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Volume 22 Toronto, June 6, 1912

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The Canadian Engineer

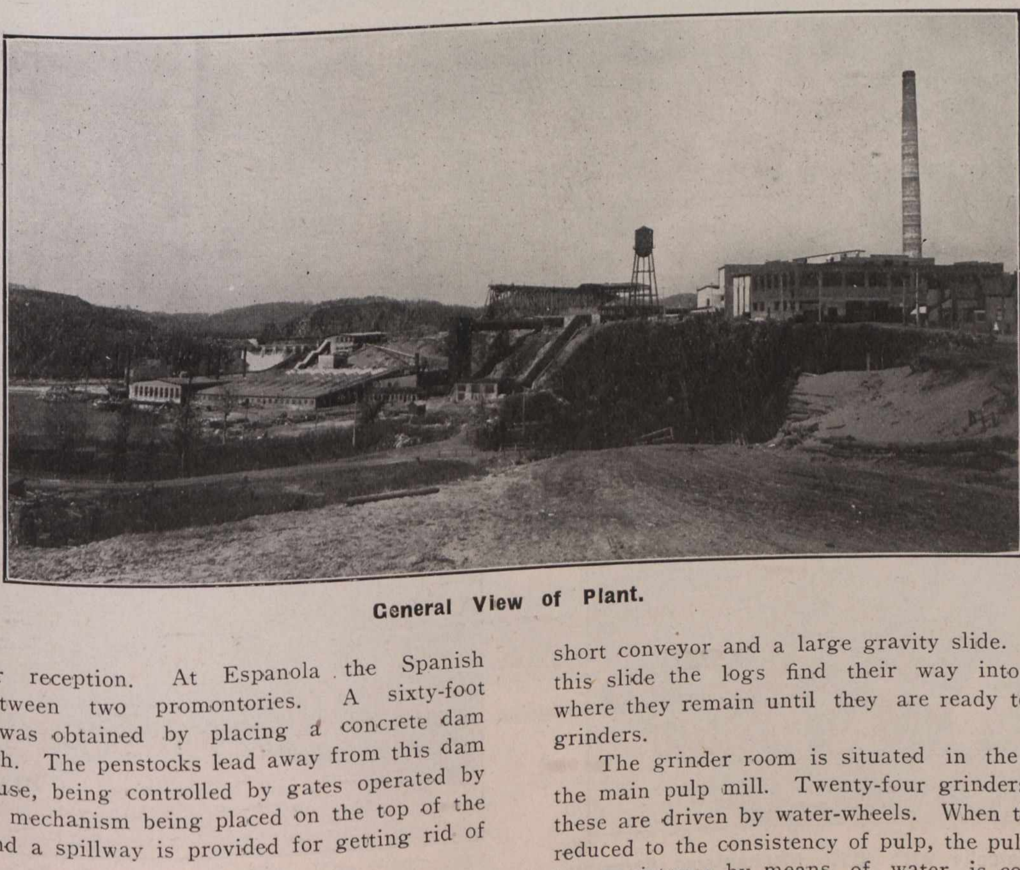
An Engineering Weekly

THE PLANT OF THE SPANISH RIVER PULP & PAPER MILLS LIMITED

The Spanish River Pulp & Paper Mills, Limited, are well located to meet the object they have in view. To Espanola, where are situated the company's mills, the Spanish River runs through the heart of the wood pulp country, its tributaries reaching practically every portion of the six thousand square miles comprised in the company's holdings.

Espanola is located on the Soo branch of the Canadian Pacific, forty miles west of Sudbury and 138 miles east of Sault Ste. Marie.

The company's timber lands consist of practically six thousand square miles, covered with the best grades of spruce and jack pine, balsam and poplar. The wood operations are carried on in the winter and in the spring; all the timber cut during the cold months is driven direct to the booming ground by means of the Spanish River, which, with its tributaries, drains the concession.



General View of Plant.

When the logs have been driven down the streams and rivers into proximity to the mills, provision has been made for their reception. At Espanola the Spanish River runs between two promontories. A sixty-foot head of water was obtained by placing a concrete dam across one branch. The penstocks lead away from this dam to the power-house, being controlled by gates operated by hand power, the mechanism being placed on the top of the dam. At one end a spillway is provided for getting rid of ice, logs, etc.

The manufacturing process commences when the logs first leave the booming ground. At this stage they vary in length from eight to sixteen feet. As they emerge from the booming ground the logs are raised on an inclined cable until they are on a level with a sixteen-foot slasher contained in a solid brick building far above the level of all the other buildings comprising the pulp plant. The slasher cuts all the logs into two-foot lengths. The dissevered logs, without any handling, drop directly from the slash table into a cable storage conveyor, which is six hundred feet long and sixty feet high. The wood, when it reaches the topmost altitude, drops into piles, where it remains until the time comes to feed the blocks into the barking machines. A supply has to be created to keep the mill going throughout the winter months, and there is a storage capacity for 40,000 cords of wood. The cost of taking the logs from the water, sawing them into two-foot lengths and storing them, is less than 15 cents a cord. This is the only saw slasher of its kind in use, as it was designed by the company's staff.

The logs are conveyed from the storage pile to a room situated on the brink of the hill overlooking the pulp mill proper. Here the rough knots and the bark are removed by means of barking machines operated by motor. The shavings and waste from the wood are mechanically conveyed by blowers to the boiler house. The barked wood, in its turn, is delivered to the grinder house by means of a short conveyor and a large gravity slide. At the bottom of this slide the logs find their way into a tank of water, where they remain until they are ready to be placed in the grinders.

The grinder room is situated in the northern part of the main pulp mill. Twenty-four grinders are in use and these are driven by water-wheels. When the logs have been reduced to the consistency of pulp, the pulp, greatly reduced in consistency by means of water, is conveyed to a large concrete tank by means of gravity. The grinders and water-wheels used in this process are set upon heavy concrete and steel foundations.

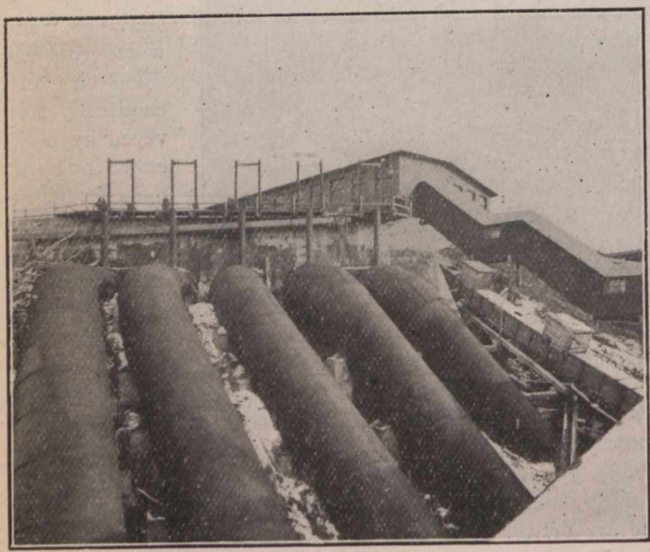
Over a period of five years, the maintenance of water-wheels and grinders has not exceeded fifteen cents per ton.

In the screen room the diluted pulp is conveyed by gravity through two sets of screens, passing thence in a steady flow to storage tanks in the machine room. In the machine room there are eighteen 84-inch wet machines. The pulp flows in at one end of these in the consistency of milk, though the color is of a creamy shade, and re-appears at the other end in sheet form. These sheets are piled on iron trucks with wire mats between each sheet.

Pulp Mill, Showing Hydraulic Presses at Work.

When the truck has been piled up to the height of several feet, it is rolled into one of the hydraulic presses, a pressure amounting to 450 tons being there applied. After the exertion of this pressure 58 per cent. of the pulp is dry. The pulp is then conveyed by means of an elevator to the upper level, where it is loaded into cars for shipment.

The pumping station contains two turbine water pumps, possessing a capacity of 6,000 gallons per minute. These pumps are used for supplying the paper plants with water. In addition are two turbine stock pumps, similar in capacity, which are used for pumping the ground woodpulp from the pulp mill on the lower level to the paper mill above. A booster pump is contained in the pumping station, electrically driven, which will be used for fire protection, and there is also a steam pump, to

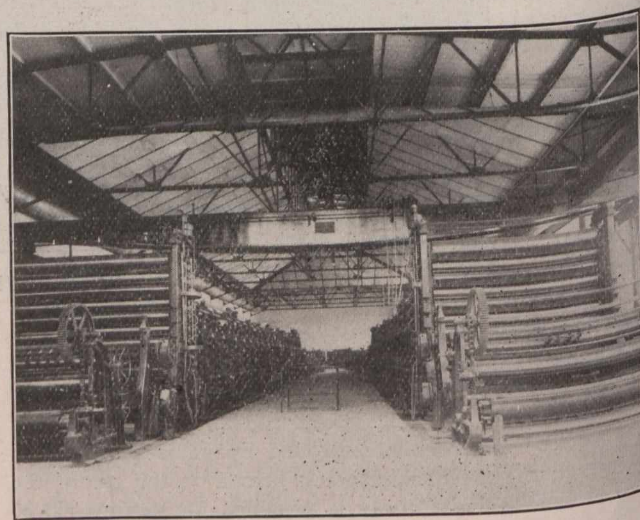


View Showing Penstocks with Gate Mechanisms Showing Above Dam.

meet the requirements of the underwriters. with a capacity of 1,500 gallons per minute.

The buildings comprising the new paper mill are all located so as to reduce the cost of manufacture, and the internal fittings are modern and complete. The filtration house has sufficient capacity to filter all the water to be used in both the pulp and paper mills. The water supply taken from the canal runs by gravity. A large freight elevator will be useful in the process of loading the company's output into cars. A storage building has been provided for the chemical pulp, a portoin of its basement to be used as a machine shop. The building containing the beater room has in its basement two ground woodpulp slush chests, on top of which are placed machines to abstract the water from the pulp, and to discharge the thick pulp into the chest ready for the beaters. Between the two chests mentioned are electrically driven pumps, which pump the thick pulp to the beaters above, thus eliminating any handling by labor.

