)
buckets .... 0.06756 W(H × L)
rails, etc. .... 0.002 WL
sprockets, drive, etc..... 0.55 W
reciprocating feeder .... 0.032 W
Depreciation account—0.0099 W(H + L) × 0.0002 WL + 0.058 W

Total depreciation (summation) = 0.10896 W(H + L) + 0.0022 WL + 0.64 W

Then:—
Yearly burden = 0.16866 W(H + L) + 0.0175 WL + 1.1288 W
N = Number of hours (total) Carrier is in use per year.
P_c = Price (cost) of a horsepower per hour.
Cost of power ...... (0.00028 L + 0.00108 H)WNP_c + 0.009 WNP_c
attendance .. (0.0000145 L + 0.000075 H)WN
supplies, etc.. (0.0000455 L + 0.000045 H)WN
Burden depending upon use of Carrier:—
= (0.00028 L + 0.00108 H)WNP_c + 0.009 WNP_c + (0.00006L + 0.00012H)WN

$$\text{N.O.C.} = \frac{16866(H + L) + 1750L + (28LP_c + 108HP_c + 6L + 12H)N + 112880 + 900NP}{100{,}000\,N}$$

Formula XXIV-a.

Examples:—

1. Conditions:—
Bucket Carrier—Rigid Buckets—Rectangular Path
Horizontal travel of load (total) .......I.D. = L = 100′ 0″
Load elevated (total) .... = H = 50′ 0″
Service:—2400 hours per year .... = N
Cost of power:—$0.02 per horsepower hour = P_c

$$\text{N.O.C.} = \frac{2372000 + 1539 \times 2400 + 107250}{100{,}000 \times 2400} = \$0.02572 \text{ per ton of material handled}$$

2. Conditions:—
Same as Example 1 except that service is for but 1200 hours per year.

$$\text{N.O.C.} = \frac{2372000 + 1539 \times 1200 + 107250}{100{,}000 \times 1200} = \$0.03605 \text{ per ton of material handled}$$

3. Conditions:—
Bucket Carrier—Pivoted Buckets—Rectangular Path
Horizontal travel of load (total) ....1D = L = 100′ 0″
Load elevated (total) .... = H = 50′ 0″
Service:—2400 hours per year .... = N
Cost of power:—$0.02 per horsepower hour = P_c

$$\text{N.O.C.} = \frac{2704900 + 1364 \times 2400 + 112880 + 43200}{100{,}000 \times 2400} = \$0.02556 \text{ per ton of material handled}$$

4. Conditions:—
Same as Example 3 except that service is for but 1200 hours per year.

$$\text{N.O.C.} = \frac{2704900 + 1364 \times 1200 + 112880 + 43200}{100{,}000 \times 1200} = \$0.03748 \text{ per ton of material handled}$$

The examples cited are based on conditions frequently found in actual practice, and bring out two interesting and important facts: First, that the hours of service of a bucket carrier installation have considerable effect upon the net operating cost of the system, and second, that the hours of service bear a greater effect upon bucket carriers with pivoted buckets than upon those in which the buckets are rigidly attached to the chains and must therefore scrape the load over horizontal stretches. The first of these facts is because the items depending upon the cost of power are relatively small compared with the other factors entering into the question of net operating cost. The items chargeable to depreciation are by far the most important, and these vary little, whether the carrier is in use continually or only half time, for the wear and tear on a well cared for carrier that is in continual use is little, if any, greater than the general depreciation that is bound to occur in an equipment allowed to remain idle half the time. The second fact is due the cost of necessary power to operate the system being even relatively smaller in the case of the more refined bucket carrier than in the case of carrier with buckets rigidly attached to the chains, making it even more imperative to use the carrier with pivoted buckets continually if the greatest benefits are to be attained. A comparison of the net operating cost of a bucket carrier with the net operating cost of a combined system of bucket elevator and any other conveyer so far discussed shows that the advantages of the more flexible system is rather a matter of convenience than economy. It costs more to operate a bucket carrier over a given path than it would to operate a combination of bucket elevator for the lifting operation and any conveyer, even one as relatively uneconomical as a flight conveyer, for the horizontal carry of the load. This is due, of course, to the much greater power requirements of the empty bucket carrier than is required for the similar work entailed in running both the elevator and conveyer without load. Nevertheless, bucket carriers do possess the advantage of simplicity and, though somewhat more expensive to operate than more complex systems, are excellent for many installations where the cost of operation is of less importance than convenience. Their greatest disadvantage is that a breakdown means a shutdown unless every possible provision is made to provide other means of handling part of the load while necessary repairs are in progress.

IMPORTANT FACTORS IN THE DESIGN OF SEWERAGE SYSTEMS.

In the construction of a new sewerage system, or of new sewers, one of the problems which first arises is the question, shall the sewers be built on the combined or on the separate system, or partly on both? The question often cannot be answered without careful study, as consideration has to be given to numerous factors. Two factors of the greatest importance are the questions of cost and of sewage disposal. In a paper presented on October 7th to the convention at Wilmington, Del., of the American Society of Municipal Improvements, Mr. John H. Gregory, consulting engineer and sanitary expert, of the firm of Hering & Gregory, New York City, discusses some phases of the subject, as well as some of the relations which the sewers bear to the problem of sewage disposal, as follows:—

As a general proposition, where both sewage and storm water are to be removed in artificially constructed channels, it is probably safe to say that the cost of building a combined system, in which both the sewage and storm water flow in the same channel, generally spoken of as a combined sewer, is less than that of constructing a separate system, in which the sewage flows in one set of pipes, frequently called sanitary sewers, and the storm water in another set, called storm water drains. This is especially true where the territory to be served is more or less closely built up and the streets are already surfaced or paved.

On the other hand, in suburban territory, not closely built up and not likely to be so built up in the near future, and where the storm water is easily and quickly diverted into natural watercourses, the separate system will in general cost less, for the reason that the sanitary sewers need only be built at first, the construction of the storm water drains being deferred for a period of years, or only such drains built as are immediately required. The cost of building a combined system in such a territory might easily be so great as to be actually prohibitive, whereas, the construction of the sanitary sewers of a separate system, as just outlined, could be carried out and would serve all requirements for a considerable period of time.

Topography an Important Consideration.—With steep grades and relatively high velocities in the sewers, it might prove more advisable, on account of the relatively small additional cost, to build combined rather than separate sewers, although the character of the development of the territory might hardly be such as to require the removal of the storm water by this means.

In narrow streets and in congested districts combined sewers have one advantage in that only one sewer is required, thereby reducing to a minimum the amount of sub-surface obstructions. True, the combined sewer will be slightly larger than the corresponding storm water drain which would be required, but the increase in size of the latter is generally so small as to be of little importance. With the separate system, however, two pipes are required, and sometimes three, when a sanitary sewer is laid on each side of the storm water drain, this condition being forced when the storm water drain has to be built so close to the surface of the street as to prevent the carrying of house connections over it.

Again, with the combined system, but one house connection is needed, whereas with the separate system, especially in closely built-up districts with paved yards and areas, two are required, one for the removal of the sewage and the other for the removal of the storm water from roofs, paved areas and other impervious surfaces. The practice of discharging storm water across the sidewalks to the gutters is not one to be recommended. The storm water is, however, sometimes removed by pipes laid just below the surface of the sidewalk and discharging at the gutter. Such pipes frequently give trouble, and often would not be low enough to drain paved areas adjacent to or in the rear of buildings. Two house connections, of course, cost more than one, but not necessarily twice as much as one.

With a combined sewer laid in the middle of the street, as is generally the case, the cost of the house connections to the abutting property owners on each side of the street is equalized. With a separate system the cost of the house connections may be greater to the property owners on one side of the street than on the other, unless the sanitary sewer and storm water drain are equally distant from the centre of the street. If the connections to the curb or property line are put in at the expense of the municipality the cost to the abutting property owners as a whole is as nearly equalized as possible.

Combined sewers are generally laid on flatter grades than separate sewers and may increase the area which can be served without pumping. They may even eliminate pumping entirely. It sometimes happens that combined sewers can be advantageously adopted for a part of the system and separate sewers for the remainder. The writer has in mind one of the large cities in the east where no pumping is required and in which three-quarters of the city is sewered on the separate system and one-quarter on the combined system. The section of the city sewered on the combined system was too low to be sewered on the separate system without pumping and it was in order to avoid pumping that this section of the city was sewered on the combined system.

Higher velocities are required in combined sewers in order to prevent the deposition of grit. Velocities which would be permissible in sanitary sewers would not give satisfactory results in combined sewers. Deposits would be likely to accumulate, especially if a great variation existed between the minimum rate of dry weather flow and the maximum rate of storm flow. When deposits occur in combined sewers organic matter is likely to be held back and settle out or become stranded. If putrefaction of this organic matter takes place before it is washed away malodorous conditions arise. With a long-continued very low dry weather flow deposits may cause the sewage to be ponded with the result that the sewage may become stale, or possibly septic, a condition which should by all means be avoided, independent of whether the sewage is to be treated or not.

The Disposal of the Sewage.—If the sewage is to be discharged into a body of water without any treatment whatsoever, a condition less and less likely to arise in the future, combined sewers would frequently offer the simplest and cheapest solution of the problem. If, however, the sewage is to be treated, separate sewers have certain advantages. In order to limit somewhat the scope of the paper it will be assumed that the sewage must receive some treatment before final discharge and that the treatment will be at one point. Further, that ample opportunity is afforded for the discharge of storm water without having to carry it any great distance.

Sewage treatment works cost money. It is therefore desirable to keep them as small as possible, and in order to do this the volume of liquid to be handled must be kept at a minimum. Rarely, if ever, would it be the case that all of the storm water would have to be treated; hence in this discussion the question of treating other than the first wash of the streets, in addition to the sewage, will not be considered.

With a separate system the volume to be handled at the treatment works is the total sewage flow in the sanitary sewers. The liquid is made up of house sewage, ground water leakage and trade wastes. The flow may, however, be increased in times of storm by taking in the first wash of the streets from the storm water drains, should it be found necessary or desirable to treat the first wash.

With a combined system, under dry weather conditions, the volume to be handled ordinarily is what is commonly spoken of as the dry weather flow, and is also made up of house sewage, ground water leakage and trade wastes. In times of storm, however, the flow in the combined sewers is increased by the storm water from the streets. The liquid then consists of a mixture of house sewage, ground water leakage, trade wastes and storm water.

The effect of the storm water in combined sewers is two-fold—it not only increases the volume of liquid flowing but it changes its character. The first wash from the streets is often exceedingly foul and may increase the organic content of the liquid flowing in the sewers, giving what may be called a stronger sewage. As more and more storm water enters the sewers the storm water becomes cleaner and cleaner, and with the greatly increased flow in the sewers the organic content of the liquid is decreased, resulting in what may be called a weak or dilute sewage.

The volume of liquid to be handled at the treatment works from a combined system depends on whether only the dry weather flow or the dry weather flow plus some storm water is to be intercepted. If only the dry weather flow is to be intercepted, then the volume to be handled at the treatment works would, in general, be substantially the same from the combined system as from the separate system.

One fundamental difference between the two systems, however, exists. With the separate system no raw sewage escapes to the streams or watercourses, while with the combined system raw sewage must at times be discharged into them. If it is planned to intercept only the dry weather flow, then, during storms, just as soon as the flow in the combined sewers exceeds the maximum rate of dry weather flow the surplus flow, over and above that which can be intercepted, escapes, with the result that a mixture of sewage and storm water must reach the streams.

It is true that the overflow of raw sewage from combined sewers into the streams ordinarily would take place only during periods of storm, but even the occasional discharge of raw unscreened sewage into a stream is a question which must be carefully considered. It might be the case, and probably often would be the case, that as far as the temporary reduction of dissolved oxgyen in the stream is concerned no harm would be done, but floating particles of paper and faecal matter are offensive to the sight. If, however, the stream into which the overflow of sewage would take place is sluggish and with but little velocity it may easily be that the continued overflow of sewage into it, from time to time, with the accumulation of sludge deposits on the bottom, would lead to offensive conditions.

Consideration for the Community.—While considering the question of the overflow of raw sewage from combined sewers one point of view of the public should not be overlooked. In general, the public knows but little of the difference between the separate and the combined system. They know that sewers are needed, that the sewage must be treated before being finally disposed of, and that a disposal works must therefore be built. Their natural inference is then that all of the sewage will be treated at all times. If the separate system is adopted—well and good. But if, instead, the sewers are built on the combined system and the public sees raw sewage, even if dilute, discharged into the streams from time to time will they be satisfied? And again, will the state authorities be satisfied? The question is one, aside from dollars and cents, which should and must receive the most careful consideration.

With a combined system, in order to reduce the number of times during the year that raw sewage would overflow, it might be planned to intercept some storm water as well as the dry weather flow. One direct effect which this would have on the sewage treatment works would be to increase their size, and consequently their cost, over and above that which would be required if the separate system had been adopted.

If it is found desirable or necessary to intercept and treat the first wash from the streets the separate system is more advantageous than the combined system, as by its adoption no overflow of raw sewage to the streams will take place. The storm water drains receive only storm water and the first wash from the streets can be intercepted in the storm water drains and discharged either into the sanitary sewers, or into the intercepting sewer leading to the treatment works. As the flow in the storm water drains increases, the surplus water, over and above that intercepted, overflows to the streams but carries no sewage with it.

The separate system, under certain conditions, offers greater flexibility in the disposal of trade wastes than does the combined system, unless the first wash of the streets is to be intercepted and treated. Some trade wastes are offensive and if discharged into the sewers in such a condition must be treated. On the other hand, some trade wastes are inoffensive and can be discharged direct into the streams without causing any nuisance or trouble.

With the separate system the offensive trade wastes can be discharged into the sanitary sewers and the inoffensive wastes into the storm water drains. The offensive trade wastes only would then be carried to the treatment works. With the combined system all of the trade wastes, the inoffensive as well as the offensive ones, would have to be intercepted and carried to the treatment works, with the result that the treatment works would have to be somewhat larger in size, and hence would cost more than would be the case if the separate system had been adopted.

With a community which is largely residential in character, the volume of trade wastes would affect but very little the total sewage flow. With a manufacturing community, however, the trade waste might amount to quite a large percentage of the total flow and in extreme cases might equal in volume the house sewage. Under such conditions it is evident that, if any considerable percentage of the trade wastes is inoffensive, separate sewers would be of decided advantage, as they would permit of the inoffensive wastes being discharged direct into the storm water drains, the offensive wastes only being discharged into the sanitary sewers and by them carried to the treatment works.

With a combined system automatic regulators are generally used on the connections between the combined sewers and the intercepting sewer to limit the amount of flow from the combined sewers to the intercepting sewer. With a separate system automatic regulators are not required unless the first wash from the streets is intercepted in the storm water drains. Automatic devices in sewers, as a general proposition, no matter how well designed, are to be avoided wherever possible.

The Removal of Grit.—The presence of grit at a sewage disposal works is generally more or less of an annoyance, especially when the sewage has to be pumped and passed through settling tanks. With combined sewers, receiving as they do storm water from the streets, a considerable amount of grit must be expected to reach the disposal works, not only during wet weather but during dry weather also. With separate sewers the amount of grit received at the disposal works is relatively small unless the first wash from the streets is intercepted in the storm water drains and carried to the disposal works.

It has been suggested that a considerable amount of grit could be prevented from reaching the disposal works from combined sewers by inserting a catch basin or sand catcher on each connection between the combined sewers and the intercepting sewer. It is probably true that such would be the case, but it is a question whether this would be a good method of removing grit. In the first place these sand catchers would sooner or later fill up, and unless cleaned at proper intervals would fail to serve the purpose for which they were built. Again, it is very probable that more or less organic matter would be deposited in them, especially when only the dry weather flow, consisting as it would mainly of sewage, was passing through them. The retention of organic matter would lead to offensive conditions as soon as putrefaction began.

The inserting of sand catchers between storm water drains and an intercepting sewer would seem to be a more practicable proposition as the possibility of retaining offensive matter from sewage would then be eliminated. The sand catchers would still, however, have to be cleaned in order to make them effective.

With combined sewers or with separate sewers in which the first wash from the streets is intercepted in the storm water drains grit must be expected. Such being the case, it is a question if the simplest way of handling the grit is not to admit it into the intercepting sewer from the combined sewers or storm water drains, without attempting to intercept any portion of it, and then to transport it with a good velocity in the intercepting sewer direct to the sewage disposal works. Even with sand catchers on the connections between the combined sewers or storm water drains and the intercepting sewer enough grit is sure to reach the sewage disposal works to require its removal before the sewage is pumped or passed through settling tanks. The removal of grit at one point instead of at numerous points has many advantages.

The common practice of removing grit at a sewage disposal works is to pass the sewage at a slow velocity, roughly about one foot per second, through a grit chamber, the grit settling out and being retained on the bottom of the chamber. In large works mechanical means are provided for removing the grit from the grit chamber, but in smaller works it is common practice to drain out the liquid from the grit chamber and to then shovel the grit out by hand.

With a separate system, in which the first wash from the streets is not intercepted from the storm water drains, a question arises as to the necessity of providing a grit chamber at the sewage disposal works. Practice varies. At some disposal works grit chambers have been provided and at others not. If the sanitary sewers are properly designed and built and are provided with tight covers but very little grit should get into the systems, but with macadam or dirt streets and perforated covers some grit must be expected. The safest plan, under ordinary conditions, seems to be to provide a grit chamber, even if it be a small one. The grit would require removal only at more or less infrequent intervals.

Perhaps the question may arise as to the necessity of removing the grit. It would, of course, be perfectly possible to pump the grit along with the sewage, but this would cause unnecessary wear and tear on the pumps. Again, if the grit is not removed before reaching the suction well, it may easily settle in and clog up the suction well causing thereby a shut-down until the well is cleaned out.

If the grit is admitted to the settling tanks it may cause trouble there. It depends, of course, on what type of tank is used and on the method of operation. If the tank is an Imhoff tank the grit, by settling down into the sludge digestion chamber, may check or prevent the proper digestion of the sludge and consequently affect the satisfactory operation of the tank. The admission of grit to a septic tank may also interfere with its satisfactory operation. If admitted to a plain settling tank, which is cleaned out at frequent intervals, the main trouble to be expected would be in the cleaning out of the tank.

With sewage from a combined system the volume of sludge accumulating in settling tanks is greater than with sewage from the separate system. It may even be nearly

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THE PROTECTION AND UPKEEP OF ROAD EQUIPMENT.*

By Daniel J. Hauer,
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No matter whether roads are built by contractors or by day labor forces under the direction of engineers, the item of plant and equipment is one of the prominent factors of cost. Inadequate plant means to materially increase the cost of construction. Only recently the writer stood watching some road building upon which only a few tools were being used, and most of them were ill-adapted to the work. It was difficult to accurately calculate the exact amount of money that was wasted, due to a lack of road equipment, but it was easily estimated that the cost of construction was increased at least twenty-five per cent. Likewise, too much plant can make an added cost. Even with the proper plant, and handled in an efficient manner, the plant item in road construction is a larger per cent. of the total cost of the work than in most other classes of construction. This is due to two causes. First, the plant necessary to build a wagon road is much more expensive than that to build, to illustrate we will say, a railroad. With light grading on both, the same equipment will be needed to do the excavation. For the railroad a small concrete mixer may be needed, and some track-laying tools to complete the job. On the other hand, for the wagon road there will be much hauling of road materials, thus wagons and a traction engine will be needed, then road scrapers or graders, and spreading machines, water sprinklers, oil sprinklers, and heating apparatus will be necessary; scarifiers, harrows and rollers must be used, while for concrete culverts and bridges, mixers, derricks, buckets, barrows, and other appliances are called for to do the job in an efficient manner. The writer has constructed a section of a railroad costing about $100,000, with a plant costing only about $5,000, while a contract for less than $50,000 of wagon road work took an outfit costing nearly $20,000; forty per cent. of the total cost instead of five.

The second reason for the larger cost of plant for wagon road construction is that this class of work is let out in small scattered contracts that are uneconomical from a constructive standpoint. The season, too, for road building in nearly every section of the country is short.

Naturally the life of any machine is dependent upon the use and care given it. The longer the life, the less the annual depreciation, consequently some of the high plant cost can be eliminated from road construction by the proper care and upkeep of the equipment, and by selecting the most improved and economical types.