In another portion of the building are found round concrete tanks, two of which are used to put the paper stock into and from the beaters, the whole being carried thence to the paper machines. In the basement are located two pumps, used to handle the paper stock from the tanks to the Jordan engines. The eight beating engines are in two units, and each unit is driven separately by a three hundred h.p. motor. On the second story are eight beaters, each of a capacity of one ton, and these



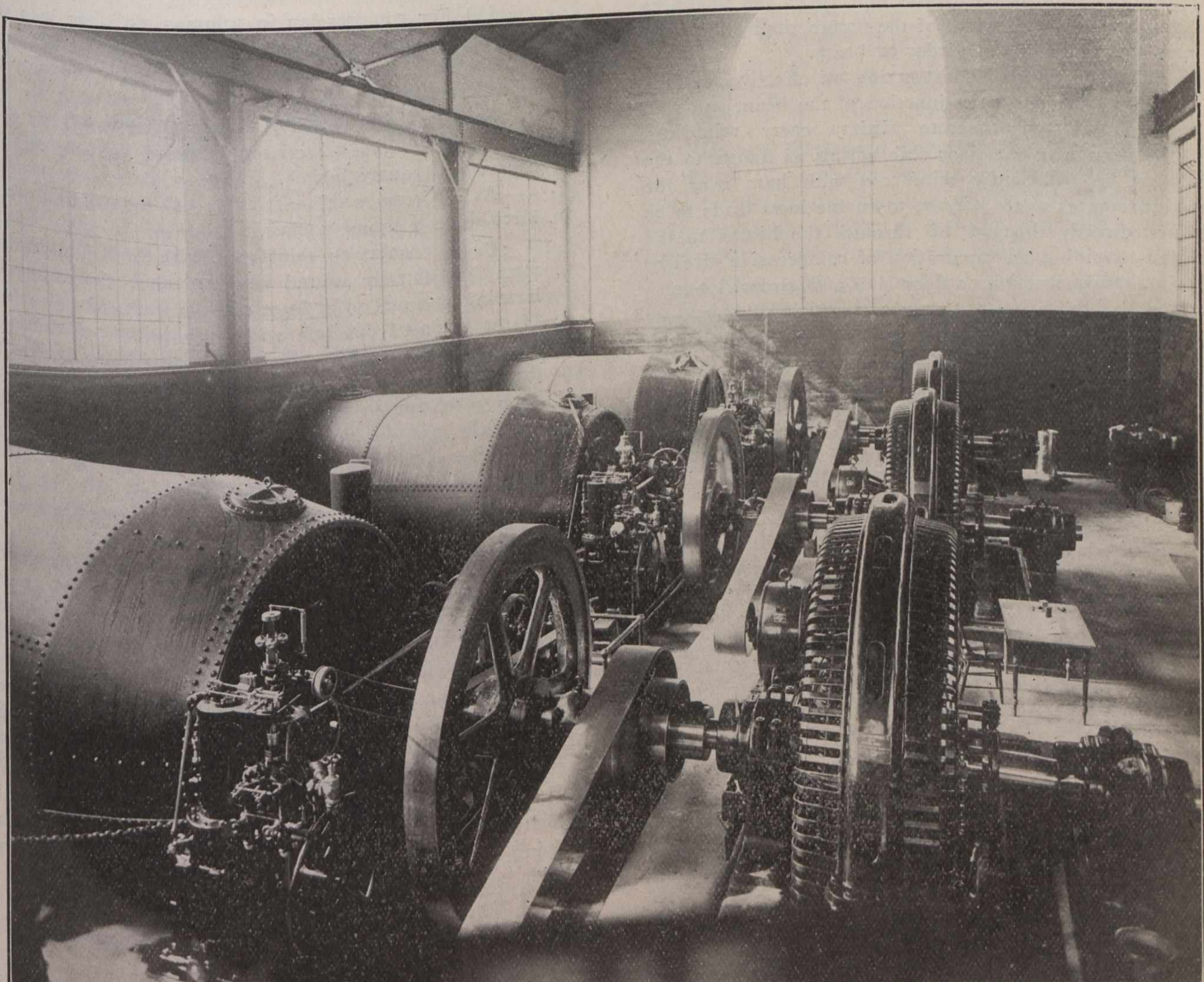
Interior View of Paper Mill, Showing Two Paper Machines Installed.

are used to prepare the paper stock for the paper machines. The two large Jordan engines which are used to refine the paper stock after it has peen prepared by the beaters are directly connected to electric motors.

The paper machinery is in the central building, which is 276 feet long by 82 feet wide. In the basement of this building are eight large suction pumps, two large stock pumps, and the necessary water pumps. To propel at variable speed the paper machines two six-hundred h.p. steam engines have been provided. The exhaust steam from these engines will be used to apply heat for the drying of the paper. In order to eliminate the handling of broken paper by labor, a beater has been placed in the basement, and after the broken paper has been treated it will be pumped once more into the stock tanks. On the second story are two Fourdrinier paper machines of the latest type. Each of these machines is capable of manufacturing a sheet of newspaper 156 inches wide, at 600 feet per minute. Each machine will have a capacity of 50 tons daily. At the north end of the machine room a gallery has been arranged, which contains four pneumatic save-alls. The water from the machines is pumped to these save-alls, and in this manner every particle of stock that the water contains is saved. A system has been arranged for the economic handling of the paper product from the machine to the finishing room.

The building in which the paper product is finished is 154 feet long and 92 feet wide. The upper story is used to finish the rolls of paper, while the lower story is designed exclusively for storage. Railroad tracks have been installed on each side of the building, with loading platforms designed for the economical loading of the paper into cars.

All the buildings connected with the paper plant are equipped with steel window frames, concrete window sills and steel lintels, with single and double glazing. The entire design of the buildings was considered with a view of installing two more paper machines at a later date, which, in view of the arrangements made, may be done at small expense. A steel water tank, 100 feet high, possessing a capacity of 50,000 gallons, has been erected, thus assuring the company in its operation a continuous supply of water pressure, as well as good sprinkling system in case of fire. Cast iron water mains have been laid round the entire plant, and a large number of hydrants, hose houses and reels have been provided, arrangements which have met with the entire approval of the Fire Underwriters.



General View of Interior of Power House, Showing Arrangement of Turbines and Generators.

The paper mill, now being completed, will give the company the following production:—

Newspaper	100 tons daily
Mechanical pulp	107 " "

Provision has been made so that the paper mill capacity can readily be doubled at minimum capital expenditure.

The hydraulic and steam power equipment will be described more fully in a succeeding article.

NEW BUILDING BY-LAW FOR TORONTO.

(Continued from last week.)

(7) In all cases where reduction in the bending moment is allowed on account of continuous action, sufficient steel reinforcement must be provided in the top of the slab or beam over the support to meet the requirements of the accepted theory of flexure, and this upper reinforcement shall extend on both sides a sufficient distance beyond the centre of the support to develop adhesion equal to at least the strength of the upper bars on the basis of the allowable unit stresses.

(8) If the girders, beams and slabs are poured in one continuous operation, then the girders or beams may be treated as T-beams with a portion of the slab acting as a flange. In no case shall the overhanging width on each side of the girder or beam exceed four times the thickness of the slab and the total width of the flange shall not exceed five times the width of the girder or beam.

(9) In beam and slab construction an effective metallic bond shall be provided at the junction of the beam and slab and where reinforced concrete girders carry reinforced beams, the portion of the floor slab acting as flange to the girder must be sufficiently reinforced with bars near the top, at right angles to the girder, to enable local loads to be transmitted directly instead of through the beams to the girder, thus avoiding an integration of compressive stresses due to simultaneous action as floor slab and girder flange.

(10) In the design of T-beams acting as continuous beams, due consideration shall be given to the compressive stresses at the support at the bottom of the beam.

(11) When the overall vertical distance of the tension members of a girder or beam is greater than one-sixth of the total depth of the girder or beam, the stresses in members shall be computed in proportion to the distance from the neutral axis.

(12) Shrinkage and thermal stresses must be provided for by the introduction of steel.

Proportion of Concrete and Allowable Stresses on Concrete and Steel.—12.—(1) All concrete for columns, girders, beams, slabs, walls, fireproofing or piles shall be composed of materials meeting the requirements of these regulations, and be mixed as hereinbefore specified, in the proportion of not less than one part of cement to two parts of fine aggregate and four parts of coarse aggregate, or in such other proportions as may be necessary to make the resistance of the mixture to crushing not less than two thousand (2,000) pounds per square inch after hardening for 28 days.

(2) Tests to determine this value must be made at the expense of the contractor when required by the inspector of buildings at a place and by a person satisfactory to him and under the direct supervision of either the said inspector of buildings or a person representing him.

(3) When the proportion of cement is increased and the quality of aggregates hereinbefore called for used, an increase may be made on the allowable working stresses proportional to the increase in compressive strength at 28 days as determined by actual tests, but this increase shall not exceed 25 per cent. On this basis the following maximum stresses for 1:2:4 concrete will be allowed in construction:

(a) Compression in extreme fibre of girders, beams and slabs, 600 pounds per square inch.

(b) Direct compression, 450 pounds per square inch.

(c) Shearing stress, when diagonal tension is not resisted by steel, 40 pounds per square inch.

(d) Shearing stress, when all diagonal tension is resisted by steel, not to exceed 100 pounds per square inch of effective cross section.

Members of web reinforcement shall be designed so as to adequately take up all involved stresses throughout their entire length. They shall not be spaced to exceed three-fourths of the depth of the beam in that portion where the web stresses exceed the allowable shearing value of the concrete.

Web reinforcement, unless rigidly attached, shall be placed at right angles to the axis of the beam and looped around the extreme tension member.

(e) For tee-beams the width of the stem only shall be used in calculating the shear.

(f) Adhesion to plain steel bars, 60 pounds per square inch of surface of bar.

(g) Adhesion to deformed steel bars, up to 100 pounds per square inch of surface of bar may be permitted.

(h) For compression in columns with not less than 1 per cent. and not more than 4 per cent. of longitudinal reinforcement, the safe load shall be computed as follows:

Safe load (in pounds) = 450 (Ac+15 As).

Ac = Net cross sectional effective bearing area of concrete in square inches.

As = Cross sectional area of longitudinal reinforcement in square inches.

(i) For columns reinforced with both longitudinal steel and spirally wound hooping when the volume of hooping is equal to at least one per cent. of the volume of the enclosed concrete and the longitudinal reinforcement is not less than one per cent. and not more than four per cent. of the cross sectional area, the safe load shall be computed as follows:

Safe load (in pounds) = 650 (Ac+15 As).

Ac = Net cross sectional area of concrete enclosed in hooping in square inches.

As = Cross sectional area of longitudinal reinforcement in square inches.

(4) The foregoing allowed stresses shall be used only where the unsupported length of the column is not greater than 15 times the least diameter of effective bearing area. Where the length exceeds this limit, the allowable stress shall be reduced according to approved standard formula.

(5) Bending stresses due to eccentric loads on columns shall be provided for by increasing the section of concrete or steel until the maximum stress on a column will not exceed the allowable working stress.

(6) The least diameter of effective bearing is to be understood to mean the distance from inside to inside of hooping in columns with spiral hooping, and in others from outside to outside of longitudinal reinforcement.

(7) The pitch of spiral reinforcement shall not be greater than one-sixth of the effective diameter of a column, and in no case more than three inches, and adequate means must be provided to hold it in place as as to form a column, the core of which will be straight and well centred.

(8) When columns are reinforced with longitudinal rods only, the reinforcement shall be tied together with bands, having an area of not less than one-sixteenth of a square inch, placed not more than the effective diameter of the column apart or in any case not more than twelve inches. The bands to be jointed in such a manner as to do away with any liability of the reinforcement spreading, and shall be wired to each longitudinal rod.

(9) The percentage of reinforcement in any column, regardless of the load carried by it, is not to be less than one per cent. of the effective cross sectional area. Reinforcement to be in all cases placed at corners of square or rectangular columns, the minimum size of which shall be 9/16 inch round or ½ inch square steel rods.

(10) No column shall have less than sixty-four square inches of effective area or a dimension of less than eight inches.

(11) When longitudinal reinforcing rods in columns have an area in excess of one and one-fourth square inches the ends shall be faced or milled off normal to the longitudinal axis and such rods shall have full and perfect bearings and a tight fitting sleeve or other approved appliance shall be provided at each joint to keep the rods in their proper position.

(11) When longitudinal reinforcing rods in columns have an area of less than one and one-fourth square inches the rods may be lapped and securely wired together, the splice to be of a sufficient length to develop by adhesion the strength of the rod.

(13) All butted joints shall be made at the floor levels or at points where the columns may be considered as fixed, and the centre of lapped joints shall not be more than one foot above floor levels or points at which rigid lateral support is afforded the columns. The ends of all rods at the base of columns shall be made smooth and right angled from the longitudinal axis and such rods shall have a perfect bearing on a steel plate or casting of sufficient size and strength to distribute the load which the column supports to such an extent that the allowable compressive stress per square inch on the material under this plate shall not be exceeded, or in lieu of the plate the stress may be distributed in concrete footings to the required extent by means of dowels of sufficient length and area to sustain the weight by adhesion of the concrete to the steel, without exceeding the specified limit for such in this regulation. The tops of all dowels to extend to the top of the footing and be made perfectly level and smooth to receive the longitudinal reinforcing rods and the joint between the dowels and the rods to be made with a pipe sleeve which is to be grouted into the footing at least six inches and extend six inches above the top of same and the reinforcing rods after being secured in their proper position are to be solidly grouted into the sleeve with liquid Portland cement.

(14) The area required in footings which have to support columns having both spiral hooping and vertical reinforcement shall be obtained in a similar manner to that immediately above specified for columns with vertical reinforcement only. The longitudinal reinforcing bars in all columns shall be straight and sufficient metallic lateral support shall be provided to keep them in their proper place until the concrete in the column has set.

(15) The allowable stress on steel in tension shall be sixteen thousand pounds (16,000) per square inch.

(16) Where it is necessary to introduce steel to resist compression in girders, beams or slabs, the compressive stress per square inch allowed on such steel shall not exceed fifteen times (15) the computed compressive stress in the concrete at the same distance from the neutral axis. All such steel shall be anchored into the mass of concrete in such a way as to prevent any possibility of buckling.

13.—The minimum protection for steel reinforcement which is to be taken, is the distance from the surface of the steel to the nearest concrete surface, shall be:

(a) For girders and columns, two inches.

(b) For beams and lintels, one inch and a half.

(c) For floor and roof slabs, one inch.

Plain and Reinforced Concrete Walls.—14.—(1) Concrete walls without reinforcement, other than those of foundation or basement, shall be constructed with concrete of the same composition and quality in all respects to that hereinbefore specified for reinforced concrete, and shall be the full thickness prescribed in this by-law for brick walls.

(2) Buildings having a complete skeleton construction of steel or of reinforced concrete construction of a combination of both, may have exterior walls of reinforced concrete at least eight inches thick; provided, however, that such walls shall support only their own weight, and that such walls shall have both vertical and horizontal steel reinforcement on both sides, the rods to be placed not more than eighteen inches apart from centres, and be securely wired together at each intersection and rigidly connected with columns and girders. All rods shall be lapped a sufficient length to develop their full stress by the allowable unit stress for adhesion. Additional rods shall be set around openings, the vertical ones to be wired to the nearest horizontal ones, and the horizontal rods at top and bottom of openings wired to the nearest vertical ones. In all cases the percentage of steel reinforcement to be provided shall be sufficient to enable the wall to safely resist a uniformly distributed horizontal pressure by thirty pounds per square foot acting on either side of it, but in no instance shall the percentage of reinforcing metal be less than one-quarter of one per cent. in each direction. The thickness of a reinforced concrete curtain wall shall not be less than one-eighteenth of the unsupported height.

Tile and Reinforced Concrete Joist Construction.—15.—(1) When tile and reinforced concrete joist construction is used for floors, the tile shall be sound, hard burned, free from shrinkage cracks, or uniform size and corrugated in a horizontal direction upon the sides.

(2) The reinforced concrete joists shall be parallel and in perfect line and of sufficient width to develop the steel, which steel is to be protected from fire with concrete of a similar mixture and thickness to that hereinbefore specified for concrete beams. Should concrete be required on the top of the tile to take compressive stress it must be not less than two inches in thickness and must be poured at the same time at the joists, and be of the same mixture. The tile shall be thoroughly soaked with water before the pouring of the concrete is commenced. In this class of construction the dead and entire live loads will be assumed to be carried by the reinforced concrete joists.

16.—Upon the completion of a reinforced concrete building the architect or engineer who designed the structure shall issue a signed certificate and have the same posted in a conspicuous place on each floor, stating the safe capacity per square foot of floor space, if the entire floor is designed to carry the same load. If, however, the floor is designed to carry different loads, each section must be provided with a certificate stating the capacity of that particular section and describing the limits thereof.

17.—Load tests shall be made by and at the expense of the contractor when required by the inspector of buildings, under his direction and in his presence or in the presence of his representative, on any portion of a reinforced concrete structure within a reasonable time after erection. Such tests shall show that the construction will sustain a load of twice the live load for which it was designed without causing any permanent deformation.

18.—No system of reinforced concrete shall be used which is not capable of design and investigation in accordance with the formula and principles laid down in these regulations.

19.—Section 111 of By-law No. 4861, being "A By-law for regulating the erection and to provide for the safety of buildings," is hereby repealed.

Comments by the Citizens' Committee.—While the proposed by-law for regulating reinforced concrete construction in the city of Toronto is in the main satisfactory to the Citizens' Committee on the revision of the building by-law, there are certain provisions to which exception is taken. In the opinion of this committee these should be amended before the proposed ordinance becomes law, if it is to represent the latest and best constructional practice.

To this end the committee wishes to make the following comments on the draft by-law, and offers corresponding suggestions for its improvement.

Section 2, sub-section 3, page 2.—It would appear from this that the weekly reports furnished the inspector of buildings are to concern only the records of the progress of concreting and the date of removal of forms. In the opinion of the committee it should be required to include also a declaration that, in the opinion of the inspector in charge, the work covered by the report has been executed in all respects in accordance with the plans, specifications and city building regulations.

Section 5, sub-section 3, page 7.—It is now recommended by the best authorities that test mortars shall show, not merely 70 per cent., but 100 per cent. of the strength of a similar mortar made with standard Ottawa sand.

Section 6, page 8.—The complete prohibition of Bessemer steel, high elastic limit steel and re-rolled steel for reinforcement, is in the opinion of this committee not warranted. If these materials are capable of passing the usual tests prescribed for them, their use should be allowed. Suitable tests for high elastic limit steel should be inserted in the by-law.

Section 7, sub-section 3, page 10.—In the interests of definiteness the volume of a bag of cement should be defined, and the committee recommends that this be fixed at 9/10 of a cubic foot.

Section 8, sub-section 11, page 12.—The minimum length of time which columns should be poured ahead of the floors should be defined.

Section 11, page 16.—The bending moments for slabs and beams fixed by this section are in excess of those required to be figured in the newer building codes of large American cities. With the careful inspection provided for in the regulations under discussion, it would, in the opinion of this committee, be entirely safe to reduce these requirements to conform to those recently adopted by the cities of New York, Chicago, St. Louis, Minneapolis and San Francisco. It is therefore recommended that for slabs and beams continuous over two or more supports the moments at the centre and at the supports be taken as 1/12 wl. and that for slabs and beams continuous over one support only, the moments shall be 1/10 wl. Corresponding alterations should be made in sub-section (4) to cover slabs reinforced in both directions and in sub-section (7) to conform with the above rules

Section 11, sub-section 6, page 18.—The reduction of reinforcing steel in slabs here prescribed is not in accordance with accepted theory. It is recommended that the steel be reduced at the support to 50 per cent. of that calculated per foot of width and that the reduction begin at the third points instead of at the quarter points.

Secion 11, sub-section 8, page 18.—Where the slab extends on only one side of the beam, it should be allowed to flange up to four times its thickness.

Section 11, sub-section 10, page 19.—It is almost universal practice to allow compressive stresses at the bottom of a beam at the support, fifteen per cent. in excess of those allowed elsewhere in the beam. This should be permitted in the present regulations.

Section 12, subsection 3, page 20.—The allowable working stresses prescribed in this sub-section are lower than those permitted in the most recently adopted building codes of American cities. It is recommended that the compression on the extreme fibre of slabs, beams and girders be 650 pounds per sq. in. The corresponding stress in the codes of New York, Chicago, St. Louis, Minneapolis and Cleveland runs from 650 to 800 pounds per sq. in. For direct compression, the specified stress of 450 pounds per sq. in. is also lower than is now generally adopted. It is recommended that this be placed at 500 pounds per sq. in., the same as permitted in New York, St. Louis, Cleveland and Baltimore. The formula for safe loads on columns, paragraph (h), should be correspondingly changed.

Section 12, sub-section 6, page 22.—It is excessively severe, and beyond the present requirements of the City Architect's department to allow as effective diameter of a longitudinally reinforced column only the distance from outside to outside of reinforcement. Were this rule adopted it would mean that a 10 inch by 10 inch column would have an effective area of only 36 sq. in., or 36 per cent. of its area. It is customary to allow the full area in this class of columns. Sub-section 10 on page 23 should be altered to read: "Sixty-four square inches, outside area."

Section 12, sub-section 8, page 22.—For bends in columns having longitudinal reinforcement only, one-quarter inch rounds should be permitted spaced not farther apart than the outside diameter of the column. Since such material is of the nature of wire, and therefore very easily worked, its use should be allowed, as tending to ease and rapidity of construction.

Section 12, sub-sections 11-13, page 23.—In sub-section 11, it should be made clear that the area of one and one-fourth square inches is of individual rods and not the aggregate area. For rods having an area less than this, it should be allowable to use a pipe-sleeve joint without milling the ends of the rods, as an alternative to the lapped splice prescribed. Shore columns require to be reinforced for moment due to wind, it should be allowable to locate the splices at other places than at the floor levels.

Section 13, sub-section 15, page 24.—There is no good reason why the use of high elastic limit steel should be prohibited. It should be allowed to be stressed up to one-third of the elastic limit, but not over 20,000 pounds per square inch.

Section 14, sub-section 2, page 25.—The amount of reinforcement here required is excessive. Steel enough to resist a pressure of 30 pounds per square foot on either face of the wall is all that is necessary.

Section 15, sub-section 1, page 26.—Provision should be here made for concrete tile or other fillers than terra-cotta tile.

Section 18, page 27.—This would technically debar the use of any new system of construction without amendment of the by-law and therefore should be omitted.

It is recommended that for definiteness and convenience the values of R in the equation $M = Rbd^2$ be listed in the by-law for working stresses from 16,000 to 20,000 pounds per square inch, as indicated in the memorial presented to you in May last, section 19, page 52. Further, it is requested that the moment area be defined as 0.87 times the distance from the top of the beam to the centre of the steel for both rectangular and T-beams.

OTTAWA WATER SUPPLY.

The Pitometer Company, who recently made a water survey for the city of Toronto, have been employed by the city of Ottawa to make an extensive survey of the water mains of that city. Investigations will begin at once and will probably cover six or eight weeks.