As far as possible the same machines should be used for many different purposes. This can be done in two ways: By trying out machines designed for one particular kind of work for other kinds, and by adding attachments to machines that thus adapt them to three or four different things.

To illustrate, a contractor once found by experimenting that a certain kind of road grader would spread crushed stone for macadam at a very much less cost than it could be done by any other known method, at that time. Then a road roller that can be used as a traction engine, with a scarifier attachment, and likewise for operating a stone crusher, or other machines, can be said to be four tools in one; not that it is possible to use it for more than one purpose at a time but in the present method of building roads a roller is only used a small portion of the time, so it is economical to adapt it to as many uses as possible. In this manner the cost of plant, or rather the investment in plant, can be maintained at the minimum.

In like manner, wagons, which are an important factor in road building, should be of the most improved type, and adapted as far as possible to all kinds of hauling. So, too, with concrete mixers. Some contracts demand a hot mixer as well as one for mixing ordinary concrete. Money is saved when one mixer will answer for both purposes.

Another item in the cost of plant is in the character of the plant purchased. Cheap and poorly made plant means money lost to the contractor in several ways. Delays occur through breakdowns and these are always expensive. Cheaply made tools mean continual repairs and a short life, and are an added expense to any job. Only well made tools should be used. A guarantee as to the construction of a machine can and does mean little. It does not mean payment for delays caused by breakdowns nor for poor work being done. The ability of a manufacturer for swearing his product is a good one is not a help to a contractor or engineer in getting his work done, nor in showing that the machine in question is well built. The greatest asset is in buying from a firm of recognized responsibility, one of integrity, and one that is so well advertised that they must stand behind their products by putting into them only the best of materials and workmanship. This is the best guarantee possible. This means work done at a low cost. A firm with such a reputation means that thousands of dollars have been spent by them and their customers in obtaining these results. The new customer profits from these past expenditures.

These are all possible factors in plant and equipment, upkeep and maintenance cost. The problem that the contractor and construction engineer must solve in this connection is a very difficult one, owing to the many adverse conditions.

Road work is done in comparatively short stretches, usually in a single season, which varies in length from about one hundred to one hundred and eighty days, according to the climatic conditions. A contractor's plant is moved on to a job, and is used along the line of the work, part or all of the time during the season. Much of a contractor's plant is made up of transportation machinery, and even other items of plant are only working in one place for a few days at a time, so that to protect plant while at work on such jobs is very difficult, and in many cases any kind of a protection is a detriment, and a great hindrance to the free movement of the men and teams.

All machinery should be protected when it is not being used, and some when in use. Boilers at work, use much more fuel when not protected. Some kind of a house, built in sections should always be used to protect boilers. Such sheds can have one side left out, and a canvas curtain used when necessary. If the sides and tops are built in sections they can be hooked together with hooks and rods and staples so as to be rigid enough to stand up against the wind and weather.

*Read at American Road Congress, held at Detroit, Mich., Sept. 29 to Oct. 4, 1913.

Machinery that cannot be protected while at work, can be covered with canvas coverings over night, during rainy spells and at such times when they are not in use. Every traction engine and roller should be thus protected. Steam drills and such tools can be covered with a canvas jacket. The machinery part of a concrete mixer can be so protected, and also pumps and other equipment. Heavy water-proofed canvas will be found to be excellent for this purpose, and not only keep the machinery clean from dust and mud, but will likewise prolong the life of the equipment. As the canvas becomes worn from use, it must be re-treated with water-proofing liquids to preserve it.

At the end of the season, with the job finished, the question always arises, "What shall be done with the plant?" To move it from its present place to some central storage point, will mean an added expense to get it on to a new job. If the work on the same road is to be continued the next season the entire outfit may have to be moved back. The plant can be moved to the next job at the minimum cost from the site upon which it last worked. Then the question comes as to how repairs should be made, and the protection to be given the plant from the winter weather.

Situated away from the machine shops, the proper overhauling cannot be given to all the plant, but it will be possible to replace many of the worn and broken parts with new ones, tighten up all loose keys and nuts, true up all bearings, and do all repairing that can be done in the open. Then all iron and wood work can be painted. This is a protection not only against the weather, prolonging the life of the plant, but is also a business proposition that pays well, as every one is impressed with machinery that looks well, and paint covers a multitude of defects.

In some localities it is possible to obtain an empty warehouse or barn in which the various machines can be stored while they are idle, or during the winter season. This keeps them entirely out of the weather, and also allows of repairs being made under cover, which means not only quicker, but also cheaper work.

For winter storage it is also possible to group a number of machines together, and build over and around them a temporary shelter made of cheap boards and single ply tar paper, which will last during a winter season. By using the tar paper, the boards can be spread six inches or more apart, both on the sides and roof. Around this temporary shed a ditch should be dug so as to prevent surface water from getting to the machines.

If it is not possible to protect the machines by any of these methods, then the canvas coverings can be resorted to, with fairly good results. These covers should, as far as possible, be shaped to the machine upon which they are to be used. Good and substantial brass eyelets should be fastened in the well bound edges, so that the coverings can be tied tightly to or under the machines, otherwise the wind will flap them loose, soon beating the covering into shreds, as a flag is worn out by the wind, and thus exposing the machine to the weather. Canvas coverings made to fit any machine will always be found useful in protecting machines over night or when not in use for a few days.

Whenever machines are not stored for the winter in buildings, they should be stripped of their brass and glass parts, otherwise these fixtures will be broken or stolen, which means a serious loss. The parts from each machine should be placed in a separate box, nailed up and properly labeled, the box being stored away for safe keeping. If the machines are stored in a building, it is not necessary to take off parts, as if any one breaks into the building they must go to the trouble of taking off the brass, while if the parts are stored in boxes, the rascals take box and all, giving them much less trouble, and thus assisting them in making a clean sweep of all the brass fixtures.

When a new machine is purchased, there should always be bought at the same time a number of spare parts, which should be kept on hand to be used as needed. No man can build a machine that will not break down in some vital part sooner or later. A breakdown in a construction job means not only a delay, but a waste of money, for even if men can be laid off and not paid, or can be given other work, yet the job, due to the changes made necessary by the breakdown, will not be worked in the most economical manner. It is true that many contractors do keep some spare parts, but they seldom have on hand enough, or the proper ones, due to the fact that as the parts are used to replace broken ones, new ones are not ordered from the factory. Then either one of two things occurs: the job is shut down or some part of it, or the machine is worked with the broken part until a new one can be ordered and put in place. This means that the machine is racked by the work it does, doing permanent injury to it.

A good blacksmith shop on the job, equipped with forge for heating heavy steel and with stocks and dies for bolts and pipe, and with good drills and vises, will be found to be a great assistance in the upkeep of road equipment. For heavy machines a few roller bearing or small hydraulic jacks will be found useful in making repairs and renewals.

Small tools can be repaired promptly in a blacksmith shop. Attention should be given to these as well as to the larger machines. To prevent such tools being lost, they should not only be branded with a die of the contractor's name or initials, but they should likewise be painted with a set of colors, selected by the contractor, to designate his equipment and advertise his business. These colors can be used on the head of some tools, and in most cases on the handles. Tools can thus be seen at some distance, and thus prevent their being stolen or lost. All bright parts of tools and machines that can't be painted should be well greased so as to prevent rusting.

Many of these suggestions seem useless, or more or less self evident, but any one who has much to do with road construction knows that tools and machines are scattered along the entire line of a piece of new road construction, just where they were last used, and there they stay, neglected, until they are needed again. Then they are found out of order, and to repair them, frequently new parts must be ordered, some days intervening before such parts arrive. The tool or machine depreciates greatly in value by such treatment, and thus contractors are compelled to figure a heavy plant expense item against every job. The cost of caring for this equipment is much less than the depreciation figured against it from neglect.

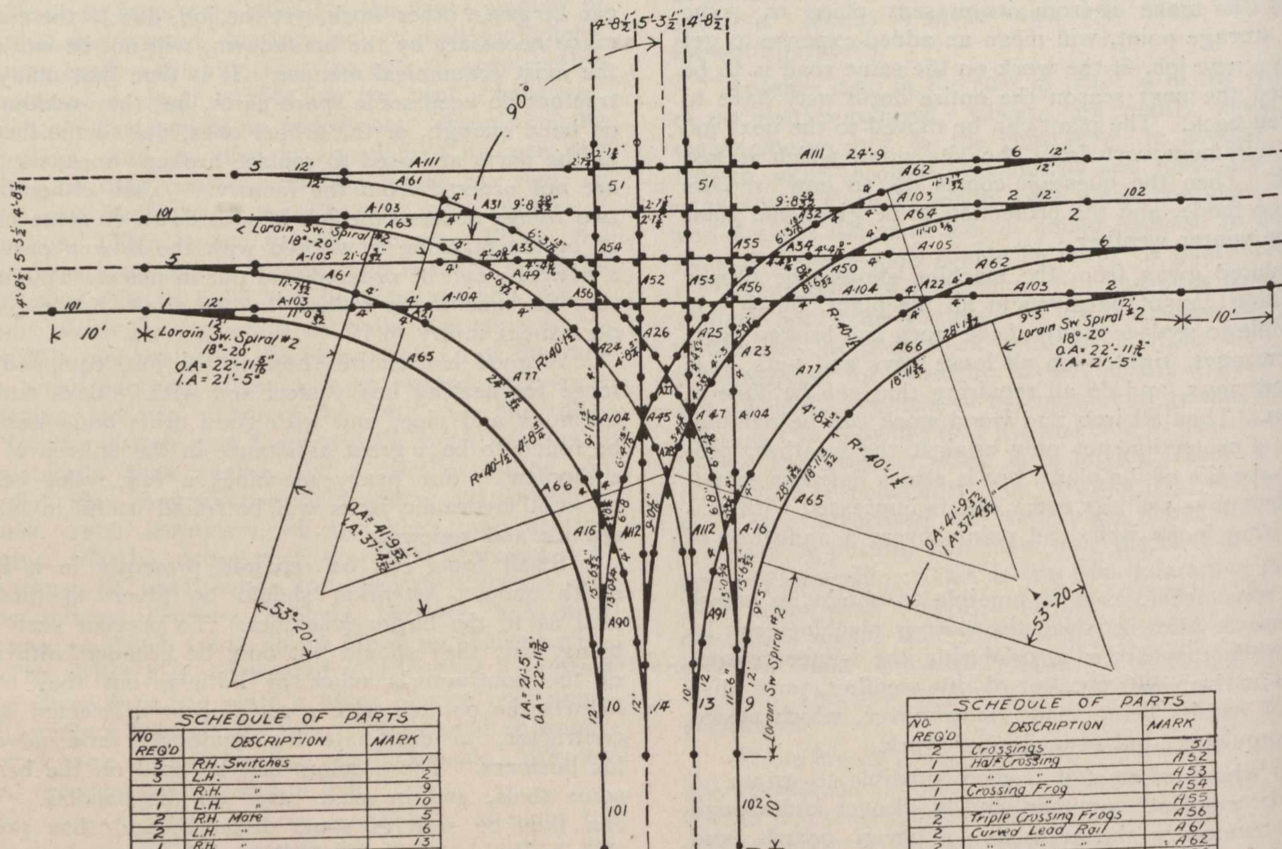
Such extra costs mean higher prices for road work, and as there are many thousand miles of roads that need improving, every dollar wasted means less mileage built each year. Both engineers and contractors are interested in obtaining good roads, and they should do everything possible to save money in the construction of roads.

STANDARDIZATION OF STREET RAILWAY SPECIAL WORK.

In line with the policy of standardizing as much of the material used by it as possible, the Metropolitan Street Railway Company, of Kansas City, Mo., has adopted a set of standards for special work which are very complete. The standards have been tried out for a year or more, and the results so far obtained are very satisfactory. They were worked out under the direction of Mr. A. E. Harvey, chief engineer, who describes them in an article in "Electric Traction," and includes details of rail curvature sections, lengths, etc., in connection with them. The following information is extracted from it, to show how standardization methods are applied in cases where layouts are renewed or new work put in, it being exceedingly desirable that the work be of such character as to be interchangeable and renewable, piece by piece, from stock.

In the establishing of something that could be standard the following points were included in Mr. Harvey's problem as it had to be solved: rail section, radii of curves, length of pieces, material, design, and various minor details in regard to the assembling of the work which present themselves as the larger details are developed.

Rail Section.—In the selection of the section of rail to be used in the special work, consideration had to be given to the fact that a very considerable percentage of the tracks in the paved streets of Kansas City were laid with 100-lb. A. S. C. E. section. This rail has proved exceedingly satisfactory; there was no reason why the section should be changed, and it was desirable that the special work should be constructed so that it would fish with this section without the use of compromise joints. Various problems presented themselves in the detailing of this special work, particularly the question of guarding, but with this problem solved, it was decided that this was the most desirable section for use in the construction of the work.



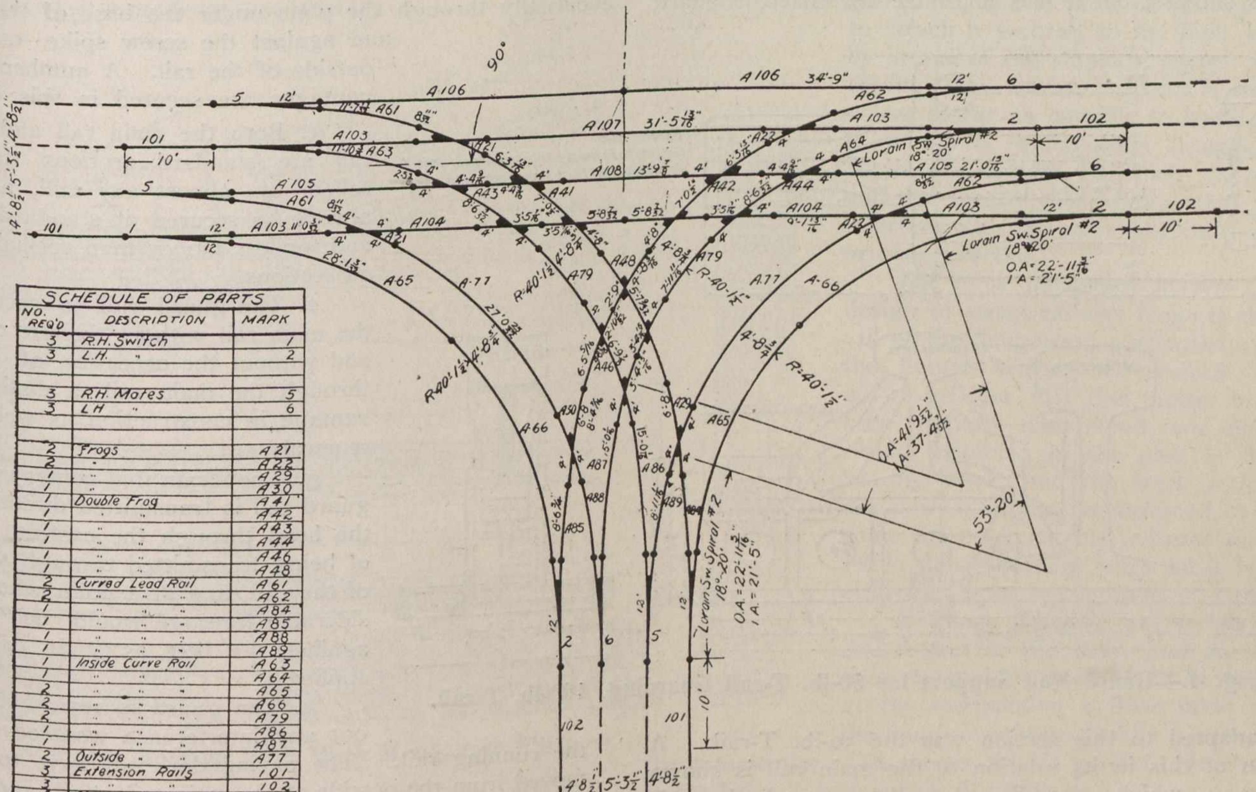
SCHEDULE OF PARTS		
NO REQ'D	DESCRIPTION	MARK
3	R.H. Switches	1
3	L.H. "	2
1	R.H. "	9
1	L.H. "	10
2	R.H. Mate	5
2	L.H. "	6
1	R.H. "	13
1	L.H. "	14
1	Combination Mate & Frog	A15
1	" " " "	A16
1	Frog	A21
1	"	A22
1	"	A23
1	"	A24
1	"	A25
1	"	A26
1	"	A27
1	"	A28
1	"	A31
1	"	A32
1	"	A34
1	"	A33
1	Double Frog	A49
1	" "	A50
1	Triple "	A45
1	" "	A47

SCHEDULE OF PARTS		
NO. REQ'D	DESCRIPTION	MARK
2	Crossings	51
1	Half Crossing	A52
1	" "	A53
1	Crossing Frog	A54
1	" "	A55
2	Triple Crossing Frogs	A56
2	Curved Lead Rail	A61
2	" " "	A62
1	" " "	A90
1	" " "	A91
1	Inside Curve Rail	A63
1	" " "	A64
2	" " "	A65
2	" " "	A66
2	Outside Curve Rail	A77
3	Extension Rail	101
3	" "	102
4	Straight Lead Rails	A103
2	" " "	A112
4	" Rails	A104
2	" "	A105
2	" "	A111

Fig. 1.—Special Work Standards for Double Track Closed "Y" and Crossing.

Radii of Curves.—The radii of the curves selected for the standard work is controlled to a certain extent by the width of streets in Kansas City. Some of these are of such width that it was impracticable to use a curve of less radius than 42.5 ft. This, therefore, was adopted as the minimum. There are few places where a larger radius than 65 ft. can be used. These two radii, with one intermediate standard of 50 ft., were adopted as standard, and the special work designed upon this basis. These curves were all used in connection with Lorain spirals No. 2. Using these radii as a basis, the various combinations that might be used in any layout on an angle of 90 degrees are detailed in the manner shown in the accompanying figures. These combinations were all laid out on an angle of 90 degrees, which could in almost every case be used in Kansas City, particularly where a few minutes can be thrown in the angle of the next block.

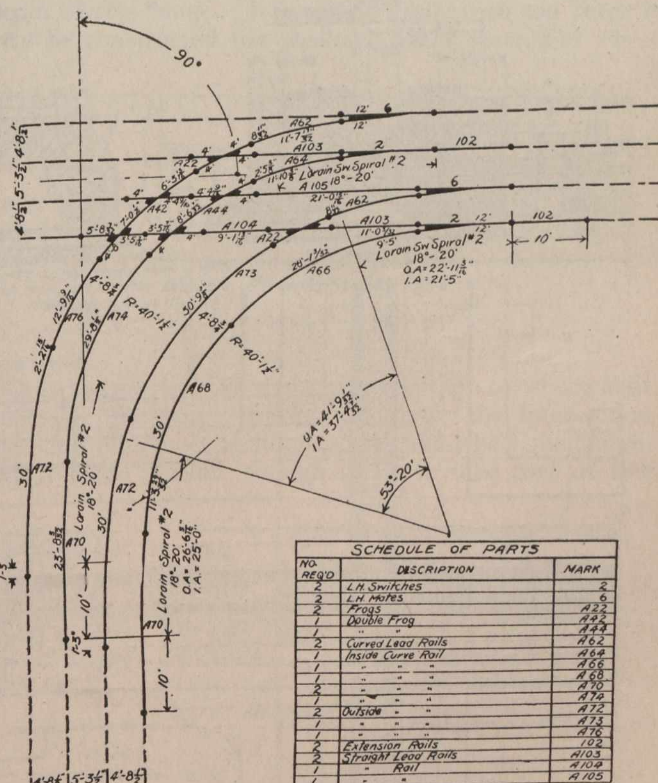
Length of Pieces.—It will be noted that the pieces are detailed so far as length is concerned, making a minimum number of joints, and establishing the length of each arm so that standard pieces are interchangeable. Under this design a minimum number of standard pieces is secured, as there are quite a number of pieces that are common to both a single track turnout and all the more complicated combinations; that is, the switch frogs and diamonds are the same in the plain turnout crossing the second track as would be found in a double track closed wye. The number of different kinds of switches is reduced to two, a right and a left, except that in some of the more complicated layouts there is a slight variation in the arm lengths for switches and mates, and in layouts which are designed for clearance, and which are used where it is practicable to obtain such clearance, a 150-ft. radius is used instead of 100 ft. The advantages of these standards and the interchangeability of these switches are manifest. In future years the cost of renewals would be very much reduced, and repairs and renewals could be made from stock without carrying a stock of any great amount. The advantage derived from it at present is that the work, as required, may proceed by taking stock pieces and assembling them in any combination required, and where material which might be ordered for one location, upon which the work for any reason might be delayed, may be used elsewhere and not stored indefinitely. All of this would tend to decrease the size stock that it is necessary to carry in our store yard.