RECENT DEVELOPMENTS IN PAINT TECHNOLOGY.*

By Henry A. Gardner.†

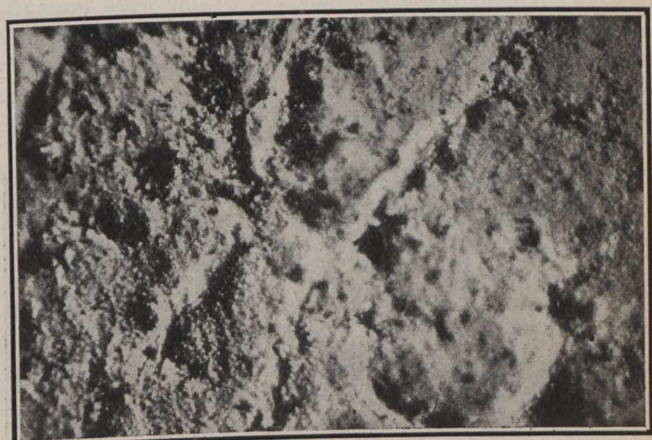
Lumber and Its Relation to Paints.—The proper choice and treatment of lumber is one of the most important problems which the builder as well as the painter has to face. When about to build a dwelling, barn, or other structure made principally of wood, the question is sure to arise in regard to what variety to select so as to get the maximum service and money value. The locality in which the structure is to be built must often have a bearing upon this question. While it is true that the painting of each type of wood demands the special consideration of the painter, it is also true that the study of paints for wood protection points toward the production of a paint that will give satisfactory results under all conditions and on all grades. It is the writer's opinion that a paint may be made that will be perfectly well suited for the preservation of every species of wood, provided the paint is properly treated in the hands of the skilful and intelligent painter, who can produce lasting results on almost every type, by varying the proportion of thinners and oil in the various coats. The painter who uses the same paint on soft pine and again on hard pine, without making a special study of how to reduce the priming coat for the hard pine, will be likely to get inferior results on the latter. In case of failure, the natural impulse is often to place the blame upon the paint, whereas the real responsibility may rest upon the painter's lack of knowledge.

Signs of Paint Failure.—Those who are responsible for the care and maintenance of property the familiar with the condition of surface presented by almost all wooden buildings or structures which have been improperly painted with inferior paints. "Chalking" or "flouring" are terms used to describe the condition of a paint surface which has deteriorated within the paint film. The formation of minute fissures generally spoken of as "checking," as well as the effects best described as cracking, scaling, peeling and blistering, are other signs of failure which cause paint coatings to present an unsightly appearance, and which point inevitably either to the use of improperly made paints or to improper application. The cause of these conditions is not difficult to understand when even a brief study of the character of the materials entering into the composition of a paint has been made. It is, however, a fortunate circumstance that the proper admixture of different types of pigments enables us to correct the strong tendency exhibited by special pigments to rapidly deteriorate in an oil film. This point will be more fully discussed in a later paragraph.

Requisites of a Good Paint.—Progressive manufacturers are aiming to produce a paint which will show, under the widest range of conditions, good hiding power, adhesiveness, freedom from internal strains, permanency of color, relatively high imperviousness to moisture, sufficient elasticity to prevent scaling or cracking when subjected to expansion or contraction, and freedom from the chemical action which results in deep checking or excessive chalking. Such a product as this cannot be obtained, in the writer's opinion, by the use of any one pigment in linseed oil. In order to meet all the demands as stated above, there should be in an economical and durable paint a proper percentage of the various pigments which, united, will tend to correct each other's faults, and thus produce a durable paint coating of maximum efficiency.

The Composition of Paints.—As is well known, a paint is a mixture of one or more pigments and a vehicle which acts the part of the spreading and binding medium. Up to the present time the vehicle portion of paints has generally been made of linseed oil, admixed with some volatile thinner, such as turpentine. The subject of oil and plant vehicles will be discussed more fully later on.

Physical Properties of Pigments.—The pigment portion of a paint for use on barns and farm buildings may, if desired, be composed of properly selected iron oxides or other colored pigments, even containing in some cases a moderately high percentage of silica, clay, or other inert materials, and give perfectly satisfactory results. For the preservation and decoration of dwellings, however, the pigment portion of paints is generally made as a whole or in part of the most expensive white pigments, such as white lead and zinc oxide. The relative values and properties of these white base pigments will now be taken up.



"Chalking."—Type of Decay Exhibited by Improperly Made Paint.

White Lead.—White lead, either of the corroded or sublimed type, is perhaps the most generally used of all the white pigments as a paint base. Corroded white lead is a basic carbonate of lead, while sublimed white lead is a basic sulphate of the same metal. Both of these types are white and admirably adapted as painting materials. They take relatively the same amount of oil and spread easily, producing paint films which are highly opaque and which, therefore, hide efficiently the surface upon which they are placed. Sublimed white lead is a relatively finer pigment than corroded white lead, and seems to show a tendency to chalk to a greater extent upon exposure to the weather. Corroded white lead is more alkaline, however, than sublimed white lead, and when used alone with linseed oil generally shows a tendency to chalk to a considerable extent in a short time and to show deep checking, thus permitting the admission of moisture. The alkaline nature of this pigment produces considerable action upon certain tinting colors and results in fading or darkening when mixed with delicate greens or blues.

The use of white lead has been condemned in some parts of this country, as well as abroad, because of its alleged poisonous properties. While it is true that lead poisoning may occasionally occur in some factories where the workman and his conditions are not properly safeguarded, it is, nevertheless, a fact that lead poisoning very seldom occurs among painters of experience and cleanly habits. Carelessness in mixing white lead is, fortunately, a practice almost obsolete among painters. The use of

* Paper delivered before American Institute of Architects.

† Assistant Director, Institute of Industrial Research, Washington, D.C.

paints already ground in oil by means of machinery to a pasty condition, allowing easy working and reducing, obviates the danger of lead poisoning from any such cause as this, even though the percentage of lead in such paints is in preponderance.

Zinc Pigments.—Another pigment which has proved itself of great value to the painter is zinc oxide. The use of this pigment may be said to have almost revolutionized the paint industry of the world, and its increased consumption during the last ten years is sufficient evidence of its value as a painting material. Zinc oxide is produced by oxidation and sublimation of zinc ores and is not only extremely fine, but of great whiteness. It has good hiding power, although not quite so great as that shown by the white leads. It tends to produce a glossy surface, making it especially valuable for use on interior work and in enamels. When used alone it has the effect of hardening the oil film in which it is enveloped, and upon long exposure causes cracking and scaling. However, when the sublimed or corroded white leads are properly combined with zinc oxide, a more durable surface is produced, the shortcomings of each pigment being overbalanced by the good properties of the other. The proper combining properties of zinc oxide with white lead may be said to vary between twenty to fifty-five per cent. of zinc oxide for paints designed for exterior use. In the opinion of the authors, lead and zinc

"Scaling."—Type of Decay Exhibited by Improperly Made Paint.

pigment in the above percentage, properly blended and ground, make paints of far better wearing value than can be produced with either white lead or zinc oxide used alone.

Zinc-Lead.—Zinc-lead, a pigment sublimed from mixed lead and zinc ores, and containing about equal proportions of zinc oxide and lead sulphate intimately combined, as well as leaded zinc, a product similarly produced, but with zinc oxide running about seventy-five per cent., are white base pigments of value which are used to a considerable extent. They are generally slightly off color, however, and are therefore used most largely in paints which are to be tinted in various colors.

Lithopone.—Lithopone, a pigment produced by precipitation, and consisting of zinc sulphide and barium sulphide, is of great value in the manufacture of interior paints. On account of its liability to darken and disintegrate, however, it is seldom used on exterior work, although recent tests have shown that when used in combination with zinc oxide and whiting, it gives very promising results.

Crystalline Pigments and Their Use.—Barytes (barium sulphate), silex (silica), whiting (calcium carbonate), gypsum (calcium sulphate), asbestine (silicate of magnesia), and china clay (silicate of alumina) are white crystalline pigments which, when ground in oil, become transparent, All of these pigments possess the property of strengthening a paint film made of white lead and zinc oxide, and often increase the durability of such a paint. Barytes, silica, and china clay are especially valuable for this purpose. Asbestine, because of its needle-like structure and low gravity, prevents settling and acts as a reinforcer of paint films. Whiting or calcium carbonate should be used when zinc oxide is in excess in a paint, so that the hardness of the paint may be overcome.

A white paint must be possessed of sufficient opacity to efficiently hide the surface upon which it is placed, when three coats are applied for new work or two coats for repainting work. Mixtures of the white leads and zinc oxide, with the latter pigment running not over fifty-five per cent., will easily produce such a result and wear well. It is generally deemed advisable, however, by most manufacturers to take advantage of the excessive opacity of such mixtures, which allows the introduction of moderate percentages of these inert pigments which give greater strength and other desirable features to a paint. The percentage of natural crystalline inert pigments to add to a white paint made of lead and zinc must, however, be moderate and insufficient to detract materially from the hiding power of the paint.

White-Paint Formulas.—From these conclusions, which have come from wide experience in the testing of paints under actual service conditions, there can be recommended to the buyer of paints and to the manufacturer and master painter those machine-mixed paints in white, made by reputable manufacturers, the composition of which will show a mixture of white lead and zinc oxide, with the latter pigment within limits of between fifteen to fifty-five per cent., and especially the same mixtures reinforced with the moderate percentage of crystalline inert pigments referred to above.

Tinted paints possess greater hiding power than white paints, and the above proportions would be somewhat changed for a tinted paint containing any percentage of coloring material. Tinted paints are, moreover, far more serviceable than white paints, as will be shown later.

Mill v. Paddle.—The mixtures under consideration should be ground in linseed oil by the manufacturer, through stone or steel mills, to a very fine condition, as it is only through proper grinding that the pigments can be properly blended. The mixing of paint by hand is, fortunately, to a large extent a thing of the past. The uneven lumping of hand-mixed paints is often the cause of their failure. Such ancient and crude practice should be avoided by every painter, for it is more economical to obtain semi-paste paints, properly ground by machinery, to such a condition that they may be easily broken up and tempered. Such paints may be reduced to the proper consistency with oil and volatile thinner for application to any kind of wood.

In the opinion of the writers, a majority of the paints sold by reputable dealers and made by reputable manufacturers in this country are not only made from the best linseed oil and highest grade pigments obtainable, but are put in a form ready for the painter to thin down with full oil or turpentine reductions, either for priming work or to be used without reductions for finishing coats. The large metropolitan painter who wishes to make his own tints and shades may, however, prefer to have his mixed pigment paint ground by the manufacturer in heavy paste form for certain purposes.

Results of Field Tests.—A careful analysis of the results of field tests which have been carried on in different parts of the country would be far too voluminous for insertion in this bulletin. The official findings of special committees of inspection have already been published in special reports. Whereas there may still remain ground for some difference of opinion in regard to the interpretation of the results obtained on the various test fences, there can be no doubt that considerable information of the highest value has been yielded both to the producers and consumers of paints. One of the principal results obtained from these tests has lead to the opinion expressed above by the writers, that better results can be obtained by a proper mixture of selected pigments than by the use of any one pigment in linseed oil. This conclusion has also been reached by engineers of the United States Navy, and, as a result, the specifications of the Bureau of Yards and Docks for paints made of straight white lead and oil have recently been changed to call for white lead combined with upward of fifty per cent. of zinc oxide. Many engineers and master painters have interpreted the results of the tests in the same way, and the attention of the authors has been called to a number of opinions which show that the tendency of demand among those who are properly informed is for a high grade combination type of paint rather than for any single pigment paint.

Color.—The selection of the color for a dwelling or other structure is a matter that depends largely upon the good judgment and taste of the owner, combined with the advice of the painter. One point, however, should be impressed upon the mind of both, namely, that practically all shades or tints made upon a good white paint base, through the use of permanent tinting colors, will better withstand exposure to the atmosphere than the white base used alone. Owing to the cheerful effect produced by the use of white paints on dwellings, a very large quantity of white will continue to be used. If these white paints are designed in line with the suggestions brought out above—that is to say, if the white lead bases are properly reinforced with zinc oxide and other pigmentary materials—better results will undoubtedly be obtained, as far as appearance and durability is concerned, than if white lead had been used alone. The consumer should remember, however, that more durable results will be obtained by the use of tinted paints.

Reductions and Thinners.—Turpentine, with its sweet odor, high solvent action, and wonderful oxidizing value, has always taken first place amont the volatile liquids used for thinning paints. Wood turpentines, produced from the steam distillation of fine-cut fat pinewood or from the destructive distillation of stumpage and sawdust, have been refined in some cases, by elimination of odor and toxic effects, to such purity that they are equally as good as the purest grades of gum turpentine, and their use is bound to increase in the paint industry.

The painter and manufacturer have come to understand that certain grades of asphaltum and paraffine distillates are equally as satisfactory as turpentine for use in paints for exterior purposes. Those volatile oils which are distilled from crude oil with either a paraffine or asphaltum base and possessed of boiling point, color and evaporative value approximating similar constants of turpentine, are excellently suited to partly, and in some cases wholly, replace turpentine in exterior paints. A little additional dryer added to paints thinned with these materials will cause oxidation to take place in the proper time.

Prominent master painters* have shown that benzol, a product obtained from the distillation of coal tar, differing from benzine, a product obtained from the distillation of petroleum, is a valuable thinner to use in the reduction of paints for the priming of resinous lumber such as cypress and yellow pitch pine. The penetrating and solvent value of benzol is high, and it often furnishes a unison between paint and wood that is a prime foundation to subsequent coatings, preventing the usual scaling and sap exudations which often appear on a painted surface. Because of the great solvent action of benzol, however, this material should never be used in the second and third coatings. These facts will doubtless interest the southern painter, who has so much wood of a refractory nature to paint.

Oils.—The increasing cost of linseed oil has raised the interesting question as to whether or not it is a good practice to use an admixture of other oils in connection with it, in high-grade paint coatings. Strong differences of opinion will probably be found in regard to this question, and undoubtedly further investigation work is necessary in order to decide it. A number of different oils have been proposed for the purpose, of which, perhaps, soya-bean is one which has been most prominently discussed. No definite formulas, however, should be recommended until the results of investigations which are now being carried on are in hand. A systematic series of test panels is now being erected in Washington, D.C., on the grounds of the Institute of Industrial Research, which are designed to gather data covering just this point.

The flax crop conditions have been most discouraging during the past two years, and the natural shortage of seed has caused a rise in the price of linseed oil, which has necessitated a rise in the price of paint. The added protection to be secured, however, through the frequent application of paint for outweighs any increased cost which has been caused by the rise in price of the raw commodities entering into the composition of paint.

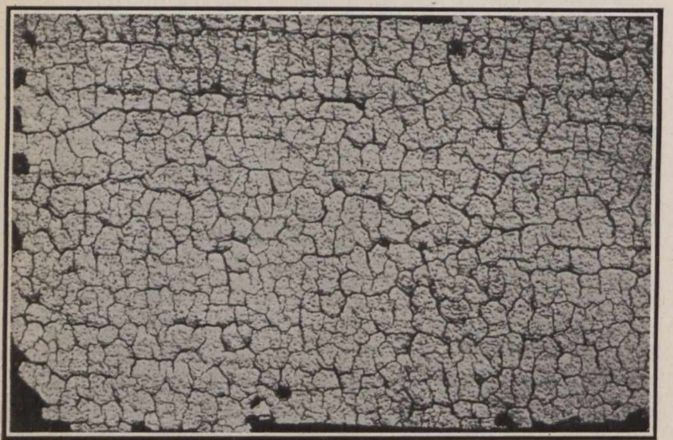
Paints for Interior of Dwellings and Buildings.—The proper decoration of the interior of dwellings and public buildings has become of even greater importance than the protection and decoration of exteriors. There is, moreover, an increased demand for harmonious effects and the production of more sanitary conditions than have prevailed in the past. Up until a few years ago, a great variety of wall papers of more or less pleasing appearance were almost exclusively used for the decoration of walls in the interior of buildings, and their application was commonly considered the most effective means of wall decoration. There seems to be no question, however, that the use of wall paper is steadily decreasing, and that the art of interior decoration is undergoing a transition to the almost universal use of paint.

Modern process demands the maintenance of sanitary conditions for the benefit of the public welfare, and there is no doubt that from the standpoint of sanitation and hygiene, properly painted wall surfaces are far superior to papered walls. There is an abundance of evidence which shows that dust germs may easily be harbored, and thus disease transmitted from wall paper. In the tenement houses which are common to the larger cities, and to a lesser extent in the dwellings found in smaller communities, where tenants are more or less transient, the continued maintenance of sanitary conditions presents a difficult problem. Infectious and epidemic illnesses generally leave behind bacilli of different types, which may find a culture medium in the fibrous and porous surfaces presented by wall paper, backed up as they invariably must be by starch, casein or other organic pastes. Occasionally the restriction of local boards cf health provide in such events for proper fumigation, but too often no precautions are taken to destroy the disease germs which are caught in the dust which collects on wall paper. As a rule, both tenant and landlord are obvious to all conditions which cannot be readily seen or detected.

* Dewar, Titzel, et al.

Burning sulphur, one of the most effective means of fumigation, will generally cause bleaching and consequent fading of the delicate colors used in printing the designs upon wall paper. Washing of the paper with antiseptic solutions will destroy its adhesiveness to the plaster and often cause bulging and general destruction.

Hospital Practice.—In hospitals, where it is necessary to maintain sanitary conditions, the walls are invariably painted, and requirements should demand the use of paints which can be washed frequently, so that there will be no possibility of uncleanliness. Inquiry made of a prominent surgeon connected with one of the large metropolitan hospitals substantiated the writer's findings regarding the greater sanitary value of wall paints; and brought forth the information that in hospitals under construction provision had been made for the finishing of walls so that a hard, non-absorbent and washable surface might be obtained. The same authority stated that the common practice, in apartments and tenements, of covering the old wall paper over with a layer of new, each time a tenant moved in, should be condemned, and that from a hygienic standpoint the use of sanitary wall paints should be advocated in all dwellings as well as public buildings.



"Alligatoring."—Type of Decay Exhibited by Improperly Made Paint.

If such conditions are maintained in hospitals, where special attention is paid to sanitation, it would appear that similar precautions should be equally as necessary in public buildings and in dwellings—wherever, in fact, people congregate to live.

Sanitary Wall Paints.—Cold water paints or kalsomines should not be used, as they often contain glue, casein, dextrine and other binders which are easily destroyed. Oil paints which are thinned with turpentine and other volatile spirits are the only real sanitary paints to use. There have recently apeared in trade a number of wall paints composed of non-poisonous pigments ground in paint vehicles having valuable waterproofing and binding properties, and of a nature to produce the flat or semi-flat finish that has become so popular. Such paints produce a sanitary, waterproof surface, which permits of frequent washing. By their use it is possible to secure a more permanent and wider range of tints than can be obtained with wall paper, as they are produced in a myriad of shades, tints and solid colors, from which any desired combination can be selected. On the border or on the body of walls decorated with such paints, attractive stencil designs, which bring out in relief the color combinations, may be applied.

For the decoration of chambers and living rooms, delicate French grays, light buffs, cream tints and ivory whites may be used, while in the library and other rooms richer and more solid colors, such as greens, reds and blues, may be harmoniously combined.

Defects of Wall Paper.—It recently occurred to the writer to investigate the conditions which obtain in many apartment houses in the larger cities. Inspection of a number of such places, in which wall paper had been exclusively used on the walls, showed generally bad conditions; bulging of the surfaces, caused by dampness in the walls, which had loosened up the binder, as well as peeling and dropping of the paper from the ceilings, were frequently observed. In many cases a shabby appearance was shown, accompanied by an odor which suggested decomposition of the paste binder used on the paper. The writer was impressed with the fact that such conditions could easily be avoided by the very simple expedient of using properly manufactured wall paints, which are so easily made dustproof and waterproof.

Samples of wall paper, which had been applied to plastered walls for a year or more, were obtained and examination under the microscope showed a most uncleanly surface. Cultures were made of these samples, and bacilli of different types were developed in the culture medium in a short time.

Experimental Evidence.—That the above conditions could not have existed had proper wall paints been used, seemed doubtless, and suggested a carefully conducted experiment to prove the relative sanitary values of wall paper and wall paints. A large sheet of fibreboard, such as is occasionally used to replace plastered walls, was painted on one side with a high-grade wall paint, three-coat work. A similar sheet was papered on one side with a clean, new wall paper. These test panels were placed where unsanitary conditions, such as dampness, foul odors, and a scarcity of air, were present. After a short period of exposure, the panels were taken to the bacteriological laboratory and a small section of the painted surface, about two inches square, as well as a small section of the papered surface of similar side, were removed and used for making cultures. In each case the surface of the section under test was washed with 100 cubic centimeter of distilled, sterilized water. The washings, which dripped from the surface, were collected in a graduated flask. One cubic centimeter of the washings was used in each case, admixed with bouillon and again with agar-agar. The enormous development of bacteria in the bouillon, treated with the washings from the wall papered surface, was sufficient evidence to convince one of the greater sanitary value of the wall paint, the washings from which gave a culture practically free from bacteria. The colonies of bacteria shown in the petri-dish made of the washings from wall paper further supports these findings. It will be noticed that the tests made from the washings of the wall paint show practical absence of bacteria, and was clear, as was the bouillon-solution test of paint. The washings from the wall paper showed active development of bacteria, both in the bouillon and agar tests.

From the Conservation Standpoint.—It would be of interest to sum up in figures the acreage and cordage of wood that annually is transformed into pulp for the manufacture of wall paper. Unfortunately there are no available statistics on this subject. It is clear, however, that from the standpoint of conservation the use of wall paints should take precedence over the use of wall paper.

Paints for the Prevention of Corrosion of Iron.—The protection of structural steel is a subject that most painters have in the past considered of minor importance, any paint that would properly hide the surface of the metal being accepted without much question. The demand, however, for structural steel for office buildings, factories, steel cars, railroad equipment, etc., has doubled the output of structural paints, and created a demand for painters having a knowledge of the proper materials to use in the painting of steel, so that its life may be preserved and its strength maintained. Such knowledge is as important to the painter as a knowledge of how to properly select materials for the painting of wood, and how to temper these materials to suit the various conditions met with.

Every one is familiar with the appearance of rust, but few actually understand what causes rust. No attempt will be made here to present even an outline of the many theories advanced to explain the phenomenon of the rusting of iron, for the subject is as diverse as it is interesting. A brief résumé, however, will be given of the now generally accepted theory that explains the subject. This theory is called the electrolytic theory.

"Auto-electrolysis" is the term used to define the peculiar tendency of iron to be transformed from a metal possessing a hard lustrous surface, high tensile strength, and other useful properties, to a crumbling oxide that falls to the ground and again becomes part of the earth from which it was originally taken by man.

This "going back to nature" is more readily accompanied by most of the steel produced to-day than by the old hand-made irons produced many years ago. It seems to be a curious fact that the more quickly a product or an article is fashioned by man, the more quickly it tends to return again to its original oxidized condition. Some manufacturers of steel, however, through an understanding of the causes of rust, have progressed in the manufacture of slow-rusting materials, either by the elimination or by the proper distribution of impurities.