SCHEDULE OF PARTS		
NO. REQ'D	DESCRIPTION	MARK
3	R.H. Switch	1
3	L.H. "	2
3	R.H. Mates	5
3	LH "	6
2	Frogs	A 21
2	"	A 22
1	"	A 29
1	"	A 30
1	Double Frog	A 41
1	" "	A 42
1	" "	A 43
1	" "	A 44
1	" "	A 46
1	" "	A 48
2	Curved Lead Rail	A 61
2	" " "	A 62
1	" " "	A 84
1	" " "	A 85
1	" " "	A 88
1	" " "	A 89
1	Inside Curve Rail	A 63
1	" " "	A 64
2	" " "	A 65
2	" " "	A 66
2	" " "	A 79
1	" " "	A 86
1	" " "	A 87
2	Outside " "	A 77
3	Extension Rails	101
3	" "	102
4	Straight Lead Rails	A 103
2	Straight Rails	A 104
2	" "	A 105
2	" "	A 106
1	" "	A 107
1	" "	A 108

Fig. 2.—Special Work Standards for Double Track Closed "Y."

Material.—Recognizing the fact that in some locations one kind of material might be required and in others a cheaper grade, the question of standard material has been left open, and the detail of the design only carried to a point where it would not forbid the use of pieces made from either solid manganese, cast bound work, built-up work or cast steel.



SCHEDULE OF PARTS		
NO. REQ'D	DESCRIPTION	MARK
2	L.H. Switches	2
2	L.H. Mates	6
2	Frogs	A22
1	Double Frog	A42
1	" "	A44
2	Curved Lead Rails	A62
1	Inside Curve Rail	A64
1	" " "	A66
1	" " "	A68
2	" " "	A70
1	" " "	A74
2	Outside " "	A72
1	" " "	A73
1	" " "	A76
2	Extension Rails	102
2	Straight Lead Rails	A103
1	" Rail	A104
1	" "	A105

Fig. 3.—Special Work Standards for Left Hand Double Track Branch-off.

Design.—In the detail of the design of this work the most serious obstacle met was that of guarding the T-rail section. Various devices were tried out with more or less success, but it was finally settled that the guard

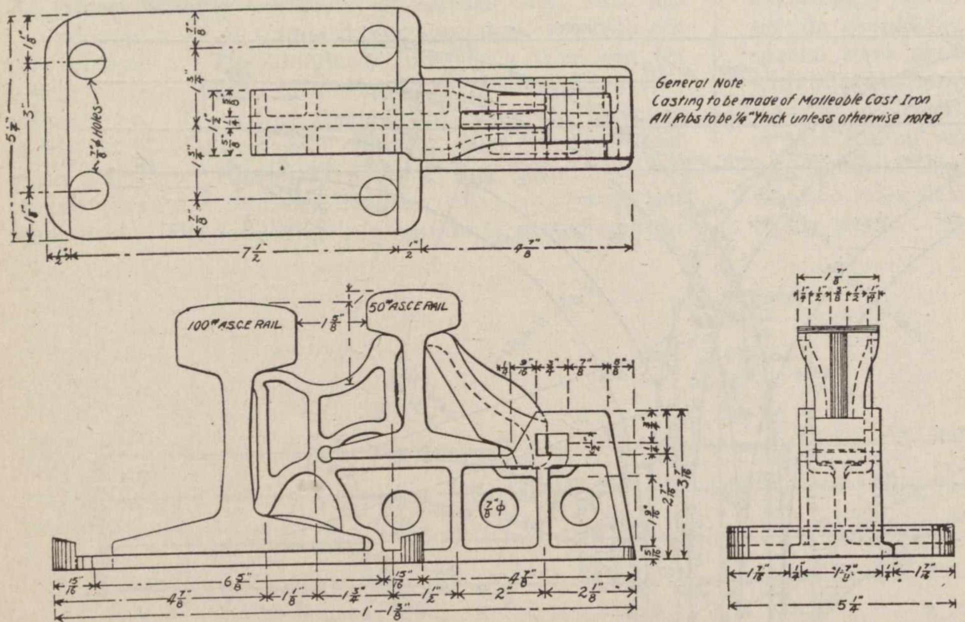


Fig. 4.—Guard Rail Support for 50-lb. T-rail Guarding 100-lb. T-rail.

best adapted to this section was the 50-lb. T-rail. A section of this in its relation to the main rail is shown in Fig. 4, which also illustrates the standard chair

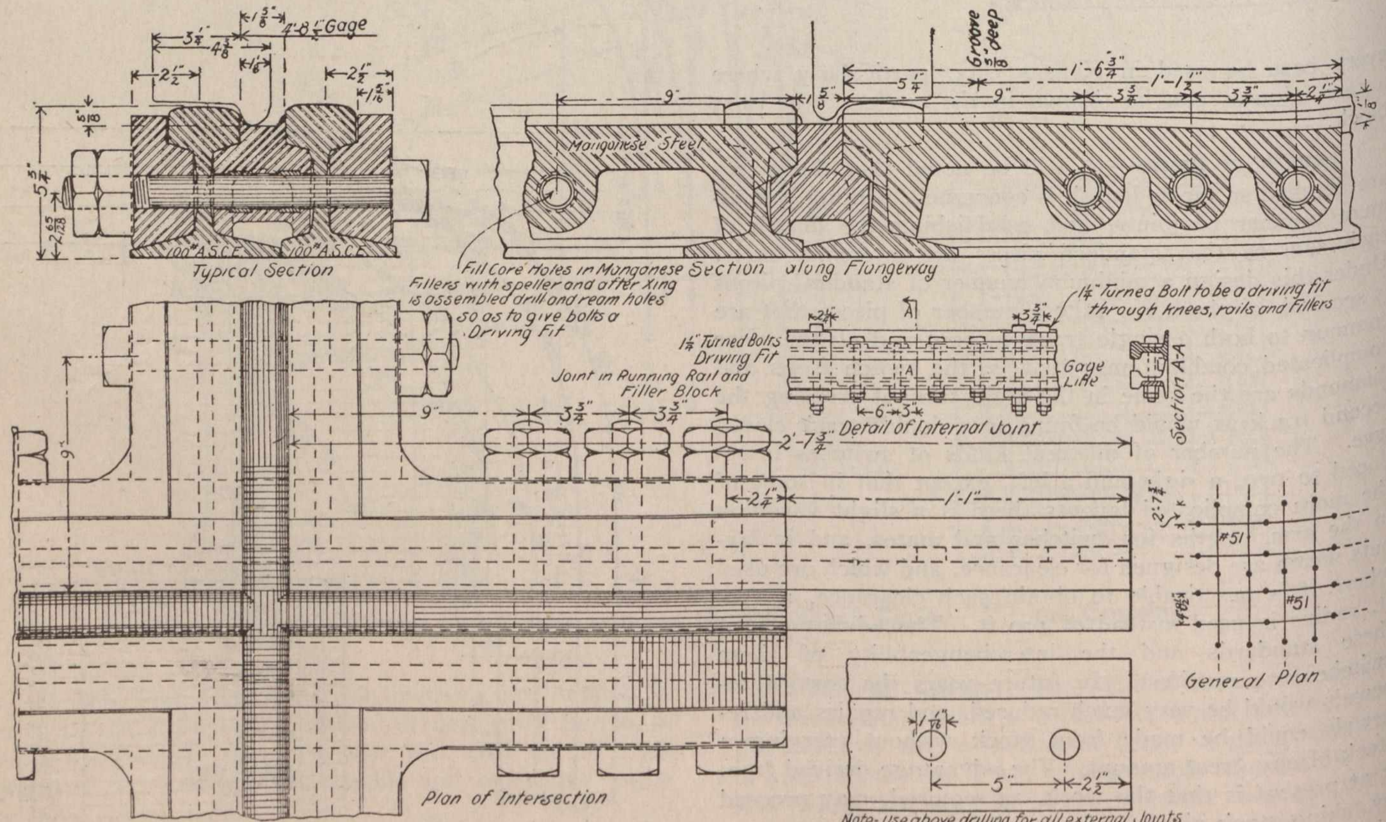


Fig. 5.—Details of Standard Double Track Crossing With 100-lb. A.S.C.E. Rail and Solid Manganese Filler.

adopted for the securing of this rail, or rather chair in combination with tie plate. This, with the omission of the plate and a slightly different arrangement for attaching it to the tie is adaptable to the use of steel ties.

This chair consists of a malleable casting in combination with the plate, together with a brace and wedge. The strain of the guard rail from the main line is taken eventually through the plate under the base of the rail and against the screw spike on the outside of the rail. A number of advantages are secured in this device:

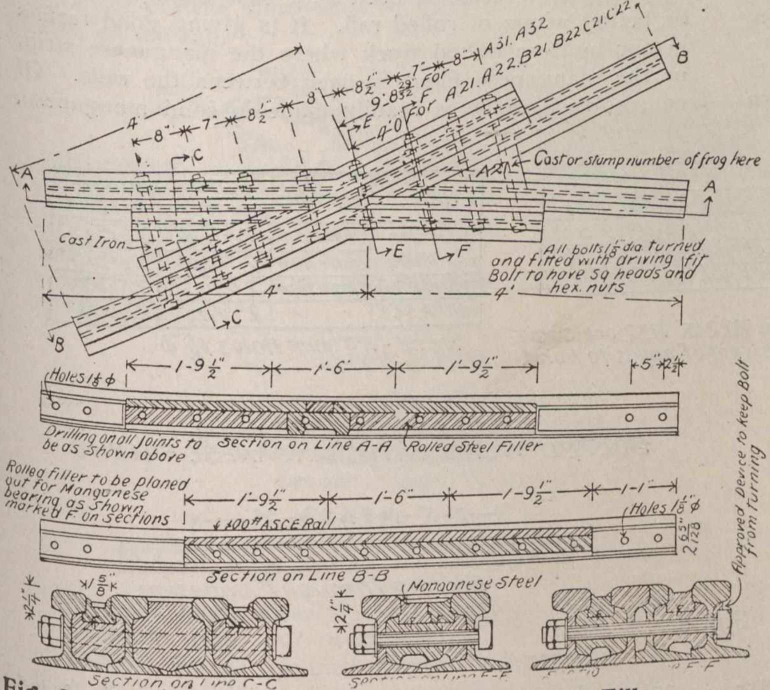
1. Both the main rail and guard rail are standard sections that are rolled by almost any mill, and can always be secured at standard prices and for less money than specially rolled sections.

2. The guard rail is secured to the main rail without the use of bolts and without the necessity of drilling through the main rail, a distinct advantage in construction as well as in renewals.

3. The strain that comes upon the guard rail is transmitted directly from the head through the casting instead of being transmitted through the web of the rail, and at a point where considerable leverage would be secured against the bolt as it is ordinarily applied.

4. The guard is renewable without any interference whatsoever with the running rail. The paving does not have to be removed from the outside of the main rail at all, and on the inside only to the base of the 50-lb. rail, which can be loosened up and a new rail slipped in place, or the old rail adjusted for wear, and moved in closer to the main rail, either by a light grinding of the bearing points on which the guard rests, or by removal of shims, which

may be put in originally in order to provide for such wear. The design has been used in a modified form by the Metropolitan Street Railway Company for some time, and is proving exceedingly satisfactory.



MARK	HAND	RAD	ANGLE
C-21	Right	67'-4¼	21° 08' 54"
C-21	Left	67'-4¼	21° 08' 54"
A-31	Right	44'-10¼	24° 19' 56"
A-32	Left	44'-10¼	24° 19' 56"

MARK	HAND	RAD	ANGLE
A-21	Right	44'-10¼	24° 19' 56"
A-22	Left	44'-10¼	24° 19' 56"
B-21	Right	52'-4¼	23° 21' 40"
B-22	Left	52'-4¼	23° 21' 40

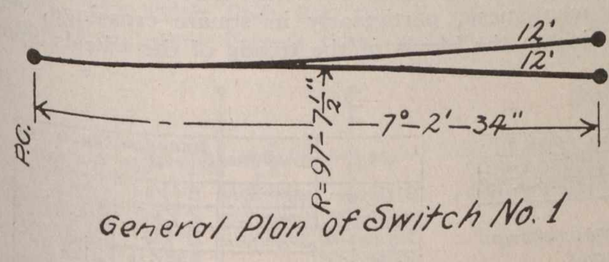
Fig. 6.—Standard Built-up Frog With Manganese Filler.

The connection of this guard to the pieces is one detail of the design that had to be solved. It was undesirable to put a joint in this guard rail connecting up to a piece of the guard cast in the cast-bound work, or otherwise attach it to a piece of other design. Any joint of that kind is necessarily unsatisfactory, and moreover, the part of the guard that was not removable from one of the pieces would wear, and could not be renewed or adjusted as could the balance of the guard around the curve. The problem was solved by making a pocket in each of the pieces and the T-rail guard was inserted and speltered in this pocket, running in so that the detachable guard would connect up closely with the manganese plate in cases of cast-bound work; and in cases of solid manganese work a small pocket at the end connecting with the manganese guard, and in cases of built-up work to attach it securely to the built section by means of the standard chair. In designing these standard pieces it was the object so far as possible to specify only those points which were necessary to obtain the results at which we aimed, and not specify those things that would interfere with the manufacturer's design or shop practice.

The most important feature in the design of street railway frogs is the detail of the flangeway, particularly where the flange bearing is desired. The writer believes that this matter has not been properly understood, nor the best results obtained in the past in flange-bearing work, and the work which we are now specifying is designed to overcome the objectionable features that exist in flange-bearing work as it is generally put upon the market.

A flange bearing as it has been understood in the past, and as it has been designed, has aimed at having just at the intersection a floor upon which the flange would rest while passing over the intersection. In theory this is perfect. In practice it has led to a great deal of trouble.

It is impossible to get a flangeway that is just the depth of the flange. It is either itself worn too deep, it may be constructed too shallow, treads wear and wheel flanges become long so that the percentage of wheels that will take the flange bearing and pass the intersection without a blow is exceedingly small, and where the flangeway is made shallow enough so as to take care of this the wheels, particularly worn wheels, will strike the metal in the bottom of the flangeway a blow that endangers the flange, chipping it. The effect is very much the same as the placing of a block of steel in the flange-



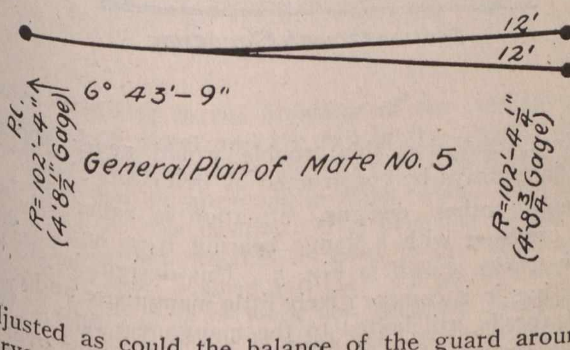
MARK	HAND
1	Right
2	Left

Note:- Switch No. 2 same as switch No. 1 except of opposite hand

RAIL	ROWS OF HOLES	DIST. FROM BASE TO CTR.	SPACING FROM RAIL END
9" Girder & Trilby	Upper Row	5 23/64"	2½"x5"x5"
	Lower Row	2 7/64"	3½"x5"x5"
7" Gird. & Tril.	Single Row	2 13/16"	2½"x4"x4"
100# A.S.C.E.	"	2 65/128"	2½"x5"
	"		

NOTE- All joint holes 1⅛" φ

Fig. 7.



MARK	HAND
5	Right
6	Left

NOTE:- Mate No 6 same as mate No 5 except of opposite hand.

RAIL	ROWS OF HOLES	DIST. FROM BASE TO CTR.	SPACING FROM RAIL END
9" Girder & Trilby	Upper Row	5 23/64"	2½"x5"x5"
	Lower Row	2 7/64"	3½"x5"x5"
7" Gird. & Tril.	Single Row	2 13/16"	2½"x4"x4"
100 A.S.C.E.	"	2 65/128"	2½"x5"

NOTE: All joint holes 1⅛" φ

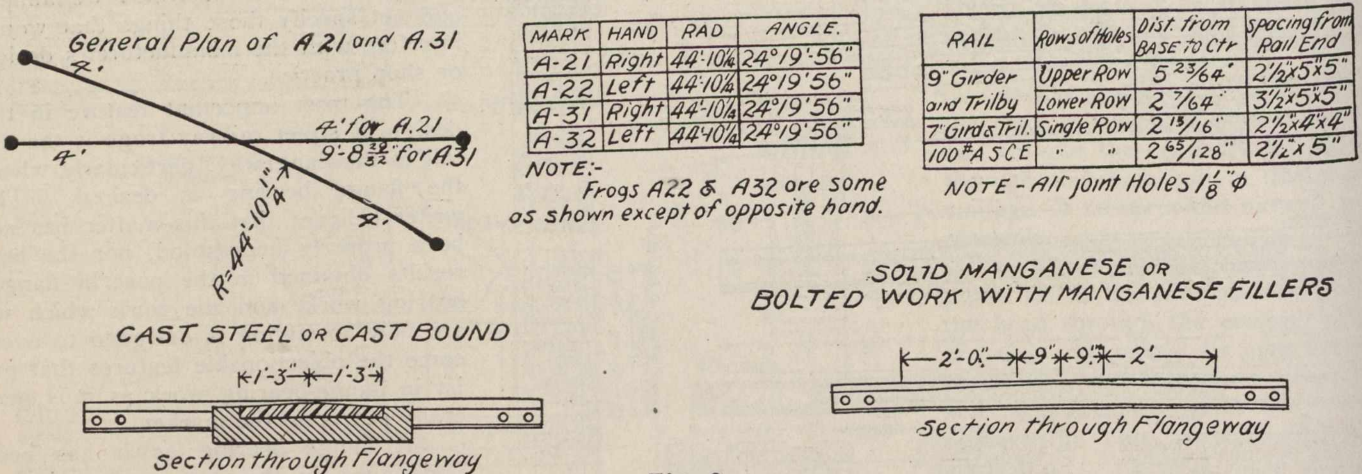
Fig. 8.

way for the wheel to run over. It results in a jolt and a blow that is detrimental to the wheel, to the car and to the special work, making a noisy and hard riding crossing.

The theory upon which we have proceeded with this work is that the wheel should be picked up on this flange with as light an angle of impact as possible at a considerable distance from the intersection, and ride upon its flange entirely across the intersection and be let down again upon its tread. Every time this proposition is presented some one will say: "What does this do to your wheel flanges?" What is the other doing to the special work and the paving? The taking of a wheel with a light angle of impact and riding it upon its flanges is easier on the track, paving, the wheel and the car, on the nerves of the public, and on adjoining buildings. It is not only upon this theory that the design of the flangeway and special work is based, but from actual experience with these flangeways, it has been found that all that has been said in regard to this matter is confirmed by results obtained in practice.

Other details of the special work pieces are rather immaterial so long as the design and profile of the flangeway are carried out, and this flangeway may be built in any type of work. In cast-bound work it can be obtained if the plate is made large enough, and some work has been furnished in this way, but the manufacturers have overlooked in some cases the object at which we were aiming, and apparently construed the specifications that more manganese was desired, which was not necessarily the case. It is not the amount of the manganese that governs the situation, but the profile of the flangeway. This flangeway is readily made in built-up work where the manganese cross is used as a base upon which may be bolted wings of rolled rail. It is giving good results in our built-up bolted work where the manganese strip, or the manganese filler, is used between the rails. Of course, this profile is readily made in solid manganese, and in that case has the advantage of keeping the treads away from the weaker points at the intersection and prevents chipping.

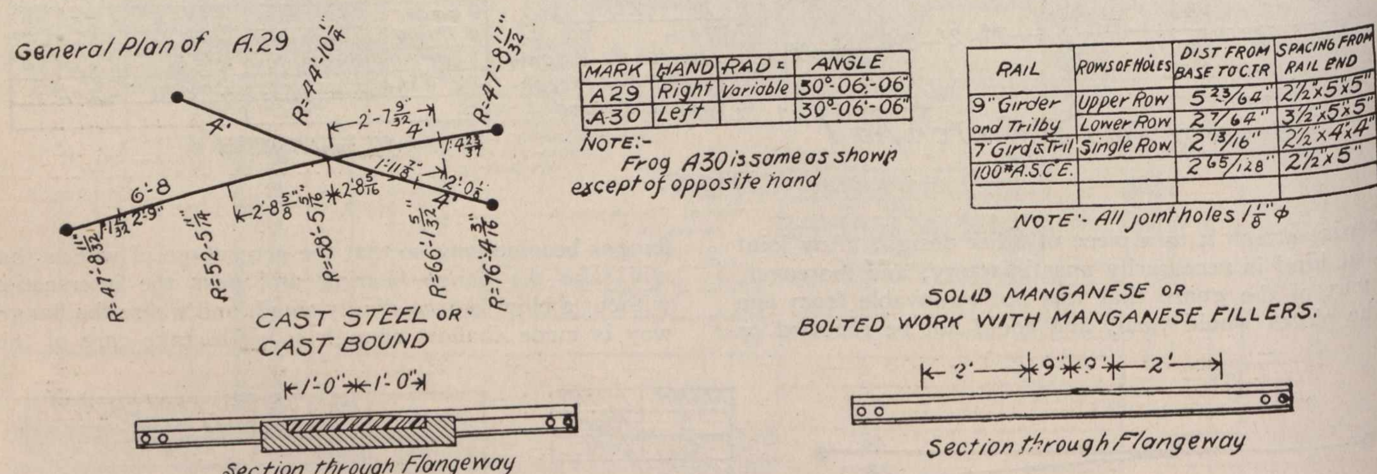
The writer believes that this question of the profile of flangeways has had a great deal to do in the past with certain difficulties that have been charged to solid manganese work, i.e., where the defect that has appeared in solid manganese, particularly in square crossings, has been due to the blows of the treads of the wheels upon the points, and that this trouble would never appear should flangeways be constructed as described above.



MARK	HAND	RAD	ANGLE.
A-21	Right	44'-10¼	24°19'-56"
A-22	Left	44'-10¼	24°19'56"
A-31	Right	44'-10¼	24°19'56"
A-32	Left	44'-10¼	24°19'56"

RAIL	Rows of Holes	Dist. from Base to Ctr	Spacing from Rail End
9" Girder and Trilby	Upper Row	5 23/64"	2½"x5"x5"
	Lower Row	2 7/64"	3½"x5"x5"
7" Gird & Tril.	Single Row	2 13/16"	2½"x4"x4"
100# A S C E	" "	2 65/128"	2½"x5"

Fig. 9.



MARK	HAND	RAD =	ANGLE
A29	Right	Variable	30°-06'-06"
A30	Left		30°-06'-06"

RAIL	ROWS OF HOLES	DIST FROM BASE TO C.TR	SPACING FROM RAIL END
9" Girder and Trilby	Upper Row	5 23/64"	2½"x5"x5"
	Lower Row	2 7/64"	3½"x5"x5"
7" Gird & Tril	Single Row	2 13/16"	2½"x4"x4"
100# A.S.C.E.		2 65/128"	2½"x5"

Fig. 10.

Among other designs, attention is called to our 100-lb. crossing with a flange bearing from end to end for both tracks shown in Fig. 5. This design, it will be noticed, has in it comparatively little manganese and consists of 100-lb. rail bolted to the manganese filler. We have had several of these crossings in service for over a year, and the results that are being obtained from them are exceedingly satisfactory. They are easier on the cars, easier riding and easy to maintain. We have adopted them as our standard crossing in all work. It may be a little difficult to build in complicated layouts where curves intersect the crossings. In such cases these complicated parts are built in solid manganese.

In the design of switches nothing is specified outside of the outside dimensions of these switches and the section of the rail.

Solid manganese work built with the flange bearings as specified by us is a most satisfactory design, and where constructed in accordance with standards so that pattern charges are not repeated from time to time, its cost will be so reduced and its advantages over other types of work such that it is an ideal special work. It has a distinct advantage over the cast-bound work in

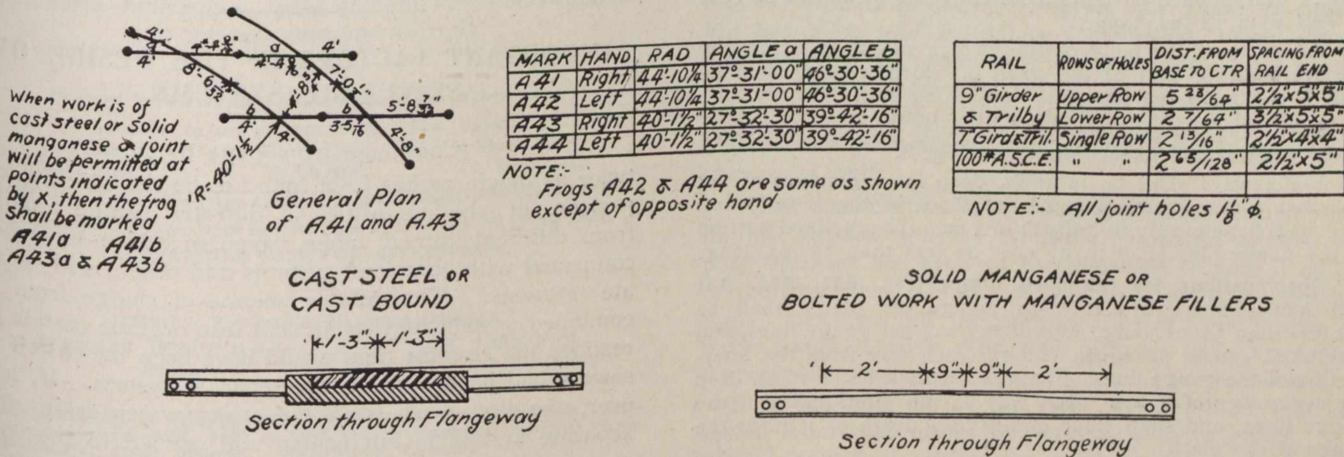


Fig. 11.

In regard to the class of work specified: Cast steel is permissible under our specifications, and nothing is standardized outside of this, except in regard to the dimensions and matters heretofore mentioned that are common to all classes of work. Cast-bound work is acceptable in its usual form, the specifications in regard to that consisting only of those matters relating to the flangeway, to the section of rail, and to the question of keeping the cast iron down on the outside of running rails so that it may not receive a blow from a worn wheel. The writer finds that this is the most common cause of the many defects that appear in cast-bound

that all special work is of the same depth and facilitates the spacing and placing of the ties in special work. This is particularly applicable to the placing of such work on steel ties.

The specifications for standard switches Nos. 1 and 2 are as follows:—

Cast Steel or Cast Bound Switches.—They must conform accurately to the general dimensions shown on Fig. 7.

Switch tongues must be of solid manganese and of heavy design and must be provided with lug for the attachment of spring lock or electric throw. The tongue must be ground to fit closely to its bed. The heel must fit perfectly so as to

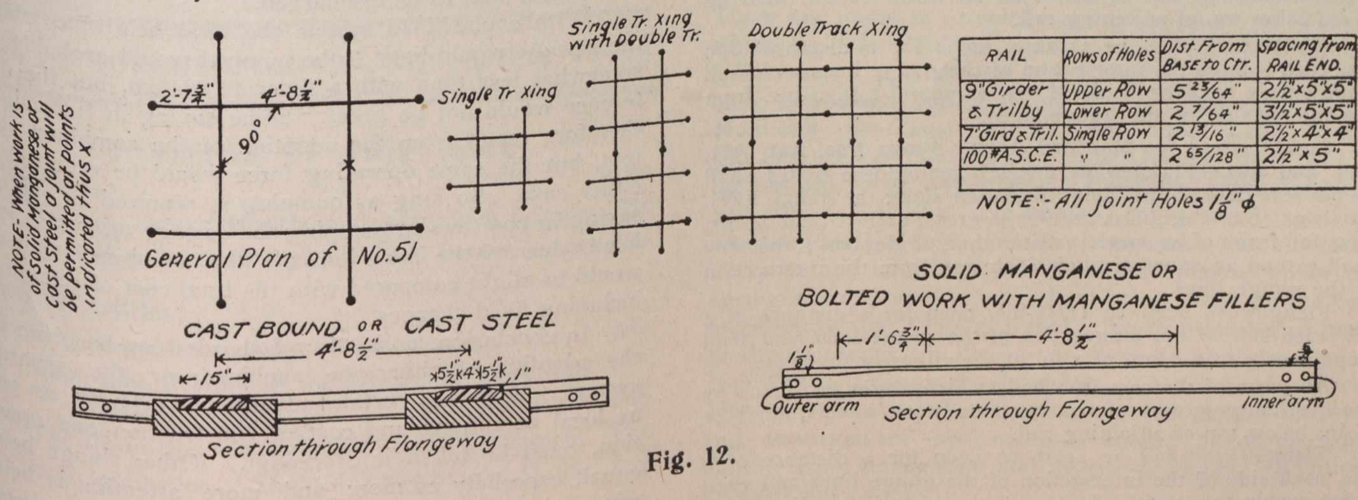


Fig. 12.

work, resulting in the breaking of the casting and the loosening of plates and the rail in the pieces. Built-up work with a manganese filler forming the flange bearing is a type that we are using in some cases. Fig. 6 shows the detail of this design. The principal points of the specifications require that all bolts in this work must be turned, all holes reamed and the bolts put in with a driving fit. This type of work was designed primarily that we should have a type of work that could be built in our own shops without delay, and without the necessity of foundry work. This type has proved exceedingly satisfactory in all respects.

prevent the entrance of snow, ice or sand under the bearing. All parts of the body which might be struck by the overhanging part of the tread on worn wheels shall be kept ¼-in. below the top of the adjoining rail.

For T-rail work the guard rail pocket shall be so constructed that the removable guard extends to the manganese centre.

Solid Manganese Switches.—They must conform accurately to the general dimensions shown on Fig. 7.

Switch tongues must be of solid manganese and of heavy design, and must be provided with lug for the attachment of spring lock or electric throw. The tongue must be ground to fit closely to its bed. The heel must fit perfectly so as to prevent the entrance of snow, ice or sand under the bearing.

Those for standard mates, Nos. 5 and 6, are as follows:—

Cast Steel or Cast Bound Mates.—They must conform accurately to the general dimensions shown on Fig. 8.

Manganese plates shall be of liberal size and of heavy design.

Flangeways shall be 11/16-in. deep for a distance of not less than 6 ins. ahead of and 6 ins. back of the ½-in. point, and shall slope evenly to a depth of 1 in. at the edges of the plate. The inclined portion of the flangeways shall in no case be less than 18 ins. long.

All parts of the body casting which might be struck by the overhanging part of the tread on worn wheels, shall be kept ¼-in. below the top of the adjoining rail.

Solid Manganese Mates.—They must conform accurately to the general dimensions shown on Fig. 8.

Flangeways shall be 11/16-in. deep for a distance of not less than 6 ins. ahead of and 6 ins. back of the ½-in. point, and shall slope evenly to a depth of 1 in. The inclined portion of the flangeways shall in no case be less than 18 ins. long.

Specifications for Standard Frogs Nos. A21, A22, A31 and A32.—Flangeways through manganese plates shall be not less than 30 ins. long, measured along the gauge lines, and they shall extend an equal distance each way from the intersection of the gauge lines. Flangeways shall be 11/16-in. deep for a distance of 4 ins. each side of the intersection of the gauge lines, and shall slope evenly to a depth of 1 in. at the edges of the plate.

All parts of the cast iron body which might be struck by the overhanging part of the tread on worn wheels, shall be ¼-in. below top of adjoining rail.

Flangeways shall be 11/16-in. deep for a distance of 9 ins. each side of the intersection of the gauge lines and shall slope evenly to a depth of 1⅛ ins. at points 2 ft. 9 ins. from the intersection of the gauge lines.

Specifications for Standard Frogs Nos. A29 and A30.—Flangeways through manganese plates shall be not less than 24 ins. long measured along the gauge lines, and they shall extend an equal distance each way from the intersection of the gauge lines.

Flangeways shall be 11/16-ins. deep for a distance of 4 ins. each side of the intersection of the gauge lines and shall slope evenly to a depth of 1 in. at the edges of the plate.

All parts of the cast iron body which might be struck by the overhanging part of the tread on worn wheels, shall be ¼-in. below top of adjoining rail.

Flangeways shall be 11/16-in. deep for a distance of 9 ins. each side of the intersection of the gauge lines and shall slope evenly to a depth of 1⅛ ins. at points 2 ft. 9 ins. from the intersection of the gauge lines.

Specifications for Standard Double Frogs Nos. A41, A42, A43, and A44.—Flangeways through manganese plates shall be not less than 30 ins. long, measured along the gauge lines, for frogs of an angle less than 28 degrees, or less than 24 ins. long for frogs of an angle greater than 28 degrees; and they shall extend an equal distance each way from the intersection of the gauge lines.

Flangeways shall be 11/16-ins. deep for a distance of 4 ins. each side of the intersection of the gauge lines and shall slope evenly to a depth of 1 in. at the edges of the plate.

All parts of the cast iron body which might be struck by the overhanging part of the tread on worn wheels, shall be ¼-in. below top of adjoining rail.

Flangeways shall be 11/16-in. deep for a distance of 9 ins. each side of the intersection of the gauge lines and shall slope evenly to a depth of 1⅛ ins. at points 2 ft. 9 ins. from the intersection of the gauge lines.

Specifications for Standard Crossing No. 51.—Flangeways through manganese plates shall be not less than 15 ins. long, measuring along the gauge lines, and they shall extend an equal distance each way from the intersection of the gauge lines.

Flangeways shall be 11/16-ins. deep for a distance of 2 ins. each side of the intersection of the gauge lines and shall slope evenly to a depth of 1 in. at the edges of the plate.

All parts of the cast iron body which might be struck by the overhanging part of the tread on worn wheels, shall be ¼-in. below top of adjoining rail.

Flangeways shall conform accurately to the profiles shown above.

In case of single track crossing, or single track crossing with double track, the outer arms shall conform to the profile shown for outer arms.

In all cases the specification requires the number of the piece to be plainly cast upon the top surface at some convenient point. When the work is of cast steel or solid manganese, the arms are required to be accurately ground to conform to the rail sections specified for the work.

IMPORTANT FACTORS IN THE DESIGN OF SEWERAGE SYSTEMS.

(Continued from page 671.)

twice as much, as has been found to be the case by comparison of the quantities of digested sludge removed from different Imhoff tanks, some of which have been connected with combined systems and others with separate systems. The greater volume of sludge from the combined system may mean that less organic matter has reached the streams than would have been the case if the sewers had been built on the separate system. If, however, the first wash from the storm water drains of a separate system is intercepted and carried to the treatment works, then the volume of sludge should be approximately the same as if the sewage came from a combined system. Similarly the amount of organic matter reaching the streams should be approximately the same, although it is possible that it might then be somewhat less.

In many instances, probably in the majority of cases, pumping is required in order to pass sewage through a treatment works. This is generally due to the fact that the site of the treatment works is more or less distant from the territory sewered and by the time the sewage has reached the treatment works enough head has been lost to prevent passing the sewage through the works by gravity. It may even be that the sewage would be delivered at an elevation below that of the stream into which the effluent was to be discharged.

With a combined system the total height to which the sewage would have to be pumped would probably be somewhat less than with a separate system, but the difference would not be great. Some saving in fuel might therefore result from the adoption of the combined system, but the same operating force would be required in either case. So long as pumping is required the actual saving in cost due to pumping the sewage against a less head, due to the adoption of the combined system, would be slight compared with the total cost of pumping, including fixed charges.

In conclusion, no hard or fast rules can be given for the adoption of either the combined or the separate system. Each has certain advantages. These, as well as local conditions and cost of construction and operation, must be taken into account. Other things being equal, especially as more and more attention is being given to the question of sewage disposal, the separate system seems to offer greater advantages. With either system, however, to secure satisfactory results, too much stress cannot be laid on the necessity of not only proper design but satisfactory maintenance and operation.

In France, efforts are being made to further a scheme for the development of river communication between Geneva and Lyons. A Franco-Swiss committee has been formed, and a meeting held recently at Satigny was attended by delegates from the Swiss communes in the vicinity of the Rhone. They discussed and supported the advisability of forming local committees to aid in popularizing the scheme.

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ESTABLISHED 1893.

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CONTENTS OF THIS ISSUE.

PRESERVATION OF HEALTH IN CONSTRUCTION CAMPS.

With the word "camp," military or constructional, there has always been associated the thought of liability to pestilence and disease, and it has been more or less of a foregone conclusion that every large camp must pay toll. Without question, however, the value of human life has risen and its safety is viewed more sanely. The scientific prevention of unsanitariness and disease has become a prominent factor in military manoeuvres, and it is to be noted with satisfaction that it has its place of similar importance in the maintenance of construction camps, as well.

The construction of the Panama Canal is memorable in this respect, and the scientific campaign against tropical diseases has been so successful as to rate it as one of the important features of the great piece of engineering. Measures for the maintenance of health were far more comprehensive than had hitherto been attempted. Streets were widened, drained, and paved; houses, as well of the poor as of the rich, were re-built and protected from mosquitoes by screens of wire gauze. The whole ground of Colon, for example, was raised above the surrounding marsh with mud taken therefrom by means of suction pumps. The breeding places of mosquitoes within 100 yards of all permanent habitations were removed, and marshes drained or filled in. The floors of the houses were cemented to afford no refuge for plague rats. Good drinking water has been constantly provided. A fine hospital is maintained.

As a result, the death rate has fallen to 7.5 per thousand per annum, and the total cost has been only about one cent per day per head of population.

Although Canada's undertakings are not accompanied by tropical conditions, the admirable mastery of adversity in the above instance suggests giving more attention to livelihood in our own construction camps. There are many in existence and many more will shortly spring up. In British Columbia there will be the Sooke Lake water supply project, the Burrard Inlet harbour and dock extensions, the tunneling of Roger's Pass, etc. In Manitoba, the construction of the Shoal Lake viaduct will begin early in the spring. In Quebec, there will be the Ottawa water supply project from the Gatineau Lakes, and there are the well-known engineering activities around Montreal and the St. Lawrence. In Ontario, many camps will be active with the opening up of the spring season, chief among them being those on the construction of the Welland Canal. No mention being made of the numerous smaller camps, such as at the many extremities of railway developments, the thousands of men who will be engaged next season in the explicit carrying out of engineers' specifications should be assured immunity from unsanitary and disease-producing conditions in their habitations.

THE VIEWS OF THE PEOPLE ON ROAD IMPROVEMENT.

As announced last week, the Ontario Highway Commission is holding a series of meetings throughout Older Ontario in the interests of the Good Roads movement. The first session was held in Ottawa on October 28th, where representatives of all the municipalities of the Ottawa Valley were present and manifested the intense interest which is being taken in the movement. The suggestions made to the Commission were practical in character, and evidenced a general desire to assist in the bettering of the roads of Eastern Ontario, generally conceded to be seriously in need of improvement.

One point that was particularly emphasized was the belief that it is essential for a permanent and comprehensive good roads policy to substitute for the present statute labor system of maintenance and improvement, a system of municipal or government control and expenditure. It was emphasized that a greater continuity of policy, better men and better supervision of highway construction and maintenance would be secured thereby. It was the general feeling of the session that there is an absolute necessity for a permanent Government Commission to supervise all road construction, and to investigate and apply new and successful methods.

The Commission outlined its aim as being in the interests of rural and urban people alike, and not of any special class of road users. Market roads for the farmers, rather than trunk roads for the automobilists, were the first consideration.

EDITORIAL COMMENT.

The placing under contract of Section II. of the new Welland Ship Canal last week, and the call for tenders for Section V., indicates that there is little delay in getting the project under way. In fact, remarkable speed is being exhibited in disposing of the various sections. Late in July the contract for Section I. was awarded to the Dominion Dredging Company, Ottawa, as announced at an amount approximating $3,500,000. Section III. followed early in September at $9,500,000, to O'Brien and Doheny, Quinlan and Robertson, both Montreal firms. Then, the award of Section II. to the English firm of Baldry, Yerburgh and Hutchinson, at an amount in the neighborhood of $5,500,000 was announced in our issue of last week.