When iron is brought into contact with moisture, currents of electricity flow over the surface of the iron between the points that are relatively pure and points that contain impurities. These currents stimulate the natural tendency of the iron to go into solution, and the solution proceeds with vigor at the positive points. The air which the water contains oxidizes the iron which has gone into solution, and precipitates the brown iron rust with which you are all so familiar. Thus water, which acts as an acid, and air, which acts as an oxidizer, have combined together to accomplish the downfall of the metal. It is obvious that if means could be devised to stop the solution pressure of iron, and make it resistant to the flow of surface electric currents, rust could be prevented. Materials which prevent the rusting of iron have been called by Dr. Cushman, who first advanced these explanations. rust inhibitors, or materials which inhibit rust. The paint maker, realizing the importance of these rust inhibitors, is incorporating them into paints designed for the protection of iron and steel, and the success which paints of this type have met with from a practical standpoint is a justification of what was first called the electrolytic theory which suggested their use. The laws of electrolytic corrosion would be a better way of stating what have become facts, and these laws are a direct result of the early pioneer researches of Dr. Cushman, who was formerly for many years in the Government service, but who is now the director of the Institute of Industrial Research in Washington. By placing small, brightly-polished steel plates into a mush of paint pigment and water, a determination may be made of the pigment's effect upon the metal. Some pigments under such conditions cause rapid corrosion of the steel plates. Such pigments are stimulators of corrosion on account of acid impurities which they contain, or because of their effect in stimulating galvanic currents. Many carbonaceous pigments are of this type. Other pigments have the effect of keeping bright the steel plates and preventing rust. Such pigments are of the inhibitive type, and their action is to check or retard the solution pressure of the iron.

Results obtained in many laboratory tests suggested a practical exposure test, and a series of three hundred large steel plates were exposed by the writer, acting under the American Society for Testing Materials, at Atlantic City, where the action of the salt air is severe on both paint and metal. In these tests separate plates were painted with nearly all the useful paint pigments, ground in a vehicle of raw and boiled linseed oil. Later in the test it was found that many pigments of the carbonaceous type, as well as those which contained acid impurities, were showing bad results. It was also found that pigments of the inhibitive type, such as chromates of lead, zinc, barium, etc., acted in an almost miraculous way, transforming the surface of the metal upon which they were applied into a practically uncorrodible condition.

The excessive chalking which took place on the corroded white lead coatings began to disappear at the end of a year, being washed away by the rains and carried away by the winds, so that there was left upon the surface thin coatings of pigments, insufficient to give good protection. Had this white lead been reinforced with sufficient zinc oxide to prevent chalking, much better results would no doubt have been obtained.

The deep cracking of the zinc oxide indicated that such a pigment required a large quantity of oil in order to satisfy its brittle nature and prevent such effects. White paints containing zinc oxide and zinc oxide products were in excellent condition, and they confirm preliminary tests which showed zinc oxide to be one of the most valuable pigments for protecting iron.

Although sublimed white and blue leads chalked very heavily, the chalked pigment seemed to be tenacious, and adhered to the plate, presenting a good surface with absence of rust. Both these pigments gave very good protection to steel. When admixed in the right proportion with certain other pigments, they give still better results.

Lithopone was early destroyed, as is usual with the pigment when used alone on exterior surfaces. It became rough and discolored, presenting a very blotchy appearance. Red lead and orange mineral both afforded excellent protection to the plates upon which they were applied. They became covered, however, after exposure with a white coating of carbonate of lead, which was due to the action of the carbonic acid of the atmosphere on the red lead, which is an oxide of lead, and susceptible to chemical action.

The iron oxide gave fair service indeed. In one case, however, there were several eruptions, indicating slight corrosion beneath the surface of the paint. One iron oxide which did wonderfully well was the black oxide of iron which not only possesses great tinting value, but up to the present time has had a high protective value. The graphite was very deeply pitted at certain spots, indicating that galvanic currents had been set up, causing stimulating effects. Barytes and blanc fixe, when used alone, gave very poor service, showing scaling, chalking disintegration, and rust soon after the test was started. Barytes, combined with some other pigments, however, presented a very good surface. Under the paint film of gypsum rust soon appeared, and although the film itself remained fairly intact, rusting progressed throughout the test, indicating that gypsum films were very poor excluders of moisture. Coal-tar paints failed in the test, and this was due, no doubt, to the strong action of the sun, which early destroys such products. China clay and asbestine gave excellent service for eighteen months. After that time, however, indications of corrosion were shown, and the apparent breakdown of the film was predicted. These pigments, however, combined with other pigments, have given excellent service.

American vermilion, zinc chromate, zinc-and-barium chromate, chrome green, Prussian blue, and zinc-and-lead chromate gave most wonderful service, presenting an appearance within two years that was almost identical with their appearance at the start of the test. These pigments with red lead, zinc oxide, litharge, sublimed leads, combinations of lead and zinc, willow charcoal, neutral oxide of iron and the inert pigments, will allow the design of paints of nearly any color. From their admixture properly adjusted with a good paint vehicle, and tested by the expert, will come the final solution of the problem that has bothered painters and engineers for so many years. The vehicle for such paints should be made of linseed oil with or without the addition of treated linoleates, tungates, and fossil gums, until such a time as a modern research has found a vehicle more suitable.

THE HEYWOOD SEWAGE PURIFICATION AND REFUSE DESTRUCTOR WORKS.*

By R. J. McKenn, Manager.

The refuse destructor works were opened on June 15th, 1903, and have since been regularly working. The plant consists of two front-feed units of the Meldrum patent "Simplex" regenerative type, hand fed, and having an effective grate area of 50 square feet, and works in conjunction with a Lancashire boiler, 20 ft. long by 7 ft. diameter, with a total heating surface of 570 square feet, working at a pressure of 150 lb. per square inch. The "Simplex" grate consists in having the furnace chamber common to the number of grates. This arrangement of continuous grate ensures the maintenance of an evenly high temperature, and allows of one section being cleaned and charged while the other is in an incandescent state, and as the gases commingle in the furnace, and again in the combustion chamber, complete immunity from dust or smell from gases leaving the chimney is ensured. The temperature in the combustion chamber varies from 1,700 deg. Fahr. to 2,000 deg. Fahr. The gases of combustion pass from the furnace into the combustion chamber, through the boiler and its settings in the usual manner, thence through the regenerator to the chimney flue. The regenerator, or air heater, consists of a number of cast iron tubes, through which the gases of combustion pass to the main flue. The air for combustion drawn by the steam jet blowers, which produces the forced draught, circulates round these tubes, and becomes heated in its passage to a temperature of from 250 deg. Fahr. to 350 deg. Fahr., this temperature varying with the quantity and quality of the refuse, as also the size of the boiler. The refuse for consumption in the destructors is obtained from dry ashpits and a good number of privy middens. That from the latter often contains 65 per cent. of moisture, and is of low calorific value. The average amount of water evaporated per pound of refuse is 0.62 lb. The engine-room contains a non-condensing engine, 8 in. diameter cylinder by 14 in. stroke, running at 160 revolutions per minute. This engine drives a 7 ft. diameter mortar mill, and a compound air compressor 8 in. and 6 in. diameter cylinders by 12 in. stroke, with a working pressure of 100 lb. per square inch, also a small inverted direct-coupled engine and dynamo, which gives 20 ampères at 200 volts. The current generated is used for lighting the works.

Sewage Purification Works.—It is now approaching eighteen years since the construction of the Heywood Sewage Works was commenced under the present engineer, Mr. Jas. Diggle, Assoc. M. Inst. C.E., F.G.S., of the firm of Messrs. Jas. Diggle and Son, of Westminster and Heywood. The actual commencement of the scheme was made on August 13th, 1894, but after the work of construction had proceeded some time a most unfortunate discovery was made. It was found that a worked-out coal mine existed practically over the whole site. This caused the committee and engineer considerable anxiety; and instead of the works being built with the usual foundations, it became necessary to excavate to a great depth and fill in with concrete. The foundations vary in depth from a few feet to 56 feet. This, together with pumping the water out of the old mine, added enormously to the cost of the works.

Heywood has a population of 27,000, and the rateable value is £121,700. The sewage treated at the works consists of, besides domestic sewage, manufacturing waste. It may be stated that the council adopt the policy of allowing manufacturers to run their waste into the sewers after treatment. The manufacturing waste consists of liquids from tanneries, flannel scouring, dye works, breweries, and paper stainers. The dry-weather flow of sewage is 850,000 gallons, and the major portion gravitates to the works, and enters by an egg-shaped culvert 4 ft. 6 in. on the major by 3 ft. on the minor axis. Passing through the primary screen, the screening bars of which are 2 in. mesh, the sewage is conveyed to the works by means of a cost iron pipe, 36 in. diameter, 300 yards long, and discharges from an inverted bell-mouth pipe. Part of the sewage is diverted on to a high breast water wheel 14 ft. diameter by 3 ft. wide. The energy generated by the water wheel is utilized for driving the secondary screens, which are of ⅜ in. mesh. A further portion of the sewage is diverted into an Adams lift, where energy is generated free of cost (with the exception of attention for cleaning), for lifting a maximum of 108,000 gallons of sewage per twenty-four hours from Hooley Bridge, which is a low-lying district. This low-level sewage enters the forcing cylinders through retentive valves, which prevent its return when the air pressure is applied. When a forcing cylinder has filled, the supply of high-level sewage used for energy is automatically turned on through the syphonic feed into the flush tanks placed overhead in the air chamber. Each flush tank when full automatically discharges its contents through the deep trap syphon and fall pipe into the air cylinder immediately below, to which it is connected. The air contained in each of these air cylinders is thus expelled as required, and by means of the air pipes is brought to exert its pressure on the low-level sewage contained in the forcing cylinder to which it is connected. The low-level sewage is thus forced automatically to the required level. The air cylinder is now full of high-level sewage, but is at once emptied by the simple syphon attached, and, so after being utilized for work, passes by gravitation to the disposal works. Thus the low-level sewage is raised automatically entirely without cost for energy, and with a minimum of oversight.

After the sewage has performed these functions it is again united, and passes alongside the overflow weir, which is set up to pass the sewage, in excess of three times and up to six times the dry-weather flow, on to the storm filters, which have an area of 6,200 square yards. The sewage from one to three times the dry-weather flow is then charged with alumino-ferric, and passes through the baffle channels and on to the precipitation tanks. There are six of these, with a total capacity of 710,000 gallons, and they are worked on the continuous system.

* Paper read before the Institution of Municipal Engineers at Heywood, Manchester, England.

When the works were originally constructed, contact filters were laid down. There were twelve in number, with a total area of 1,325 square yards. These gave excellent results, but they were not sufficient to deal with the whole volume of sewage; consequently it was necessary to construct additional beds. There are twelve beds, constructed on the percolating system, each 60 ft. diameter by 8 ft. deep, having a total area of 3,720 square yards. The sewage is distributed on to the beds by means of the "Simplex" distributing apparatus. This apparatus can be set to feed the beds in rotation for any desired period of time. When No. 1 bed has had a ten minutes' supply the distributor automatically diverts the flow to No. 2 bed for ten minutes, and so on throughout the series. Should the flow of sewage increase through rain or any other cause, one bed is not sufficient to deal with the flow, and the distributor automatically brings additional beds into action in ratio to the flow, and as the flow decreases the beds go out of action in ratio to the flow. The cycle of changing is going on continuously. Provision is also made which enables any bed in the series to be put out of action by simply placing a disc on the distributor, for no matter how well a sewage works may be managed there are times when the beds become sick and require a rest.

The bacteria beds are constructed on a concrete base, cone-shaped—that is, the centre of the beds is higher than the outer circumference. This allows the effluent to run to the effluent channels, which are constructed round the outside of the beds. The filtering media is laid on floors constructed with Ames-Crosta's floor tiles, which give a free access of air under the beds and allows a free passage for the humus matter to escape. The outside walls are constructed of pigeon-hole brickwork, 14 in. thick for 4 ft. high and 9 in. thick for the remaining 4 ft., and eight buttresses are constructed to each bed. As the effluent discharges from the beds it is collected by two main carriers, which convey it to the humus tanks. These tanks, two in number, are each 130 ft. long by 24 ft. wide, and vary in depth from 18 in. at the inlet to 2 ft. 6 in. at the outlet sills. These tanks are cleaned out every week. A Shone's ejector of 50 gallons capacity is fixed for raising the humus sludge from the humus tanks up to the precipitating tanks. This ejector is worked by compressed air, and works against a head of 24.62 ft., exclusive of pipe friction.