It is understood that, following Section V., Section IV and the remaining four sections will be placed under contract as rapidly as possible.

* * * *

The provincial conference which met in Ottawa last week to discuss the question of pollution of navigable waterways adopted the resolution forwarded by the Canadian Public Health Association, from its Regina convention, asking the Government to consider the desirability of establishing a federal department of public health. Particulars leading up to the framing of this memorial were given in *The Canadian Engineer* for October 16th. The resolution read as follows:—

"Whereas in the past sanitary questions affecting public health have suffered from the non-existence of a federal health department, this conference considers the creation of a federal department of public health might well receive the early attention of the government.

"The conference believes such a department would be of assistance in solving interprovincial problems as to the protection of public health."

A recent number of "The Electrician" states that there are more than 6,000 towns and villages in France at present without a system of distributed public lighting. Of the 4,094 small towns already artificially lighted, 2,673 have adopted electricity, 1,249 gas lighting, and 172 acetylene.

LETTERS TO THE EDITOR.

Discussion of "Bending Moments in Flat Slabs."*

Sir,—The present writer has had occasion recently in his treatise on Flat Slabs† to consider and make application of the general principles of the strength and flexure of flat plates uniformly loaded throughout to the computation of reinforced concrete floor slabs of many panels, especially with reference to the case of those constructed on the mushroom system by Mr. C. A. P. Turner.

While the writer has no fault to find with the method of mathematical analysis adopted by Mr. Elmont, which in fact agrees with his own so far as it goes, he nevertheless feels compelled to say that Mr. Elmont's method of applying that analysis to flat slab design is not, in his estimation, correct, and the conclusions he draws as to the stresses in the steel are not warranted by the analysis.

The reason for this statement lies in the fact that Mr. Elmont has overlooked the effect of the very uneven distribution of the reinforcement in the different parts of the panel area, and the influence which this has in causing a somewhat different distribution of stresses in the slab from what occurs in a uniform plate of metal. In particular he singles out for especial attention the positive bending moments that cause tensions in the material at the upper surface of the slab in directions perpendicular to the sides of the panels at their edges where there are no reinforcing rods to resist such tensions, and argues that ordinary flat slabs are unsafe for that reason.

I deny that such is the fact where the column heads are sufficiently stiff and strong, and say that the capacity of a slab for carrying loads is sot affected to any material extent by cracks in the concrete extending lengthwise of the edges at the top of the slab. Such cracks occurred, for example, in the test of the Deere and Webber Building in this city, which was built by a competitor of Mr. Turner, and the test reported in the Proceedings of the National Association of Cement Users for 1911, page 177, by Mr. A. R. Lord.

The reason why such cracks are unimportant is this: the construction of the slab is such that the important question is not as to just how the moment about the edge is distributed along the edge, but whether there is sufficient steel all told across each edge to resist the total stress. Stress which by plate theory occurs across the central portion of the edge of the panel is ordinarily transferred by twisting moments in the slab to the stiff heads of the columns. The middle portion of the side belts can yield to the positive moments across them to a very limited extent only (usually not enough for the formation of cracks) before resisting stresses in these heads are brought into play. This yielding, however, may and does take place without injury to the slab and without developing any real weakness in it. That such cracks and lack of steel to resist them are matters of no consequence is evidently the opinion of Professor Talbot, to whom Mr. Elmont refers as an authority on slabs, as appears from a passage which I quote from a discussion on flat slab floors, page 191 of the Proceedings previously referred to:

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*By V. J. Elmont, B.Sc., in *The Canadian Engineer* of Sept. 25th, 1913.

†Reinforced Concrete Floor Slabs, by H. T. Eddy, published by Rogers & Co., Minneapolis, 1913.

"Mr. W. B. Phillips: In the floor under test, (of the Deere and Webber Building) was reinforcement provided at the centre of the span, at right angles to that connecting two columns at the side of the panel? I believe some reinforcement should be provided between the columns in order to take care of the reverse moment, eliminating cracks to which Mr. Lord refers.

"Mr. A. N. Talbot: In so far as I know, such reinforcement is not used in any of the girderless floors. The cracks referred to are minute hair cracks which, when the load is removed, will close up so as not to be visible. . . . . So far as any one knows, they are not detrimental to a structure."

This is the only point on which Mr. Elmont attempts to substantiate his general sweeping criticism and condemnation of flat slab systems.

But this is not a question that can be settled by quoting opinions or citing authorities. It is a question of fact and experimental verification. There are no observed facts whatever in support of any such stresses as Mr. Elmont computes. It is quite true that systems in which the heads of the columns are not sufficiently large and stiff might be amenable to the objections stated by Mr. Elmont, but when he attempts to excite general distrust of the stability and safety of the pioneer system of flat slab construction by saying that "to-day theoretical and practical experience will veto most of those early systems," he speaks without authority because he is not the possessor of any adequate theory, and is not supported by reference to the facts, which show that not only have such slabs satisfactorily passed the test of carrying twice the live load without failure, but have done this for months at a time without signs of distress; a kind of test to which no other form of structure could be safely subjected.

It may be an open question as to what should be regarded as a sufficient and satisfactory test of a given type of structure. But is would seem as though one which no other type of structure could equal should be so regarded.

There is one peculiarity of flat slab construction which makes it perhaps the safest type of structure which it is possible to erect, but it is a peculiarity not ordinarily recognized, viz., its toughness. It will not collapse, nor give way suddenly under any load that it is possible to place upon it. By sufficient over-load or by too early removal of forms, a flat slab may be made to bag downwards and do almost anything, except actually to fall. A gradual yielding without impairment of strength is the worst that can occur under over-load. Lack of recognition of this fact seems to be the background of the attempt here made to awaken distrust in reinforced flat slabs.

In my treatise on flat slabs, rational formulas have been established that agree closely with a large mass of observations on many different slabs made by various experimenters, the details of which are not there given. But the result of a numerical discussion of half a dozen of the most complete of these tests is now accepted and awaiting publication in the Proceedings of the American Society of Civil Engineers, which will entirely corroborate the statement just made as to the agreement between computed and observed values of both deflections and stresses. Mr. Elmont cannot cite any such agreement of his computations with observations, and until such agreement can be established he is not justified in asserting what will or will not happen to slabs whose entire behavior can be predicted by rational formulas.

My present opinion is that not only has Mr. Elmont drawn incorrect and unwarranted conclusions from the analysis he has offered, but has also seriously misunderstood and misrepresented the position of Professor Talbot when he refers to him as having shown "the insufficiency of reinforcing in flat slabs as ordinarily constructed."

I would respectfully ask Mr. Elmont either to substantiate this statement or to withdraw it. I have been unable to find any such thing in Professor Talbot's publications, but, on the contrary, much to make me think that he is quite unwilling to express the opinion that flat slabs constructed on the lines which Mr. Elmont condemns are necessarily unsafe.

Had Mr. Elmont been willing to point out types or specific instances of the kind of weakness which he depreciates, it would have been possible to agree or disagree with him in better spirit than is now possible, when he apparently intends to bring flat slabs in general into disrepute, and especially in case they are not reinforced across the top at the side belts, a view known to be so erroneous by all constructors of flat slabs, Professor Talbot included, as to detract very greatly from the weight that might otherwise be attached to any other views he might express upon the properties of flat slabs.

H. T. EDDY.

Minneapolis, Minn., Oct. 8th, 1913.

[A copy of Dr. Eddy's criticism was forwarded to Mr. Elmont, who furnishes the following reply.—Ed.]

Sir,—It was certainly not the intention in the writer's paper to bring flat slabs into general disrepute, and the writer has difficulty in understanding how Dr. Eddy could read that out of the paper. The writer considers the reinforced concrete flat slab as being a very economical and suitable structure for many purposes, and thinks that great credit is due to Mr. Grashof for his theoretical investigations, to Mr. Matrai for his reinforcing system leading up to the reinforced concrete flat slab, and Mr. Mensch for being the first—to the writer's knowledge—who employed a flat slab in an actual building.

The aim of the paper was to improve the present design of flat slabs. What the writer expressly directed his efforts against was mentioned in the following words:

> "In nearly all flat slabs it is found that the positive bending moments and the negative moments over the columns are provided for . . . but the negative moments perpendicular to the sides of the panels are, as a rule, entirely neglected, although they have about the same numerical value as the maximum positive moments."

Dr. Eddy denies (1) the necessity of reinforcing against these negative moments perpendicular to the sides of the panels; (2) that Prof. Talbot's test loadings tend to prove this necessity.

(1) In his above writings Dr. Eddy refers to his book "Reinforced Concrete Floor Slabs." The writer obtained this book, thinking that it was a pure professional treatise, but found it to be mixed up with advertising matters for Mr. Turner's system. If nothing else, the writer had the surprising satisfaction of finding that Dr. Eddy not only arrived at the result that the above-mentioned negative moments exist, but that they have

far greater values than those given in his paper (though the writer disagrees with the procedure by which Dr. Eddy arrives at these high values).

In spite of this, to state that they do not need to be taken into consideration and resisted by reinforcement is rather strange. It must be granted to Dr. Eddy that so far no flat slab in reinforced concrete has failed on account of lack of this reinforcement, but at the same time, no well-trained structural engineer would consider this circumstance to be a proof that this reinforcement was unnecessary and neither is any proof contained in the fact that flat slabs, designed without this reinforcement, are able "to carry twice the live load without failure, and have done this for months at a time without signs of distress, a kind of test to which no other form of structure could be safely subjected." These last lines, quoted from Dr. Eddy's discussion above, together with the following lines

> "It may be an open question as to what should be regarded as a sufficient and satisfactory test of a given type of structure. But it would seem as though one which no other type of structure could equal should be so regarded."

certainly form the most astonishing engineering state- that the writer has ever seen in print.

First of all, it is not sufficient for an engineer to know that a structure is still standing carrying twice the live load; the important thing to know is how much greater load it would be able to carry without failing. Furthermore, the writer would like to show Dr. Eddy that there is nothing extraordinary when a flat slab carries twice the live load for such a period as "months at a time." That load is only a comparatively small percentage of what it ought to be able to carry before failing. Dr. Eddy might, perhaps, know that numerous very careful experiments have shown that reinforced concrete slabs, reinforced with the usual percentage and kind of steel, are able to carry at least three times the total load (live + dead) for which it has been calculated. The load Dr. Eddy is so proud of is

$$P = 2 \times \textit{live load} + l \times \textit{dead load};$$

$$\text{or, } P = 2 \times p + l \times g;$$

but it should be possible to load these slabs—of course only when properly designed—with,

$$Q = 3 \times p + 3 \times g.$$

Taking $g = \frac{1}{2} p$, we obtain,

$$P = 2.5\, p,$$

$$\text{and, } Q = 4.5\, p;$$

thus P is only about 55% of what a correctly reinforced flat slab should carry before failing.

Dr. Eddy's statement that "no other form of structure could be safely subjected to a test load equal to twice the live load" is, in the writer's knowledge, incorrect; it seems to indicate that Dr. Eddy's design would not be effective beyond that test load. A remedy for this could no doubt be effected if Dr. Eddy were to adopt the reinforcement as advised in the writer's paper, and take the positive bending moment at the centre of the slab, as derived in the paper, to be about $\frac{Wl}{23}$, which is also close to the bending moment, given in the new building regulations for the city of Cleveland. The writer noticed on page 878, Vol. 24, of this paper that Dr. Eddy figures with $\frac{Wl}{50}$. It is also stated "that Mr. Turner's design is extremely light and seems somewhat daring when compared with designs made by other engineers.

(2) The test loading, conducted by Prof. Talbot, that the writer especially had in mind, was that in the Deere and Webber building, described fully in Bulletin 64 of the University of Illinois, published January, 1913, (Tests of Reinforced Concrete Buildings Under Load, page 88 and following). This test loading appears to the writer to have been carried through in a careful way and to be of unusual importance as it has been conducted in an actual building with almost the same exactness in studying the results as can be obtained in a laboratory test.

The floors were calculated for 225 lbs. for sq. ft.; at a test load of 350 lbs. per sq. ft. cracks appeared along the sides of the panels which plainly indicated the negative bending moments. These cracks are plotted in Fig. 75 of the Bulletin.

In conclusion, the writer would quote what Prof. Talbot says with regard to these cracks: "Another set of cracks (besides those about the column heads) which developed only under the maximum load of 350 lbs. per sq. ft. is significant. These cracks ran along the centre line of the cross bands, being easily traced in the portion about half way between columns, growing fainter towards the columns, and disappearing entirely in most cases before reaching the crack over the edge of the capital. Evidently there is negative bending moment at these sections. These cracks, we believe, had not been observed before, probably because other building tests have not been so extensive, and because cracks have not ordinarily been very carefully observed."

V. J. ELMONT.

Montreal, Que., Oct. 17th, 1913.

WIRELESS TELEPHONY IN BRITISH MINE.

An invention of Josef Heinrich Reineke, a system of wireless telephony, which has been installed in the Dinnington colliery, near Rotheram, has been found to give excellent results. The invention is used widely in Germany; and now that the British home office order for the installation of underground telephones in mines has come into force, an English company has been formed to work the patent, and the Postmaster's license to use the patent has been granted to W. Holmes, M.I.E.E. Its chief merit is that signalling can take place through solid rock over a distance of at least one mile. At the Dinnington colliery, stationary instruments are fixed at given points in the mine, and each station can communicate with any other station. In addition, each gang of colliers may be provided with a portable telephone, which can be brought into communication with the stationary telephones in case of need. A further advantage is that communication can be maintained from the pit head or the pit bottom with the moving cage. The apparatus is described as follows:—

"The instruments are exactly like those used in ordinary telephoning, consisting of receiver, transmitter and battery. The battery is of the dry-cell type, and has a life of three years. The portable instrument contains the same parts as the fixed one, and weights about twenty pounds. It is enclosed in a box, and can be carried from one part of the mine to the other. The instruments are fixed up like ordinary telephones, but instead of a wire connection two wires are connected from each instrument to some metallic substance buried in the ground. Connection can be made to the tramway lines in the pit or to water pipes or any convenient metallic substance in the workings."

ENGINEERING AS A PROFESSION

SOME CHARACTERISTICS OF THE ENGINEER AND OF HIS PROFESSION THAT ARE NOT GENERALLY KNOWN—EXTRACTS FROM AN ADDRESS TO THE UNIVERSITY OF TORONTO ENGINEERING SOCIETY, OCTOBER 15TH, 1913

By **WALTER J. FRANCIS, C.E.,**
Consulting Engineer, Montreal

ENGINEERING is such a material thing, such a practical thing, and such an engrossing thing, that it is very difficult to talk about it in the abstract. Moreover, the engineer is known as a man who does things, and one who is doing things is too busy to talk. You will, therefore, appreciate the greater difficulty experienced by one who is supposed to be an engineer talking in the abstract on such a subject as engineering.

In order that we may have some appreciation of the subject, it is necessary for us to arrive at some definite understanding of the two words "Engineering" and "Profession," although I cannot promise you that these definitions will entirely sweep away the mist.

"Professions."—We all have our ideas what a profession is, yet it might be very difficult for us to name many professions and, having named them, to state the reasons why they are professions. Probably the first of the professions that would come to our mind would be that of law, medicine and theology. Later we would add pedagogy, dentistry, architecture, and surveying. Some might even go so far as to add engineering. The predominating characteristic of all these callings is their protection by law and their recognition as lawfully constituted bodies by the powers that be and by the people themselves. The distinguishing feature of a profession is that it requires its members to have special training and to perform mental rather than physical labor. Custom has decreed that an individual member must earn his livelihood by his chosen profession. The representative society or societies of each profession have a written or an unwritten code of ethics. This code requires, amongst other things, that the remuneration received by a member for his services shall not be in any way contingent upon the result of his work, or, in other words, the professional man may not share in the profits. Thus, a lawyer may not, theoretically at least, accept a case on the understanding that he will be recompensed only in event of a victory over the opposing party, or a doctor may not perform an operation on the understanding that his fee will be greater if his patient should live than it would be if he should die. Further, the law recognizes, more or less, certain fees that must be paid in court for the services of certain professional men, the surveyor, for example. You will doubtless be pleased to learn that the law allows a surveyor six dollars a day for attendance at court, while engineers and other ordinary mortals receive one dollar and a quarter as an emolument for such service.

The standing of the professions in the popular mind is due largely to the character, ability and dignity of the men engaged therein.

The societies representing the professions are the result of the interest that the leaders of the professions have taken in order that the professions may be recognized as such by the world at large.

Generally speaking, a man is no longer considered a member of a profession when he ceases to earn his livelihood by the practice of the profession. A dentist leaving his calling to become a vendor of real estate is no longer considered a dentist, although he has had his training and may still be holding his diploma. A doctor may have received all his degrees and may have practised for decades, but let him devote his energies to commercially exploiting, say, some well-tried prescription, and the medical profession no longer recognizes him as a member. And so we see that the connection of earning that which is needful to purchase food, clothing and the necessities of life is intimately connected with the recognition of a person as a member of a profession.

"Engineering."—It is much more difficult to define engineering. What is an engineer? I confess I have been trying for twenty-five years to find out—and I am still trying. I remember two boys, now both on the list of graduates of this university, arguing about whether a civil engineer should know all about a locomotive or not. He thought he should. I didn't know. The other fellow is now practising surveying. Once I heard a judge of the Supreme Court of the United States struggle with the definition of an engineer in a brilliant twenty-minute speech, and he wound up by concluding that he didn't know anything definite about engineers excepting that they were jolly good fellows. In the daily press we often read of engineers, but before we get through the description we are fully aware that the person referred to drove locomotive No. 522 between two given stations at seventy miles an hour, or that he was the man who turned the throttle valve of the engine in the hold of the excursion boat.

The term "engineer" is very much overworked. It is not surprising that the great public gets confused in the multiplicity of engineers that are sometimes referred to. There are the civil engineer, the mechanical engineer, the military engineer, the electrical engineer, the hydraulic engineer, the sanitary engineer, the municipal engineer, the production engineer, the publicity engineer, the mining engineer, the chemical engineer, the structural engineer, the bridge engineer, the elevator engineer the harbor engineer, the stationary engineer, the government engineer, the city engineer, the town engineer, the tunnel engineer, the county engineer, the marine engineer, the railway engineer and the consulting engineer.

Mr. Dunn, the president of the American Institute of Electrical Engineers, in Boston last year referred to twenty-seven recognized classes of engineers, and I understand that someone of a statistical turn of mind has succeeded in isolating over one hundred and ten separate and distinct varieties of the bacterium *Engineerious Universalis.* Is it any wonder the public gets confused?

Compared with the professional men of law, medicine and theology, the engineer never comes to the attention of the public as a learned man doing things. Let a man be a member of one of the other professions and as soon as he begins to accomplish things he will be heard of. Let a geologist make a speech on his chosen subject and the newspapers of the land will blaze forth with startling headlines that Professor Geologus has unlocked the great secrets which Mother Earth has hidden in her bosom for millions of years. Professor Haultain accounts for this by the fact that the geologist takes time to tell the people what he is doing and what he thinks he has discovered. Let the lawyer defend some celebrity, whether famous or notorious, and before many hours the whole world will know it and will be gazing upon indifferent pictures of that lawyer. It is, probably, safe to say that the engineer may devote his life to the service of the world and die doing his duty, and yet never be heard of during his career, unless he unfortunately make an error in judgment or a slip of some kind. I venture to suggest that Quebec Bridge was more widely known by its failure than it or any other bridge will be in its success. I do not know that the engineer cares particularly about publicity, for he is too busy doing things. I am referring now only to the recognition or non-recognition of his professional existence by the great public. Anyway, he is too busy doing things to stop for the sake of publicity. One of the powers that the engineer under-rates is the power of the press. Summing up, it would appear that the public has, at the best, a very hazy idea of what engineering is. Every engine runner of the country is an engineer, no matter whether he operates a locomotive or a threshing engine. Even the plumbers try to play on the title and have in our own country succeeded in getting an association incorporated under the name of the Canadian Society of Sanitary Engineers. All respect to the man who can wipe joints and collect his bills of world-famous magnitude, but it looks very much like trespassing on the dignity of the name of the great recognized engineering body of Canada, the Canadian Society of Civil Engineers. It is, indeed, a most fortunate thing that the motorman does not term himself a street car engineer, that the chauffeur does not call himself an automobile engineer, and that the aviator does not wish to be known as a monoplane or biplane engineer. I was just wondering, if the analogy were carried on, what the man would call himself who runs a wheelbarrow.