The sludge from the precipitation tanks gravitates to the sludge well, which is situate under the engine-room. A cast iron box is fixed in this well, into which the sludge falls, and when a charge is required compressed air is turned on and the contents of the box ejected up and into the sludge mixer. There are three sludge presses, each fitted with twenty-eight plates. The press liquor runs from the presses into a steel boiler-shaped receiver, and when the rams have discharged the sludge into the presses, the exhaust air is conveyed to the steel receiver; the whole of the press liquor being thus raised to the precipitation tanks. The energy required for driving the agitating gear in the mixer, also the hauling gear for bringing the pressed cake to the top road, is obtained from a 6 in. diameter cylinder engine by 12 in. stroke, which is driven by compressed air.

Automatic samples are fixed on the crude sewage inlet to the Adams lift tanks, the effluent from the precipitation tanks and the final effluent. This is an advantage, and obviates the necessity of workmen taking samples every hour. The appliances are simple and work continuously, thus ensuing an average sample being obtained extending over the twenty-four hours.

OZONE PLANT OF THE CENTRAL LONDON RAILWAY.

The management of the above underground railway has recently attempted to improve the condition of the air in their runways by the addition of an ozone plant manufactured by the Ozonair Company. As an experiment, the railway officials installed a trial outfit in the Bank Street station about two years ago and the results obtained justified the extension of the system to other stations along the line.

The supply of ozone is dependent upon the well-known principle of the silent electrical discharge on the oxygen of the air. At each station the equipment includes a rotary converter, a transformer and a motor-driven Sirocco fan; accessory to these are air washers and filtering screens. This apparatus is fixed at surface level and usually in the booking hall whence the upper air is drawn into the particular local system. Reference to Fig. 1 will explain the details of the arrangements employed. In each plant air is drawn from outside through a fine copper mesh filter screen, over the surface of which a thin film of water continually flows. This washes the incoming air, removing dirt and smuts, and deleterious gases.

The air is drawn into a Sirocco ventilating fan driven by a motor of 7 h.p., where it meets a comparatively strong ozone mixture delivered from an adjacent ozone generator, and is discharged in its ozonized and purified condition through trunking to the station platforms down below.

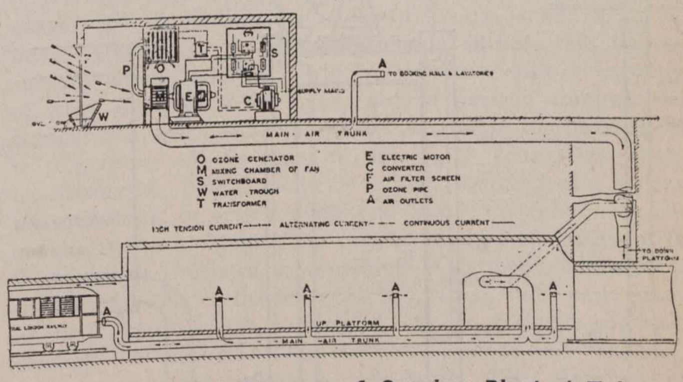


Fig. 1.—General Diagram of Ozonizer Plant at Tube Stations, Showing Details of Equipment and Delivery Ducts.

The ozone apparatus consists of 10 mica and gauze generating units, the gauze sheets being supplied with current at 5,000-6,000 volts pressure from the secondary of a small transformer, the primary of which is connected to the 380-volt a.c. side of a small rotary converter, running on a 550-volt d.c. circuit. A suitable switchboard is provided for controlling the fan motor and converter, and the whole apparatus is exceedingly compact and controllable as to the amount of air delivered and strength of the added ozone mixture, according to temperature or barometric requirements; moreover, the working is practically automatic.

In each station a small proportion of the clean treated air is supplied to the ticket office, lavatories, etc., on the surface; the remainder passes down a main trunk to a distributing duct under each platform, rising branches delivering air at a height of about 7 feet above platform level.

The large ducts under the platforms are continued about 40 feet along the tunnels in the direction in which the trains leave, with a view to the trains themselves assisting in the circulation of the treated air through the tunnels. About a third of the total air delivered is distributed over the platforms, the remainder being delivered into the tunnels.

A DOSING APPARATUS FOR WATER SUPPLIES.

An apparatus for introducing a chemical reagent into water flowing through a pipe under pressure is described in a recent issue of The Engineer (March 29, 1912).

In this device, shown diagrammatically in the figure herewith, the pressures in the mouth and throat of the Venturi tube at A are communicated to the two vertical tanks B and C respectively, so that the height of liquid in these two tanks varies with the Venturi pressures. In these tanks are suspended the hollow cast-iron cylinders G and F, hung from hooks in the end of the balance beam with fulcrum at E. These cylinders are so proportioned that their specific gravity is somewhat greater than unity, so that they are submerged in the liquid in the tank.

With no water flowing through the main the pressure at the mouth and throat of the Venturi tube is the same and consequently the liquid in the two tanks B and C stands at the same height, say at H_1 in the figure. Under these conditions the cylinders G and F will hang at the same height. The lengths of the rods connecting the cylinders to the balance beam are so proportioned that with the cylinders at the same

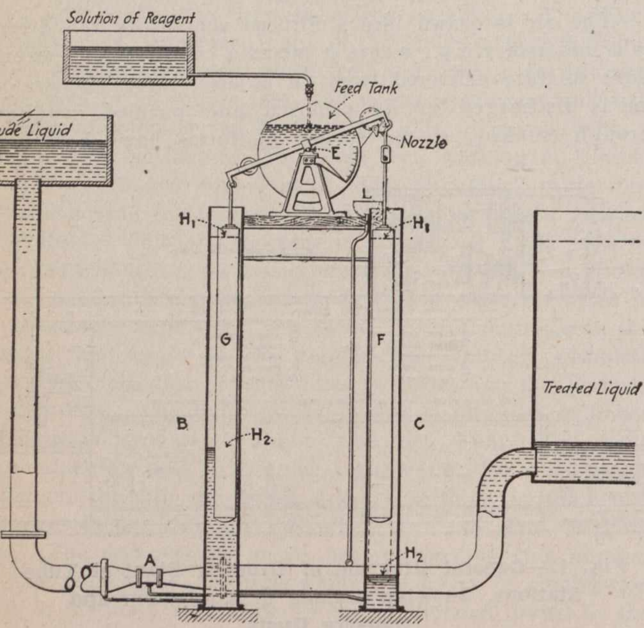


Diagram of the Tiltometer Dosing Apparatus.

height the feed tank, which it attached to the balance beam, will be in such a position that the level of the solution in the feed tank will be just below the discharge nozzle. The level of the solution in the feed tank is kept constant by a float valve. The position of the tank can be adjusted by means of the turnbuckle in the rod at the right end of the beam in the figure.

When the water is started flowing through the main, the water level in both tanks will fall, say to the levels of H_2 in the figure, with the level in the left-hand tank, connected to the mouth of the Venturi tube, higher than that in the right-hand tank, connected to the throat of the tube. As a result the equilibrium of the cylinders and balance beam will be disturbed and the right-hand cylinder F will descend sufficiently to equalize the immersion of the two cylinders. This motion of the cylinders causes the balance beam and consequently the feed tank to be tipped down at the right, so that some of the solution in the tank flows out through the nozzle into the cup L and then through the feed pipe into the main.

The amount by which the feed tank is tipped and consequently the head producing the flow of solution through the feed nozzle is proportional to the movement of the cylinders G and F and therefore to the difference in head at the mouth and throat of the Venturi tube. Hence the quantity of solution added is at all times proportional approximately to the amount of water passing through the main. The orifice of the feed nozzle can be adjusted to give the desired number of grains of solution per gallon of water treated.

It is claimed by the manufacturer, George Kent, Ltd., of High Holborn, W.C., London, England, that the variation in the proportion of solution added does not exceed 1⅔ % from the mean under the most extreme conditions of working. In support of this claim, the following results are given of tests made upon one of these devices:

	Solution.	
Water.	gals. per hr.	Per cent.
640	19.8	3.09
1720	52.2	3.04
1820	57.2	3.14
2390	73.7	3.08

The device has been patented jointly by the Hon. R. C. Parsons and Mr. Walter G. Kent. It is manufactured under the trade name of "tiltometer."

HEAVY-OIL ENGINES.

The first of a series of four lectures under the Howard Bequest, on the subject of "Heavy-Oil Engines," was delivered by Captain H. R. Sankey before the Royal Society of Arts on the 29th ult. Captain Sankey began by pointing out that some twenty years ago there was only one form of oil-engine of which the Hornsby-Akroyd and Priestman could be taken as types. These engines required external heat at starting for the evaporation of their fuel, and worked on paraffin. In 1890 Daimler invented the petrol-engine which worked with petrol having a specific gravity of about 0.68, and which required no external heat for the evaporation of its fuel, while in 1897 Diesel introduced his engine, which worked with heavy oil, and required no external heat, as the fuel was mechanically pulverized instead of being evaporated.

Oil-engines at the present time were, Captain Sankey said usually considered as divisibe into two casses: the light-oil engines, which used fuel capable of forming explosive mixtures at ordinary temperatures, and having a specific gravity ranging from 0.68 to 0.72, and heavy-oil engines, which used fuel requiring high temperature or mechanical pulverization, for the formation of explosive mixtures, and which had a specific gravity ranging from 0.8 to 0.9. He proposed in his lectures to confine himself entirely to the heavy-oil class. In the Diesel engine the compression took place entirely on a charge of air, into which the fuel was afterwards injected, so that there was no danger of pre-ignition, and compression pressures up to from 450 to 500 pounds per square inch could be used. It was in its high compression that the great efficiency of the Diesel engine lay. In the semi-Diesel type of engine, in which, after compression of air, the fuel was injected into a hot bulb, there was no danger of pre-ignition, but compressions up to about 200 pounds per square inch were usually found sufficient to ensure ignition.

Captain Sankey, after pointing out that the Diesel engine was the most important of the heavy-oil class, and stating that he proposed to devote the greater part of his four lectures to it, then gave a brief history of its development, beginning with Dr. Diesel's first example of 1897. Incidentally, and in connection with his historical summary, Captain Sankey suggested that the relative backwardness of this country in the development of the Diesel engine was due to the cheapness of our coal. He thought, however, that great progress was likely to take place in the future, particularly in connection with marine work.

Captain Sankey then dealt in a comparatively elementary way with some theoretical aspects of the Diesel engine. He drew a comparison between water-wheels, or water-turbines, and heat engines, pointing out that while the possible work which might be obtained from the former depended only on the height of the head of water, the possible work which might be obtained from the latter did not depend merely on the head of heat available—i.e., on the temperature—since the question of the specific heat of the working substance had to be taken into account. Captain Sankey illustrated this point by means of a heat-chart, and compared the efficiency of the Diesel cycle with the Carnot cycle. He pointed out that the Carnot cycle involved both admission at constant temperature and exhaust at constant temperature, and stated that Dr. Diesel's original idea had been to construct an engine working on the Carnot cycle and using pulverized coal as a fuel. In the Diesel engine admission took place at constant pressure and exhaust at constant volume, as compared with the gas-engine and petrol-engine, in which admission took place at constant volume. This difference gave the Diesel engine an advantage, since there was a greater difference between the upper portions of the actual and theoretical diagrams in the two cases. The economy of the Diesel engine was also largely accounted for by the high compressions, up to from 450 pounds to 500 pounds per square inch, which could be used. These figures compared with from 130 pounds to 150 pounds per square inch for gas-engines, and 70 pounds to 80 pounds per square inch for petrol-engines. In the latter cases the figure had to be kept low for fear of pre-ignition.