Engineering Societies and Engineering Defined.—There are in every country recognized engineering societies having for their object the betterment of the profession and the uplifting of its members, all of whom are required to have certain pre-requisites of training and experience. In Canada there is the Canadian Society of Civil Engineers, in Great Britain the Institution of Civil Engineers. In the United States the American Society of Civil Engineers takes a corresponding place with, however, the addition of very strong societies known as the American Society of Mechanical Engineers, the American Institute of Electrical Engineers and the American Institute of Mining Engineers. We have in Canada also the Mining Institute of Canada. In the constitution of the Canadian Society of Civil Engineers and of the Institution of Civil Engineers the art of engineering is defined, but, so far as I know, no definition is given by the other bodies I have named. The definition used by the Institution is that devised by Tredgold, well nigh a century ago. He calls engineering "the art of directing the great sources of power in nature for the use and convenience of man." The Canadian Society of Civil Engineers has based its definition on the same formulæ in the words "the profession whereby the great sources of power in nature are converted, adapted and applied for the use and convenience of man." With definitions such as these given us by two of the leading English-speaking engineering organizations, it is not surprising that the public has some difficulty in comprehending what an engineer really is; that is, assuming that these definitions ever reached the public. I think it may fairly be said that you could not be considered much of an engineer when you first learned to overcome the law of gravity and stood on end to direct that great source of power in nature to your use and convenience. It has truly been said that the greatest source of power in nature is the tongue of a woman, nevertheless, to your engineering ability could not be applied any other definition than that of "contriving" when you succeeded in getting your mother to persuade your father to buy your first rubber boots. We are told that this definition of Tredgold was primarily intended to distinguish the military engineer from the civil engineer. I think there might be some difficulty in endeavoring to apply Tredgold's definition of a civil engineer to the military engineer, because that military engineer would not find it easy to convince his enemy that the cannon balls were for the use and convenience of said enemy, even if there were any enemy left to argue with. Maybe my lack of soldier enthusiasm prompts the remark. The conflicts for the necessities of life are surely serious enough without adding other struggles blazing with uniforms, glittering with cold steel and reeking with blood. But we must not forget that in the olden days much of what is now known as "public work" was done under the direction of the military authorities who possessed the only complete organization of the time.

Professor Swain has perhaps unconsciously given a definition which, it seems to me, excels all others, where he calls engineering "the application of the laws of nature, the principles of mechanics and materials of construction to the business of the world." It seems to me that we have in these words a definition of engineering in its broadest sense.

Engineering Training.—This definition brings me right up to the present moment speaking to you as a body of young men who have entered one of the great engineering schools to learn something of how to apply "the laws of nature, the principles of mechanics, and the materials of construction to the business of the world." You have come to a great institution. Its graduates are to be found everywhere making good. Go from Tyrrell on the north to Laschinger on the south, start with Lash in Java and encircle the world, and you will find the alumni of Toronto. I myself am proud to be on the same list as Duggan, Stern, Thomson, Wright, Ross, Deacon, Mitchell, Fairbairn, Speller, Angus, Chalmers—I should not have started to name them personally, because they should be named by the hundreds—an honor list of which everyone should be proud. It has been said of Sir Christopher Wren in St. Paul's, "If you would see his monument look around you." I say to you, if you would see the monument of John Galbraith just look around the world at the engineering alumni of Toronto.

The definition necessarily implies broad-mindedness. You cannot be a good engineer and be narrow-minded. So, do not forget that this broad Dominion has other universities, older ones in the Old East and newer ones in the New West. Queen's and McGill are great universities. There are many great universities in the

States. England has a great number of the highest engineering schools in the world. So has France. Germany was well advanced with engineering training before some of the other countries began to be serious about it.

But your university training will not make you an engineer. It will equip you to become an engineer—if the engineering spirit were born in you. By hard work and the application of the training you will here receive you will, I trust, all become engineers.

You are now, doubtless, realizing the difficulties surrounding "engineering as a profession." Eliminating all those engineers who share in the profits of their labors, it will be seen that it reduces the number to a comparatively small number of men—small as compared with the number composing the profession of law or medicine. Yet, it cannot be said that those eliminated are not engineers. On the contrary, they are engineers in every sense of the word, and they are so recognized by all the great national engineering organizations. Many of the leading ship builders, bridge builders and contractors are amongst the best engineers of the world, and they have and are occupying the topmost positions of honor in the engineering world.

The idea of a part of the engineers taking a stand shoulder to shoulder with the other professions is growing fast. Already a powerful movement is taking place in this direction, and it is interesting to note here that the indefatigable secretary of the only really professional organization of engineers was a member of the class of 1884. I refer to Eugene W. Stern, secretary of the American Institute of Consulting Engineers. Let me, in passing, call attention to the pre-requisites of membership with these professional engineers. A member must be at least 35 years of age, he must be actively engaged in the independent practice of the profession, he must be a full member of one of the great recognized engineering bodies, he must have a high character, he must have attained a degree of eminence in the profession, and he must not be engaged in contracting. When you come to realize the requirements for admission to any of the great recognized engineering bodies and add to that all the other stipulations that have been named, you will see that the standard set up by the American Institute of Consulting Engineers is one of which the engineering world should be proud. The membership is jealously guarded and, of course, it is not great in numbers. At present I think there are less than 70. This organization illustrates to some extent the difficulties surrounding "engineering as a profession." One is forced to conclude that "engineering" is too great and too comprehensive to ever be confined within the narrow limits of a "profession" in the same way as law and medicine. As it looks at present, we should associate ourselves with the recognized engineering bodies first and, later, if our choice take us in that direction, the Institute of Consulting Engineers. In the meantime study the work that the Canadian Society of Civil Engineers is doing.

As I look at the whole question that there are in this world two classes of people, the producer and the non-producer. At the bottom of the non-producers I place the real estate men and the speculators. At the top of the producers I place the agriculturist and the engineer. Between these extremes live all the other callings, and I shall leave you, each for himself, to place them according as they may, in your judgment, be producers or non-producers. Under our present social system the agriculturist must come first, because we must have food and clothing. Next in order in the world's progress is the engineer. The Indian in his native state, the Arab with his caravan has no need of the engineer. The farther we get from the primitive the greater the need of those who are able to apply to our use and convenience the great sources of power in nature. The marvelous advances of the last century are engineering advances. The other professions are older than engineering. Art is centuries old, yet it is a question if the art of to-day is on the same plane as that of Greece and Rome centuries ago. The grandest examples of the work of modern architects are based on the ancient orders, and the advances of architecture in modern times are due to the engineer in introducing steel skeletons and reinforced concrete. In surgery wonderful progress has been made within a lifetime, but the skill of noted surgeons was developed only through the medium of the engineer's handiwork in fine instruments and electrical appliances. The physician heals the sick and deals with individuals, while the engineer holds in his hand the health of towns, cities and nations. The preacher has no particular use for the engineer excepting as illustrations in sermons. The lawyer lives on the engineer's quarrels and on the relations which by his ingenuity he has set up between others. The teacher helps to prepare the embryo engineer for his admission into a cold-blooded world and promptly forgets him in the future pursuit of embryology.

It is the engineer who harnesses the Niagaras of the world to transform the night of our cities into noonday and to turn the wheels of commerce. It is the engineer who develops the mining and furnishes the metal with which he builds machines that by their ingenuity compel us to stand in awe and admiration. It is the engineer who produces the steel to form a network of highways over our continents and that makes possible the myriads of floating palaces on our oceans. It is the engineer who has abolished famine and pestilence. It is the engineer who has annihilated distance with his telegraph and his telephone. It is the engineer who has made possible the conquest of the air. It is the engineer who places in the hand of the president of a nation the power whereby he is able with a touch to remove from a point thousands of miles away a barrier of nature separating two oceans. It is the engineer who furnishes the worker in the golden west with the machines whereby millions of bushels of wheat are each year made ready to enter the hopper that the engineer has constructed. It is the engineer who has made Canada of to-day what she is.

In concluding, Mr. Francis referred to the foregoing generalities as being accomplished by the summation of the efforts of individuals, and he impressed upon the members of the society the necessity of upholding the high ideals of the engineering profession.

RAPID DAM CONSTRUCTION.

Near San Antonio, Texas, a concrete dam 164 ft. high, and having a crest length of 1,580 ft., was recently completed in 12 months. It contained 300,000 cubic yards of concrete, and forms part of an irrigation scheme for an area of about 60,000 acres. It has a spillway 1,200 ft. long, which delivers into an adjoining ravine. The delivery of the water involved the use of semi-circular sheet-metal flumes, one of which was supported on towers for a length of 1,500 ft., the greatest height being 95 ft.

THE LEONARD LOCOMOTIVE AND CAR SHOPS OF THE NATIONAL TRANSCONTINENTAL RAILWAY AT QUEBEC, P.Q.

THE general layout of the repair shops of the National Transcontinental Railway at Quebec, P.Q., is such as to show that not only has convenience of operation been the general principle governing the design, but that future needs have also been provided for. Each shop is capable of extension without interfering with any other, and any department can be increased separately as occasion may require.

There are eleven buildings in all, of various dimensions, each suitably designed for the special work to be done in them. These buildings consist of a locomotive, erecting, machine and boiler shop, forge shop, freight car shop, power house, planing mill, dry kiln, lumber shed, forge stores and scrap bins, oil house, stores, and office building for the executive staff. The total area covered is about five and one-half acres. The locomotive, erecting, boiler and machine shops are all under one roof, and arranged as shown in the plan (Fig. 1). The building is 602 ft. 6 in. in length and 152 ft. wide. It is shown in cross-section in Fig. 2.

In the erecting shop there are eighteen pits, placed transversely, and over them a 120-ton crane operates, lifting locomotives into and removing them from, their respective positions. A 20-ton crane operates over the same area at a few feet lower level. It carries small material, and is designed for light and rapid service.

The transverse-pit layout has the advantage of doing away with many side doors in the building for the in-and-out movement of locomotives. There are two doors, conveniently placed, through which engines and material enter and leave. It will be noted that this arrangement is economical in the matter of heating. It dispenses also with the necessity of a transfer-table, with all its inconvenience from snow and ice. The practically unbroken side-wall permits the use of jib cranes, one serving the fronts of two locomotives, being capable of lifting smoke-stacks, main valves, smoke-box doors and rings, etc. The use of these very handy cranes would be most difficult if the wall of the shop had been cut up into a series of doors.

The cross-section of the shop (Fig. 2) shows the position of the cranes. The large crane is carried on a series of built-up columns, so that the heavy load is central over the line of foundations. As one crane does the work of lifting and placing each locomotive, there is no chance of confusion such as might occur when two cranes are used, and where two men do the work. The single powerful crane has also the advantage over the usual twin-crane arrangement in economy of first cost and maintenance.

All the overhead cranes are provided with effective safety appliances. One of the most important of these appliances prevents the load from being "over-wound" by the lifting-drum. It consists of a device which, when the maximum lift has been reached, automatically opens a switch on the hoisting circuit, thereby cutting off the current, and suddenly removing the driving power. The cessation of the current immediately brings into powerful action a gravity-operated brake, which is normally held out of service by the flow of current.

The direction in which the midway crane operates is a new departure in railway shop construction, and substantial advantages are secured. The midway is laid out so as to be alongside of the shops, and not at the ends of the buildings, as is frequently the case. The object

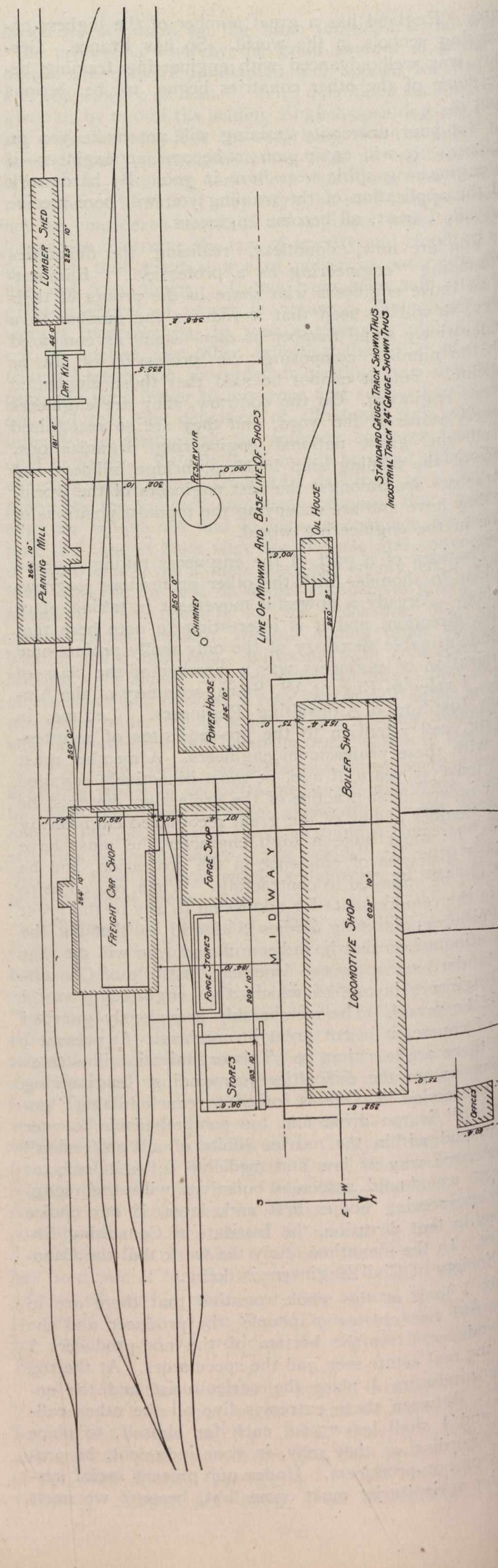

Fig. 1.—General Plan of the Leonard Locomotive and Car Shops, Quebec.

of this arrangement is that when material is brought by the midway crane from the storehouse, forge shop, or foundry to the machine, erecting or boiler shop, it is placed at the door nearest to the machine on which the material will be handled, or to the engine upon which it will be used. In this way the delivery of material is not concentrated at one spot at the extreme end of the building. It avoids distribution from a congested area, and it obviates long haul through the shop. Material is laid down at a point as near as possible to its destination, and economy of time and labor, as well as facility in handling, is thus secured.

The system of placing machines is such that the movement of material will be in one direction, and the distance over which any locomotive part is carried will not be unnecessarily lengthened by journeys forward from one machine and back to another. The continuous one-way movement of material saves time and labor and prevents interference.

The pits in the locomotive shops are supplied with steam, compressed air, hot and cold water. Depressions in the pit walls carry the pipes. By this arrangement the working space in the pits is not restricted, and the pipes are not where they can be easily damaged by workmen dropping material on them; and thus while being quite safe, they are out of the way.

The forge shop and the boiler shop are placed as near as possible to the power house. This is important, for in the case of the forge shop, where hammers are operated by live steam, the short distance between boiler and hammer reduces condensation and delivers steam where it is required with small loss. A similar condition holds good in a sense, for the delivery of compressed air to the boiler shop machinery. The nearer the source of supply, the less the pipe friction involved and the smaller the losses due to the forcing of air through the pipes.

Industrial tracks form convenient means of communication between the various shops. The buildings, cars, engines and supplies are protected by a water-system arranged to be readily put in use in case of fire. A further protection is afforded by reason of the use of concrete and steel in the various structures.

The shops are situated at Quebec, and have been named after Major R. W. Leonard, chairman of the National Transcontinental Railway Commission, under whose administration they were projected. The outlay has been carefully supervised, so that excellent results will be attained and full value received for the money expended. The permanent and substantial character of the shops and the size of the plant will be of material advantage to the city of Quebec, by providing steady employment for

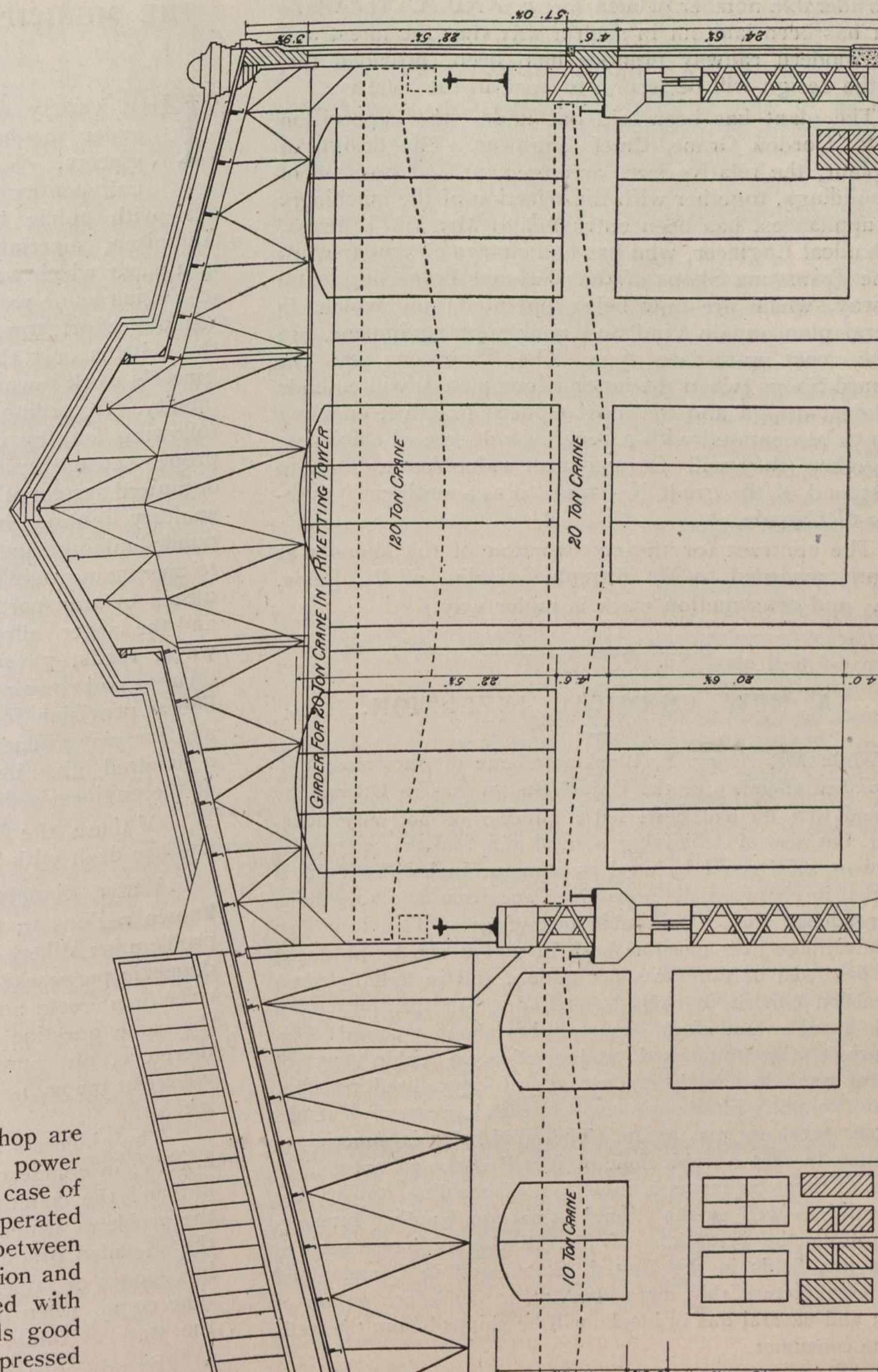

Fig. 2.—Cross-Section of Locomotive Shop—National Transcontinental Railway, Quebec.

a considerable number of men the year round. The whole plant has been laid out in such a way that the latest and most modern railway practice has been provided for, and the design will be second to none in the country.

The plant has been laid out under the supervision of Mr. Gordon Grant, Chief Engineer. The design of the plant, the relative size, arrangement and position of the buildings, together with the selection of the machinery and appliances, has been entrusted to Mr. W. J. Press, Mechanical Engineer, who has had charge of similar work at the Transcona Shops of the National Transcontinental Railway, which are now being operated, and which, in general plan and in kind and quality of equipment, are of the most up-to-date type. The Transcona and the Leonard Shops (when the latter is completed) will embody the latest design and the most modern practice, enabling them to be operated with a very high degree of efficiency. Altogether they will form a most valuable addition to the second of the great National "cross-continent" highways of Canada.

The contract for the construction of the shops was recently awarded to Mr. Joseph Gosselin, of Pt. Levis, Que., and construction work is under way.

A NEW CHEMICAL INVENTION.

While Mr. Henry S. Blackmore, one of the most distinguished chemists of the United States, was in Ottawa, he claimed that he had perfected a process of not only liquefying, but also of solidifying natural gas, and that either the liquid or solid could be used as a motor fuel. The fluid is ethereal in character, like gasoline; and from 8 to 10 gallons are produced from 1,000 cubic feet of gas. This fluid has the advantage over gasoline both in that it can be produced at a first cost of two cents per gallon, and in that it leaves no carbon deposit to clog the cylinder. In the form of a solid, a cubic foot of the fuel weights about 5 pounds, and comprises the condensed product of 2,500 cubic feet of natural gas. It has the appearance of crystallized paraffin, softens to putty-like consistency at 212 degrees, and at 312 degrees turns to gas again. The solid also is superior to gasoline in that a cubic foot of it will carry an automobile 12 to 15 times as far as a cubic foot of gasoline, and in that the solid as well as the liquid is safe to handle. Interests controlling the inventions of Mr. Blackmore have secured large gas fields in the United States and in Canada, and will manufacture this motor fuel at 10 cents per gallon or less; and natural gas in blocks will be shipped from the wells to the consumer.

WIRELESS RESEARCH.

The International Wireless Company has decided on the organization of committees in all the countries adhering to the wireless telegraph treaty, which was signed at London, in July, 1912, to aid the governments in extensive wireless observations and experiments. These will be carried out with the object, first, of determining a way to insure constancy and steadiness of wireless waves; secondly, measuring the variations in the signals and atmosphere disturbances at the different stations; third, comparing the intensity of the signals. These experiments will be conducted simultaneously on three days of each week, beginning in January. Special meteorological observations will also be made once a month. Reports of the work of the committees will be made to the wireless conference at Brussels in 1914 with a view to legislation.

THE MUNICIPAL ENGINEER AND PUBLIC HEALTH.

THE variety of problems that arrange themselves under the heading of "Duties of Municipal Engineers," is constantly being added to, and each unit continues to expand. Those which have to deal with public health were summarized by Mr. J. Antonisen, superintendent, Brandon Municipal Railway, in a paper which was read at the Public Health Congress in Regina some weeks ago. The subject was dealt with without effort toward comprehensiveness, but included those items only that fall within the borders of the engineer's work toward the establishment of a healthy community. According to Mr. Antonisen, they constitute the following lengthy list: A pure, plentiful water supply; proper sewage system; effective drainage system; well-organized system of collecting and destroying the garbage; sanitary lighting, heating and ventilating system for our public buildings and private houses; development of power to operate our public utilities and factories; cheap and safe means of transportation, both by urban and interurban and the larger railroad lines; proper construction of highways, roads, pavements and sidewalks; efficient maintenance and cleaning of our streets; proper city planning; liberal provision for park areas in our congested cities, and for playgrounds, public baths, comfort stations, and a hundred other items, which all come within the scope of the engineer's duties.

Of these, the first several are prominently important, and are dealt with by Mr. Antonisen as follows:—

Water Supply.—When the pioneer goes into unknown regions to find a new home for himself, his first problem is: Where can water be obtained for all kinds of domestic purposes? He locates his house near a lake, a river or a creek, and when other settlers follow, they ask the same question with respect to water supply. It is, therefore, not purely accidental that the majority of villages, towns and cities are located near rivers and lakes.

The pioneer's cabin becomes surrounded by settlers' houses; in course of time a village or small town grows up, and the community is gradually confronted with all the problems which have just been enumerated. At first the so-called practical men try to solve these questions, but sooner or later in the development of each town, the time comes when it becomes apparent to everybody that the state of things bespeak the need of an engineer.

By advertisement or by application to some large city a number of candidates for the position are obtained, and after due consideration the community selects their county or town engineer, who is then expected, for a salary of $75 to $125 per month, to be an expert in all branches of civil engineering. Thus the average town engineer puts up a bold front, commences to lick things into shape and, although he makes many daring leaps into darkness, he generally lands on his feet. By constant hard work and diligent study, seeking advice and information in engineering literature and from more experienced colleagues, he gradually develops into that modern wizard—the city engineer. During his development period he has laid out systems for waterworks, sewerage, built sidewalks, streets, bridges, subways, sewage disposal plants, reservoirs, water towers, dams, incinerators, grandstands, race tracks, and a thousand other things.

As long as the town is small it is contented to pump the water from a river or lake and using it without any kind of treatment; it is considered all right to discharge raw sewage into the creek or river or lake, as long as the waterworks intake pipe is up-stream and the sewer outlet down-stream; or, in case of a lake supply, a couple of miles apart; but when the death rate rises up to uncomfortable figures, then the first question asked is: Have we got a pure water supply? The overworked, busy city engineer has worried over this question in idle moments, between midnight and sunrise generally, and has, perhaps, formed an opinion of what steps should be taken to safeguard against contamination of an existing pure supply, or procure a better supply than one already contaminated. Sound advice to the city engineer is: Get your council's permission to employ a consulting engineer of known repute; lay all your information, together with your own opinions, before him, and then let him decide what should be done. It is well-spent money to employ the consulting engineer, and when he has worked out the project, and it proves a success, give him the full credit for it, although you have furnished him with some useful information; because, if his scheme does not prove an unconditional success, he gets more than his full share of the blame.

Sewage Disposal.—Once a pure water supply has been secured, the engineer must turn his attention to the sewerage system, as this problem is of equal importance to the public health; not alone in his own town or city, but to all the inhabitants of the drainage area further down the stream or bordering upon the lake into which the sewage is being discharged. It was considered sufficient once upon a time to discharge the sewage raw into a flowing stream or a fairly large lake, and then trust to Nature for the rest; but Nature fails to respond to our trust, and we engineers are obliged to erect sewage disposal plants, a better name for which would, by the way, be sewage treatment plants.

This treatment of sewage in such a manner as to render it harmless is probably the greatest problem of modern engineering authority, and one that should not be tampered with, because a poorly or wrongly designed plant is worse than no plant at all. The province of Saskatchewan is to be congratulated upon the way in which this important problem is being dealt with. The Provincial Government has very strict rules regarding this subject. They employ their own experts, whose advice can always be obtained in designing a system, the plans of which must be approved by the government.

In connection with this matter there is one feature which could possibly be made a subject of recommendation to the government, and that is the operation of these plants after they are installed. No matter how scientifically a plant is designed, nor how properly it has been constructed, if a properly trained and enthusiastic man is not placed in charge of the operation to take proper observations of the results and see that proper results are obtained, the plant will be a dismal failure.

The conviction forced itself upon me, while city engineer in Moose Jaw, that the government ought to place a scientifically trained person in charge at each plant and contribute a portion of the cost of his salary as well as the cost of an experimental station, so that complete and reliable records could be obtained regarding the operation of the different plants.

Garbage Destruction.—Assuming, now, that an ample supply of pure water has been secured, and that there is in operation a plant where the sewage is being treated so successfully, that it ceases to be a menace to the public health. The system of collecting and destroying garbage is another important question. It is not exaggerating to claim that inside the limits of every city in Canada there are always hundreds of tons of garbage lying in a more or less advanced state of decay with the resulting dangers to children and adults. The air is poisoned by the emanating odors, but in spite of all this some cities are very careless and indifferent towards the garbage problem.

Here is a broad field for the engineer to organize a proper system of collecting garbage regularly and then also destroying it properly. When a town has grown to a size of 15,000 inhabitants, it can afford, and should erect, a garbage destructor which, when properly constructed and carefully managed, can be operated at a reasonable cost. The incinerator, which was erected during my stay in Moose Jaw, cost about $45,000, and had a capacity of 50 tons per 24 hours. It was operated without the use of any coal and developed enough steam for 50—75 h.p.

The most essential problem in connection with garbage is, however, to educate the public to co-operate with the authorities by reducing the garbage to a minimum, instead of having an abundance of barrels and boxes in the back yard filled to overflowing. There is no reason why the average household could not dispose of most of the garbage in the ordinary stove and furnace; the ashes can and should be kept separately and used for filling purposes; tin cans, when emptied, should be rinsed with water and then put on the bonfire, where it is permitted to have bonfires.

My attention has lately been called to a water-heating garbage burner, which is manufactured in Kewanee, Ill., and can be installed in ordinary private houses for from $150 to $250. It is claimed for this apparatus that it will destroy all house garbage and develop sufficient heat to provide hot water for domestic purposes. The municipal engineer should investigate such matters, and advocate their introduction in hotels, boarding houses, large private and public institutions, hospitals and asylums.

In smaller cities, which have not reached the stage where they can afford incinerators, the nuisance ground flourishes, and is generally very badly managed or not managed at all, but simply left as a perfect Gehenna. There is no necessity for such a state of affairs, as a nuisance ground, under proper management, can be made a smaller pestilence than at present by the display and use of common sense.

Fires should be maintained; a system of ditches should be dug, into which garbage that can not be destroyed in the fires can be dumped and afterwards covered with the excavated earth. On the average nuisance ground we can generally find enough combustible material, in shape of paper, rags and boxes, to maintain fires which will burn most of the garbage, or at least disinfect it, and in charge of the place are some old fellows who have been given that job because they are old ratepayers.

City Beautification.—But let us turn away from all this and consider the more pleasant tasks of the engineer, through which he promotes the comfort of his fellow-citizens and beautifies the city. These comprise matters such as building sidewalks, curbs, pavements, boulevards, parks and tree-planting. It is of comparatively small importance whether the sidewalks are laid at the property line or at the curb, as far as the public health is concerned; the main thing is to get a network of sidewalks built so that the citizens can come back and forth from their homes without walking in ankle-deep mud, which is then dragged into the house. Dirt in every shape and form is a menace to health.

The boulevards should be made as wide as possible and trees planted thereon, as grass and trees have a beneficial effect upon the health of the inhabitants. A paved street is easily cleaned, as it can be swept with brooms and flushed with water, so that the dust and dirt can be removed into storm sewers or by street cleaning wagons.

No city can have too many parks and open spaces, as long as these can be provided for, while the land is cheap. The town engineer has to examine all plans of subdivisions, and he can often induce the owner of subdivisions to set aside a parcel of land for public parks and also get them to make some of the streets wider than the usual 66 feet. Provisions like these may seem unnecessary at the time, when the subdivision plans are submitted, but they prove themselves of great value to the public health when these districts become settled.

The roadways in residential sections of cities should be made as narrow as possible, just sufficient for the light traffic, as they produce dust and dirt, which is blown into the houses, whereas boulevards with grass are always clean, healthy and beautiful, when well kept.

As long as the town is small, the transportation problem does, of course, not signify, as the distances between residential and business sections are short, but when the land becomes very valuable, due to the progress of the city, and therefore the working classes must move away from the vicinity of their working places, then arises the necessity for rapid and cheap transit, and we build our electric street railways, which enable the man of moderate means to make his home in the outskirts or suburbs of a city, where land can still be bought or houses rented for a reasonable price.

The man who works in an office, shop or factory the whole day, needs change of air, when he is through with his day of labor, and the street cars, elevated and underground railways, as well as the steam-operated suburban trains, carry the working population back and forth between their places of work and their healthy homes at a small cost. We extend the water and sewer mains, electric light and telephone lines to the farthest limits of a city, so that there should be no excuse for overcrowding in tenement houses.

And when a city has reached the stage where this housing problem becomes an acute question, then we commence to talk of city planning, and we discover all the mistakes which have been made while the city was growing. And why were those mistakes made? Principally because the municipality had no power to control the city planning, and then, also, often because even though the authorities of a city had power to control the city planning, the engineer's advice was not obtained, but private interests dictated the policy of the controlling bodies.

This branch of engineering, the city planning, should be taken up more thoroughly by municipal engineers, because generally the town engineer has to pass all subdivision plans, and if he does not take a look into the future before passing a plan, it is pretty certain that nobody else will; and thus occur many blunders which it afterwards costs enormous sums to rectify.

The proper way is to let the city engineer lay out a city plan and then make property owners conform to this plan. That may appear autocratic to the free citizen of the new world, whose idea of liberty is often that he should have the right to disregard the rights of the community for his own personal advantage, but true liberty exists when law and order is most respected.

NEW DEPARTURES IN TELEPHONE.

An article in the *New York Telephone Review*, entitled "From a Limousine to the Depths of a Coal Mine," describes two types of special telephone equipment—e.g., a chauphone, or telephone for automobiles, and a special portable telephone equipment used in mine rescue work. The chauphone, which consists of a hand transmitter for the passenger connected to a loud speaking receiver at the chauffeur's ear, obviates the difficulties of speaking-tubes for automobile use. The mine rescue equipment has a special type of transmitter known as the "throat transmitter," since a man wearing an oxygen helmet which covers his month cannot use the ordinary type of telephone transmitter. The throat transmitter is light and compact, and is provided with a soft rubber cap, which adapts itself to the curves of the throat. The telephone equipment used by the men outside the mine or at the directing end consists of a chest-type transmitter and head-band receiver. The two are connected by a small wire cable, in 500-foot coils, carried in a leather case and fastened to the helmet man's belt, which pays out as he advances.

CANADA AND HER PAPER MANUFACTURING INDUSTRY.

When the Senate of the United States passed the Tariff Bill and removed the suggested countervailing duty of $2.00 per ton on chemical wood pulp manufactured in Canada, it threw open the gates of the United States to the wood pulp industry of Canada. The United States requires about 4,500 tons of paper daily, New York alone using 600 to 800 tons; and her wood pulp forests are fast disappearing. Her water powers not only are decreasing, due to the bareness of the hills, but are more valuable for other commercial purposes than for driving paper mills, that are very much inferior in supply of material and in limitation of power to competing Canadian establishments. For Canada is extremely fortunate in the possession of those three requisites underlying the manufacture of paper—i.e., cheap and abundant water power, cheap and contiguous wood supply, and ready transportation. And the United States has found that its manufacturers can no longer compete successfully in this business. Since 1911, when not more than 440 tons of paper per day were manufactured, there has been an increase in capacity of 1,055 tons per day; so that up to date the total capacity of Canadian mills is 1,495 tons daily. At present the total production of United States mills is about 4,000 tons per day; but the increase of production in 1912 in the United States was 235 tons per day as compared with 430 tons per day in Canada; in 1913 up to date, 110 tons in contrast to 225 tons, which by January 1, 1914, will have been increased further by a capacity of 390 tons per day. Thus, whereas in 1909 and 1910, the capacity of Canadian mills was but 12 per cent. of that of United States mills, in 1914 the Canadian industry is substantially 40 per cent. of the American industry. So, for the interests of the republic, it was not a time to have restrictions placed upon Canadian wood pulp; and as far as Canada is concerned, the new tariff has meant the opening up of new towns in her backwood forests, and the great development of her lumber industry. Canada has taken precedence, because, in the words of Senator Weeks, of the United States Congress, "Canada is in a better situation to make the products which are absolutely necessary in this paper age of the twentieth century."

COAST TO COAST.

Edmonton, Alta.—Premier Sifton made the statement in the Provincial House on October 22nd that the Government will expend next year about $2,000,000 in telephone extensions.

Ottawa, Ont.—A West End Ratepayers' Association has been formed with the prime purpose of securing drainage for the district west of Rosemount Avenue, a matter which has been delayed for some time, much to the disadvantage of this section.

Vancouver, B.C.—The city solicitor has been instructed by Mayor Baxter to bring before the Railway Commissioners the matter of commencement on the C.P.R. tunnel from its west end reserve to the waterfront to obviate the great inconvenience to traffic.

Sutherland, Sask.—The program of civic works for which some time ago the ratepayers approved by-laws amounting to $200,000, will be commenced in its entirety early next season. However, grading operations on the thoroughfares is now in progress.

Vancouver, B.C.—The C.P.R. has presented to the city board of works plans in connection with the proposal to take over the railway reserve, which has become a warehouse district. But action upon these has been deferred until more comprehensive plans are produced by the railway.

Coquitlam, B.C.—A syndicate of Fort William, Minneapolis, and Winnipeg capitalists has selected Coquitlam as a grain elevator site. The head of the syndicate is Mr. J. H. Henderson, of Fort William, formerly head of the Grain Growers' Association elevators of that city.

Lethbridge, Alta.—The inefficiency of the Lethbridge waterworks system is shown in the report of City Engineer Harvey for the month of September. The report says that the city waterworks system sprang a total of 45 leaks, and this is a great increase upon the leakage of previous months.

Hamilton, Ont.—To endeavor to eliminate neglected features in connection with civic works in Hamilton, Alderman Byers is advocating the appointment of a works commissioner, who will closely inspect all works and conduct a cost system in connection therewith, and who will furnish a report weekly, or more frequently, to the city's board of control.

Vancouver, B.C.—Alderman Black, chairman of the civic water committee, has been considering with the water rights commissioner of Victoria the question of securing additional water supply for Vancouver. His desire is to obtain from the water rights and forestry departments of the Government full information in regard to the question of supplying additional water facilities from Seymour Creek.

Montreal, Que.—The firm of investment bankers, Nesbitt, Thompson & Company, of Montreal, have recently purchased $600,000 of the limited preferred stock of the Dominion Power and Transmission Company, Limited. This investment is a recognition of the important position the Power Company has taken and maintains in Hamilton and the surrounding territory.

South Vancouver, B.C.—A deputation from the Main Street Improvement Association has asked the Richmond Municipal Council to assist the association in its campaign to obtain the Main Street bridge across False Creek for the north arm of the Fraser River. The proposal is to remove this bridge from False Creek when it has been filled in, and when a sea wall 300 feet west of the bridge has been completed.

Victoria, B.C.—In connection with the construction and plans of the C.N.P. Railway's bridge across Selkirk water, Alderman Gleason has objected to the proposed pile structure across the beautiful waters of the Arm, and considers that at least a steel bridge should be erected. The council finally adopted a motion made by the alderman to leave the matter with the engineer and solicitor to bring the subject to the attention of the Canadian Northern representatives.

Toronto, Ont.—The new Danforth Avenue civic car line in Toronto has been duly opened with a formal ceremony and with evening illuminations, music, and processions in carnival dress. Those taking part in the official ceremony were Miss Hocken, daughter of the Mayor, the Mayor, and several of the city's aldermen and controllers. A dinner was served later in Playter's Hall; and a meeting was held in Riverdale rink, at which speeches were given by Hon. Dr. R. A. Pyne, Hon. A. E. Kemp, and Geo. S. Henry, M.P.P.

Vancouver, B.C.—The board of works for Vancouver has approved the plans of the southern approach to the Second Narrows bridge, and these have been placed before the Railway Commissioners at their sitting here on October 27th. The site of the approach was moved some sixty feet east, but the general location of the railway line was approved, subject to the bridge company's consent to construct retaining walls, and the necessary subways and bridges. The city engineer was authorized by the board to sign the plans upon these conditions.

Port Arthur, Ont.—The most modern elevator in the entire world, the new government elevator at Port Arthur, is now receiving the finishing touches to its construction. The contractors, the Barnett & McQueen Company, are still in charge of the contract, not having handed the elevator over to be operated under the government's control, nor will it be turned over until completed in every detail, which will perhaps not be for two or three weeks more. Although grain is being unloaded for storage, the full capacity of the big plant will not be called upon until such time as all the last bits of machinery are installed.

Fort William, Ont.—It is reported that the big Stanley Avenue sewer is nearing completion, and under favorable conditions will be finished this year. The open trench work running from the Kaministiquia River to a point 700 feet east of the Canadian Car and Foundry Company's plant was to be completed in October; after which, 300 feet of pipe will be laid under the car works, through which a tunnel will be run if possible. The trench has been built through a heavy loam and blue clay, and the workmen have experienced great trouble with water oozing into the cut when it had been dug to a certain depth. The entire length of the trench had to be shored up with long planks to keep the sides from caving in.

Elmira, Ont.—On October 29th the Hydro-Electric power was turned on in the skating rink at Elmira by Reeve I. Hilborn, and in the evening the current for the street lights was turned on by the Hon. Adam Beck. Delegates were present from all neighboring municipalities, and a band was in attendance to give the event an enthusiastic celebration. Many formal proceedings presided over by Reeve Hilborn, notably a "Made-in-Elmira" exhibition, were conducted by the municipal officials, and were lauded by the congratulatory speeches delivered by the guests of the day. A 250 horse-power current has been thus inaugurated in this enterprising village of a population of 200.

Peterboro', Ont.—At Peterboro', a street lighting system in connection with the Hydro-Electric system has almost been completed. Iron poles and brackets are now in position to support the magnetic arc lamps, which will be assembled in the course of a few days. There is, however, difficulty arising in connection with the securing of a supply of electrical energy with which to operate the lamps. The present existing contract for the supply of power to the city by the Peterboro' Light and Power Company expires at the close of the present year. In the meantime the Power Committee of the City Council anticipate the successful issue of the expropriation proceedings which have been instituted with a view of obtaining civic control of a stated portion of the company's system in accordance with a special Act enacted by the Ontario Legislature.

Montreal, Que.—President W. G. Ross, of the Harbor Commissioners, in company with Lieutenant-Colonel Labelle and M. P. Fennell, assistant secretary, have made recently an inspection of the grain-handling facilities at Buffalo. As a result, Mr. Ross is advocating strongly that further terminals and grain-handling facilities at Montreal, and the improvement of this city's canal system must be undertaken as a national duty, and the national prestige of handling Canadian business through Canadian seaports, instead of allowing Canada's trade to be taken care of by United States ports, must be preserved. To keep pace with the demands of the development of the Canadian West, and of the increase in trade which will be brought with the completion of the Erie Canal, Buffalo is contemplating the erection at once of several new elevators. For like reasons, improvements are being constructed in connection with the trading port of that city.

Victoria, B.C.—Since the first of the month exceptional progress has been made on the Sooke Lake waterworks scheme, especially on the construction of the dam at Humpback Reservoir and of the dam and head works at the lower end of Sooke Lake. And Engineer Rust expects, that with favorable weather conditions the concreting of both localities will soon be completed. At Sooke Lake, the arrival of the four large metal gates which are to be placed in the gatehouse in such a manner as to permit of the entry of lake water at various levels, is expected daily, and the installation of these will be carried out immediately. Moreover, a start has been made in laying the temporary railway line along the right-of-way from the lake works to the point on the flow line grade above Cooper's Cove, Sooke Harbor, whence the concrete pipe lengths for the flow line will be carried to the pipe line grade by inclined railway and thence distributed by railway along the grade. At Humpback, early in November, the work will be almost completed as far as the city intends to carry it by day labor, and will be ready for the call of tenders for concrete flow line and steel pressure pipe line.

St. John, N.B.—The water distributing system of St. John has undergone a splendid improvement during the past year. The renewals in the water mains covering a very wide area of the city are a necessary supplement to the increased supply and pressure obtained through the new supplying main which was laid to Loch Lomond a few years ago. The great increase in supply and pressure available through the supplying mains was in some sections of the city unavailable owing to the deplorable condition of the distributing mains. These mains have been renewed in the city this past year to the extent of 11,410 feet of 8-inch iron mains, taking the place of mains which ranged in size from 1 inch up to 4 inches. The mains which have been replaced were practically all blocked up to a considerable extent by the corrosion of the pipes. The expenditure on the renewals amounted to $30,000. The department has prepared for a comprehensive scheme of supplying Lancaster and the West side by means of a 20-inch main, which will be laid across the new bridge at the falls. About 2,000 feet of new 12-inch water main has been laid from the Riverview Park out to the bridge. This main will be connected with the Strait Shore main, and both mains will feed the extension across the new bridge. The level of Spruce Lake is only a few feet above the level of Lancaster, and the water supply in this section is hardly adequate, and in view of the rapidity of the growth of that section will become increasingly inadequate. The level of Loch Lomond is sufficiently higher than Lancaster to give an efficient water service there. There will also be the advantage of two sources of supply.

PERSONAL.

DR. FRANK D. ADAMS, Dean of the Faculty of Applied Science, McGill University, Montreal, has been elected an honorary member of the American Institute of Mining Engineers as one of the 20 honorary members of that organization.

A. C. D. BLANCHARD, B.Sc., M.Can.Soc., C.E., formerly city engineer of Lethbridge, Alta., has accepted an appointment to the engineering staff of the Greater Winnipeg Water District. Mr. Blanchard assumed his new duties a few days ago.

T. C. KEEFER, C.M.G., of Ottawa, a past president of the Canadian Society of Civil Engineers, and of the American Society of Civil Engineers, and a member of the Institution of Civil Engineers of Great Britain, was recently elected by the unanimous vote, an honorary member of the American Society of Civil Engineers. When president of that society, Mr. Keefer experienced the distinction of being the first to hold the office, who was not a citizen of the United States, and the society has further extended this honor in the above way. Mr. Keefer is well known among engineers. He has been connected in the past with many of the most important engineering problems of Canada, being as a student the winner of Lord Elgin's prize on "The Railways of Canada," and being one of the first to advocate the construction of the Transcontinental Railway 50 years ago. Mr. Keefer, for a number of years, held a professorship in engineering at McGill University.

OBITUARY.

GEORGE CROFT, contractor, who was putting in the concrete work in connection with the harbor development at Cobourg, Ont., met death on October 29th, by accidental drowning. Mr. Croft was a brother of C. E. Croft of the R. and O. Line, and of Harry Croft, superintendent of government work at Cobourg.

COMING MEETINGS.

UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, L021 Brown-Marx Building, Birmingham, Ala.

NATIONAL MUNICIPAL LEAGUE.—Annual meeting will be held in Toronto, November 12-15. Secretary, C. R. Woodruff, 705 North American Building, Philadelphia, Pa.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The annual meeting will be held in New York, December 2nd to 5th, 1913.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

20648—October 22—Authorizing Twp. Saltfoot, Co. Wentworth, Ont., to construct and maintain highway known as 'Cochrane Road' across T.H.&B. Ry. in Lot 34, Con. 4, Tp. Saltfleet, Ontario, at its own expense. 2. Refusing application to construct highway known as 'Rosseay Road' across said Railway.

20649—October 23—Authorizing C.L.O.&W. Ry. (C.P.R.) to take certain lands for purpose of carrying out diversion of road allowance in Lot 34, Con. 8, Tp. Camden, Co. Lennox and Addington, and removing ground on north side of Co.'s right- of-way, in order to provide a non-obstructive view from said road allowance towards west as far as crossing of Bay of Quinte Ry. by C.L.O.&W. Ry. for a distance of 105 feet from said crossing, in accordance with provisions of Order No. 18696, dated February 13th, 1913.

20650—October 23—Authorizing C.P.R. to change present grade crossing in road allowance between Lots 24 and 25, Con. 3, Tp. Scarborogh, Co. York, Ont.; and construct additional track across said road allowance, at mileage 87.9 on Co.'s main line.

20651—October 23—Authorizing C.P.R. to construct road diversion in Lot 32, Con. 1, Tp. Scarborough, Ont., and to construct its tracks, by means of grade crossing, across said diversion, at mileage 90.4 on its main line, Toronto Subdivision.

20652—October 23—Approving location C.P.R. station at Lonsdale, Lot 23, Con. 2, Tp. Tyendinaga, Ont., at mileage 63.87 from Glen Tay; provided whenever it so develops that traffic on highway is blocked for more than 5 minutes at any one time by reason of location hereby approved, Board shall be at liberty to relocate said station.

20653—October 23—Authorizing C.P.R. to change present grade crossing on road allowance between Lots 34 and 35, Con. 1, Tp. Scarborough; and construct additional track (double track) by means of a grade crossing, across said road allowance, at mileage 91.2, on Con.'s main line, Toronto, Subdivision.

20654—October 23—Authorizing C.N.O.R. to construct across Third Street, town of North Bay, Ontario.

20655—October 22—Refusing application of village of Brechin for an Order directing C.P.R. to move its station from present location (approved by Order No. 15165, dated October 20th, 1912,) to a point nearer said village.

20656—October 22—Authorizing C.N.O.R. to construct, at its own expense, across Eglinton Avenue, between Lot 1, Con. 4, and Lot 5, Con. 3, Tp York, Co. York, Ontario.

20657—October 24—Authorizing C.N.R. to open for traffic that portion of its line from Macrorie to Tichfield, a distance of six (6) miles, and from the junction between Macrorie and Tichfield to Elrose, a distance of fifty (50) miles, in Prov. Sask.; trains operated over said line be limited to a speed not exceeding eighteen (18) miles an hour.

20658—October 24—Extending, until December 31st, 1914, time within which Quebec Oriental Ry. complete work of ballasting its railway from Metapedia to New Carlisle, with a complete lift of six (6) inches of ballast; and of renewing fences, gates, wooden culverts, and all decayed portions of trestles.

20659—October 23—Rescinding Order No. 19702, dated June 27th, 1913. 2. Approving Montreal and Southern Counties Ry. Co.'s Standard Passenger Tariff of Maximum Tolls, C.R.C. No. 4, on basis of 2½ cents a mile, to apply between Co.'s stations, south of St. Lawrence River; said Tariff, with a copy of this Order, be published in at least two consecutive weekly issues of "The Canada Gazette."

20660—October 24—Dismissing application of Clifton Sand, Gravel and Construction Co., Limited, for an Order reducing, adjusting and fixing rates on sand, gravel and concrete material between Stamford, Ont., and surrounding points in Ontario, including Niagara Falls, Chippewa, Welland, Port Colborne, Thorold, Merritton, St. Catharines, Hamilton and Toronto and intermediate points.

20661—October 24—Authorizing town of Sarnia, Ont., to construct, at its own expense, highway across right of way and tracks of Pere Marquette Ry. at south limit of said town. 2. R.R. Co., at its own expense, raise its tracks so as to be level with highway, and keep cars 75 feet back from edge of crossing on each side. 3. R.R. Co. install improved automatic electric bell at said crossing, and thereafter maintain bell at its own expense. Town to reimburse R.R. Co. cost of installing said bell.

20662—October 24—Authorizing C.P.R. to construct road diversion in N.W. ¼ Sec. 8-11-9, W. 4 M., Alta.; and to construct tracks of its main line, Alta. Div., Lethbridge Subdivision, across said diversion.

20663—October 24—Amending Order No. 18110, dated November 23rd, 1912, by substituting name, "Robert W. King," for name, "King Construction Co.," wherever it occurs in said Order. 2. That words, "of the location of the said branch line, or spurs therefrom," following word "reason," where it appears in operative paragraph of said Order, be stricken out and following words substituted, "of the construction of the said branch line, or spurs therefrom, including damages, if any, occuring by reason of location of said branch line north of centre line of the said Sudbury Street." 3. That, with consent of all parties, Herbert E. Denton, Esquire, Junior Judge of the Co. York, be appointed Referee to ascertain and fix amount of compensation which Robert W. King, Wm. Bretzner, Mary Lyons, John McLean and John O'Neill are severally entitled to receive under terms of said Order No. 18110. 4. That costs of and incidental to said Reference, including those of said Referee shall be in discretion of said Referee. 5. That G.T.R. pay such, if any, sum or sums as said Referee may order to be paid to said claimants, or any of them.

20664—October 21—Directing that cost of installing new diamond, back-up derails, and derails necessitated by construction of double track at crossing by C.P.R. of G.T.R. in W. ½, Lot 14, Con. 2, Tp. Trafalgar, Co. Halton, Ont., at mileage 32.56 from Toronto, be paid by C.P.R. That cost of maintaining additional protection at said crossing be paid one-half by C.P.R., and one-half by G.T.R.

20665—October 27—Amending Order No. 180, dated July 6th, 1904, to provide further protection at crossing of Dundas Street, by G.T.R. and London Street Ry., city of London, Ont.

20666—October 25—Authorizing C.P.R. to open for traffic portion of double track from Pilot Butte, mileage 84.7 to Regina, mileage 92.0, Moose Jaw Subdivision, Prov. Sask.

20667—October 25—Authorizing C.P.R. to operate bridge No. 46.9 on Megantic Subdivision, Eastern Div.

20668—October 24—Recommending to the Governor in Council for sanction agreement entered into in duplicate, June 2nd, 1913, between C.P.R. and Kettle Valley Ry., providing for interchange of traffic between said two companies.

20669—October 24—Authorizing C.P.R. to construct siding for F. T. Proctor, Toronto, Ont., from point on S.W. limit of its main line, in Lot 10, 4th Con. West, Tp. Caledonia, Co. Peel, Ont., at mileage 24.5, Orangeville, Subdivision.

20670—October 23—Authorizing C.P.R. to construct, by means of grade crossing, its Ballast Pit spur across road allowance between Indian Reserve and Tp. Thessalon, Dist. Algoma, Ont., mileage 3.08 of said spur, subject to certain conditions.

20671—October 24—Approving location C.L.O. and W. Ry. (C.P.R.) station at Bowmanville, in Subdivision, Lots 2 and 3, and Lot 13, Con. 1, Tp. Darlington, Co. Durham, Ont., lying west of Scugog Street, town of Bowmanville.

20672—October 25—Directing that New Ontario Farm and Townsites, Limited, and Lieutenant-Colonel Geo. A. Shaw, be declared parties interested and Respondents herein, together with Whitford Vanduson, the registered owner of land above mentioned. And authorizing C.N.O.R. to take, for purposes of efficient construction and operation of its railway, and in order to carry out works approved by Governor in Council on April 27th, 1910, portion Lot 13, Con. 1, Tp. Nepigon, Ont., paying compensation to parties entitled thereto in accordance with provisions of Railway Act.

20673—October 24—Approving revised location C.N.O.R. through Tp. York, and part city of Toronto, Ont., mileage 2.23 to 6.16 from Yonge Street, subject to certain conditions. And refusing Co.'s application for level crossing of C.P.R. main line.

20674—October 27—Authorizing C.N.R. to open for traffic its line from Alsask to Hanna, distance of 93 miles; and from Hanna to Munson, a distance of 40 miles.

20675—October 25—Authorizing C.N.R. to construct across Leitchfield Avenue, Athabasca, Alta., subject to terms of consent.

20676—October 23—Refusing application residents of La Conception, Que., for Order directing C.P.R. to employ an agent at La Conception. 2. C.P.R. provide telephone connection at La Conception Station with agent at Mont Tremlant, also with station at Labelle: That Conductors on Ry. Co.'s trains sell tickets to patrons boarding trains at said flag station or stations, on same basis and advantages as authorized at organized stations.

20677—October 24—Directing that C.N.O.R. forthwith construct livestock pass under its railway on farm of W. R. Kirk, Foresters Falls, Ont., on or beside his farm lane; pass to be 7 feet wide by 7 feet high, properly drained and paved. Co. also construct, at such points as Applicant may desire, grade crossing convenient and proper for farm purposes. Co. shall not block said grade crossing longer than five minutes at any one time when crossing is desired to be used.

20678—October 27—Rescinding Order No. 19468, June 4th, 1913; and Lake Erie and Northern Ry. is declared to have seniority as to trains over Brantford Street Ry., at point of crossing.

20679—October 23—Granting leave to Ottawa Electric Co. to erect poles and wires across C.P.R. on River Road, south of Hurdman's Bridge, Ottawa, Ont.

20680—October 23—Granting leave to Ottawa Electric Co. to erect poles and wires across C.P.R. on private road leading from River Road south, to Convent of Grey Nuns, near Hurdman's Bridge, Ottawa, Ont.

20681—October 27—Directing that, pending extension and operation of C.N.R. to Estevan, C.P.R. publish and file through freight tariff of class rates from Estevan, via Midale, to those points on C.N.R. to which through class rates, via Midale, are published and filed by C.P.R. from Weyburn, Sask., said through rates from Estevan not to exceed sums of published and filed local rates of C.P.R. to Midale and of C.N.R. from Midale to Weyburn destinations: Provided so long as Midale Transfer continues a non-agency, C.P.R. be permitted to consolidate less-than-carload shipments by holding them at Estevan until they approximate a carload of 20,000 lbs. in weight for transfer to C.N.R., without breaking bulk. Said tariff to be made effective not later than November 20th, 1913.

20682—October 27—Approving and authorizing clearances as shown on plan of door openings at factory of Canada Wire and Cable Company, Limited, Leaside, Ont.

20683—October 27—Approving plan showing method of temporarily reinforcing existing piers of New Brunswick Coal and Railway Co.'s Bridge No. 44.7 over Salmon River, near Chipman, New Brunswick.

TRADE ENQUIRIES.

The following inquiries relating to Canadian trade have been received:—1105.—A Maritzburg firm of hardware merchants wishes samples and quotations of fencing wire. 1106.—A Natal firm desires quotations and samples of Canadian bolts and nuts. 1116.—A Natal firm of hardware merchants can handle a quantity of splitwood pulleys, small sizes, 6 to 18, and a few 24. 1163.—A South African firm wishes catalogues and quotations on Canadian-made shovels. 1168.—Quotations are requested by a South African firm of commission agents on Canadian lumber. 1175—A Johannesburg firm of lumber dealers requests quotations on best quality pine in the rough. Width, 12 inches and wider. 1176—A Johannesburg firm of lumber dealers desires quotations on best quality poplar lumber in the rough. Width, 12 inches and wider. 1177.—A Transvaal firm of lumber dealers desires quotations on No. 2 quality pine shelving. Width, 12 inches only. 1178.—A Johannesburg firm of lumber dealers request quotations on spruce shelving. Width, 12 inches only. 1179.—Quotations requested by a Johannesburg firm of lumber dealers on deals and timber of various sizes, all in the rough. 1181.—A Johannesburg firm of machinery dealers will take up a Canadian agency for above. 1182.—A Transvaal firm of machinery importers is willing to take up an agency for Canadian esbestos. 1204.—A Johannesburg firm of importers desires catalogues and prices of all kinds of Canadian-made mining tools. 1205.—Catalogues and prices are requested by a Transvaal importing house on all kinds of mining material. 1206.— A Johannesburg firm of mining material importers wishes catalogues and prices of Canadian manufactured mining machinery. 1289.—Wanted by a Bloemfontein firm, an agency foi Canadian-made motor delivery waggons and vans. 1301.—An Orange Free State firm of importers requests prices and samples, if possible of Canadian-made leather belting. 1306.—A South African firm of hardware importers desires catalogues and prices of Canadian-made brickmaking machinery. 1308.—An Orange Free State firm of hardware merchants desires catalogues and prices on cranes and elevators of Canadian manufacture. 1309.—A South African firm of general merchants desires catalogues and prices on Canadian-made irrigation machinery. 1310.—An Orange Free State firm of hardware importers would like to communicate with Canadian manufacturers and exporters of milling machinery. Catalogues and prices requested. 1311.—A South African firm of general merchants requires catalogues and prices on sawing machinery of Canadian manufacture. 1312.—A South African firm of general importers wishes to correspond with Canadian manufacturers and exporters of mining machinery. Catalogues and prices required. 1313.—A Bloemfontein firm of hardware dealers would like to be placed in communication with Canadian manufacturers and exporters of windmills. Catalogues and prices requested. 1336.—A Capetown firm of commission agents wishes to be placed in communication with Canadian manufacturers and exporters of forges. 1374.—Samples and prices are requested on bolts and nuts of Canadian manufacture by a Natal firm. 1481.—A Transvaal firm of importers asks for catalogues and prices on mining tools of Canadian manufacture. 1482.—A South African firm of importers requests prices and catalogues on Canadian-made shovels.

The names of the firms making these inquiries may be obtained upon application to:—"The Inquiries Branch the Department of Trade and Commerce, Ottawa, or the Secretary of the Canadian Manufacturers' Association, Toronto; or the Secretary of the Board of Trade at London, Toronto, Brandon, Halifax, Montreal, St. John, Sherbrooke, Vancouver, Victoria, Winnipeg, Calgary, and Chambre de Commerce du District du Montreal."

The following was among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W. An engineer, in Yorkshire, who has, for many years' past specialized in the manufacture of brickmaking machinery, would like to correspond with manufacturers in Canada who might be disposed to enter into negotiations for the manufacture of machines from his patterns and drawings.