Captain Sankey then referred to the temperature reached in the cylinder of a Diesel engine. This was usually stated to be about 1,000 deg. Fahr., but he thought the figure too low. He did not know that the temperature had ever been directly measured, but the formula for the temperature of compression of air showed that the temperature should be about 1,500 deg. Fahr. No doubt it would be less than this in practice, owing to conduction loss, but he suggested that it was usually nearer 1,200 deg. or 1,300 deg. than 1,000 deg. He thought the temperature of 1,000 deg., which was so frequently given, might be explained on the assumption that, in calculating the matter, the lower temperature of the air had been taken as that of the outer atmosphere, but, arguing from gas-engine practice, it was likely that this lower temperature was nearer that of boiling water than of the atmosphere. Captain Sankey then traced through the various operations of the four-stroke cycle and two-stroke cycle of the Diesel engine. He pointed out that with a two-stroke cycle gas-engine there was danger that some of the new working charge might be blown out of the exhaust by the scavenging air, but that in a Diesel engine this could not happen, so that the Diesel might be looked upon as essentially a two-stroke engine. It was usual practice in such engines to admit scavenging air to about 80 per cent. greater amount than the volume of the cylinder. The four-cycle Diesel was more economical than the two-cycle, owing to the slight loss at the toe of the diagram with the latter consequent on the entry of the scavenging air.

INTERMITTENCY IN ELECTRIC TRACTION.

In a paper read before the Society of Engineers of England on "Intermittency: its Effect in Limiting Electric Traction for City and Suburban Passenger Transport," Mr. Wm. Yorath Lewis remarked that intermittency was a characteristic common to all systems of passenger transport in general use, and, while it might not be an objectionable feature in the case of a trunk line railway with long distance trains, its effect upon urban and suburban passenger transport was extremely detrimental. In city, urban, and suburban service the inherent nature of the traffic was that of a continuously flowing stream, which varied considerably in volume at more or less definite periods of each day, maximum density occurring at morning and evening during what were known as the "rush" hours. Usually the flow was along well-defined and regular channels between certain localities, but periodically the traffic stream was diverted, and was often augmented in volume, according to special circumstances. The means for dealing with this human stream should, consequently, partake so far as was practicable, of a continuous as distinguished from an intermittent nature.

Results of Intermittency.—The result of damming a human stream moving at the rate of three miles an hour—if the volume was four abreast six feet apart, and if the period of check was only one minute—consisted in the accumulation of a crowd of 176 people, meaning discomfort and a serious time loss of more than one minute, because of the time required to enable this detachment to board the conveyance, pending the arrival of which it had accumulated. Obviously, if instead of interrupting this human stream, accommodation could be provided with a capacity of, say, about three seats per second passing through the station at a speed sufficiently slow to enable the passengers to step on or off the cars, all delay and congestion would be eliminated. There would be neither the need of a station platform, nor of trains long and large enough to accommodate the assemblage. The present method of dealing with the situation consisted in providing a distinctly intermittent service of trains of limited capacity, run at sufficiently short intervals to ensure the passing of, say, 10,560 seats per hour through the stations. This involved, with 50-seat cars and, say, six-car trains, 35 trains per hour. The Metropolitan District Railway now ran over a section of its lines during the rush hours 40 trains an hour in each direction. Assuming that these trains were composed of six 50-seat cars, their capacity was 12,000 seats per hour. The length of the train was 300 feet, necessitating platforms about 400 feet long. The corresponding time interval between the trains was 90 seconds. The schedule speed was about 15 to 16 m.p.h., and the stations averaged half a mile apart, whilst the average stop at each station was about 20 seconds. As the trains were made up of six 50-foot cars, the aggregate length of train passing hourly through a station amounted to 12,000 feet, or 2.28 miles.

Defects of Present Methods.—The intermittent character of the train-system service was the factor which limited the schedule speed, and consequently the capacity of the line. The limitation of the speed necessitated a larger amount of rolling stock than would be requisite for the same capacity, were it possible to maintain higher schedule speeds. It would manifestly be impracticable and commercially impossible to negotiate such an intensity of service as that of the present underground railways of London, if the stations were to be located at an average distance of only one-quarter mile apart; although, from the viewpoint of traffic and public convenience, stations at these shorter intervals were highly desirable in the case of city and urban routes. Here again the intermittent characteristic proved to be the bugbear of the electric train system, but still further detrimental effects might be indicated. The maintenance of an intense service (say, 12,000 seats an hour in each direction) involved the problem of starting a heavy mass in the nature of a long train, accelerating this mass to a high speed and then retarding it to rest forty times an hour. With the electric train system this was rendered possible only by providing equipment of a very costly and complicated nature, which involved much skilled attention and a considerable element of human labor for its operation and control. Furthermore, a system involving the transportation of passengers in crowds instead of in streams required not only long, but also very bulky trains, which could be accommodated only in relatively spacious tunnels and at long station platforms. The stresses due to the severity of the service and the weight of the electric apparatus and accessories necessarily carried on the train were so great that the aggregate weight of the rolling stock rarely averaged less than 1,000 pounds per seat, and for more severe services it was much higher. Consequently the permanent way had to be of a substantial nature, and such locations must, notwithstanding the expense, be acquired for the railway, as to eliminate all possibility that neighboring property should be affected by the vibration resulting from the periodic passing of heavy rolling loads.

Conclusion.—The author then discussed acceleration, brake losses, energy consumption, and fixed charges, and finally submitted that in respect of the electric train system, the fundamental cause of its inherent limitations, its excessively high initial and operating costs, and its consequent inability to meet adequately the requirements of the dense traffic usual in all large cities, was its characteristic "intermittency." He urged that in view of the future, which undoubtedly demanded better and cheaper transit facilities in the interest of the community, recourse must be made to the continuous plan because, as he had endeavored to show in a paper read before the Royal Society of Arts on "Continuous Service Passenger Transportation in Relation to the London Traffic Problems," the difficulties which attended the present cumbersome method did not exist in that method, and consequently the prospects of superior achievements were relatively much brighter. He mentioned that it is proposed to put down a full-size railway on the Adkins-Lewis system of about a quarter of a mile in length on the Aldwych island site in order to enable the public to ascertain whether they could mount and dismount the cars when moving at a constant speed of two or three miles an hour. It is considered that, although the system has been demonstrated successfully by the Ipswich experimental plant, the next step in its development must be of the nature of a public trial.

HYDRO-ELECTRIC DEVELOPMENT AT PRINCE ALBERT.

Some time ago we noted that the city of Prince Albert intended to instal a municipal hydro-electric plant at Lacolle Falls on the North Saskatchewan River. The work is now under construction. The completed plant will cost in the neighborhood of a million dollars and will be completed in less than two years. The municipality of Prince Albert are financing the undertaking and Messrs. C. H. and P. H. Mitchell, Toronto, are the engineers. The development includes headworks, dam, navigation lock, power canal, intake works and power house. The contract for the headworks has been let to the Ambursen Hydraulic Construction Company, of Montreal, for $578,000. This contract includes the dam, a navigation lock 40 x 150 feet long and 6 feet deep, and the intake works. The power canal leads from the headworks to the power house, half a mile below the dam, and the excavation will be mainly in boulder clay. With the water available during minimum flow 12,000 horsepower can be produced, while the head obtained will be 30 feet. The turbines will be of the vertical type and six units will be eventually installed. Two will be placed immediately, of 2,000 k.v.a. capacity. The voltage used on the transmission line to Prince Albert will be 35,000. This will be stepped down to 2,300 volts in the local receiving station.

GRILLAGE FOR I-BEAMS.

The conventional base for columns of buildings is a cast-iron (or, in recent years, cast-steel) shoe, of sufficient size of bottom to suit the permissible loading of the stone or concrete foundation. E. W. Stern, consulting engineer, of New York City, has developed a base of the I-beam grillage type, as an improvement on cast bases, which is described in a recent issue of Engineering News, from which this description is taken. A typical design of his form of base is shown by sketch, Fig. 1, herewith. In a letter Mr. Stern gives the following comparisons:

"1. In comparison with cast-steel bases, the grillage base is both cheaper and more reliable. In my own experience, I have had cast-steel bases develop cracks after having been erected, although they had been carefully annealed and inspected before leaving the shop. These had to be replaced after several stories of steelwork had been erected, which entailed very considerable expense.

"2. In comparison with cast-iron, it is cheaper and very much more reliable. In an experience extending over many

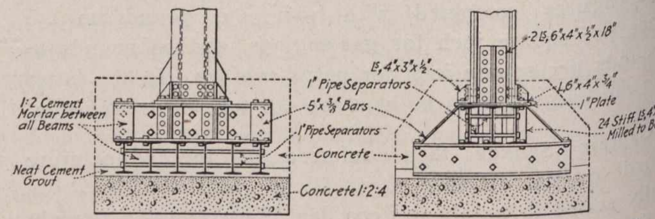


Fig. 1.—Typical I-Beam Base for a Building Column.

years in the use of cast-iron bases, I have known far too many to have developed cracks after they had been erected in the building, often entailing large expense for replacing them. For this reason I have not been using cast-iron bases for about 10 years.

"3. The grillage form of base is easier to set properly being much more readily grouted.

"4. Stresses can be readily calculated (which cannot be said of the usual design of cast base). The conventional method of analysis for shear, crippling and bending is accurate enough or all practical purposes."

The design shown has been used on loads up to 16,000 tons, and by slight modifications it may be used for much larger loads.

Shallow beams with heavy webs are preferred, avoiding the necessity of reinforcing the webs. However, Mr. Stern always uses stiffeners ground to fit, in the upper tier of beams, whether or not the calculations show them to be required.

In building these grillage bases, the beams are bolted up complete in the shop, and each tier of beams is bolted together, ready for erection in one piece. Pipe separators should be used plentifully, and in the top layer they should be spaced not over 6 in. vertically and in. horizontally. After setting, the base is, of course, grouted, all spaces between beams being filled with 1:2 Portland cement mortar.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

Managing Director: JAMES J. SALMOND.
Managing Editor: T. H. HOGG, B.A.Sc.
Advertising Manager: A. E. JENNINGS.

Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
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Everything affecting the editorial department should be directed to the Editor.

The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

NOTICE TO ADVERTISERS:

Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 22. TORONTO, CANADA, JUNE 6, 1912. No. 23

CONTENTS OF THIS ISSUE.

BRITISH MANUFACTURERS.

A party of British business men and manufacturers arrive on June 6th at Quebec on a visit of inspection of the Dominion. The party will make an exhaustive tour from coast to coast, visiting all the chief cities and industrial centres. The tour has been organized by the Financial News of London, which of late years has devoted marked attention to Canadian affairs, and under whose auspices the trip will be carried out, with the hearty co-operation and support of the Dominion Government. In speaking of the proposed trip, the Financial News says: "The British Dominion of Canada is clearly intended by Nature to be an industrial, as well as an agricultural, land of the first magnitude. She possesses the raw material of modern industry in an almost boundless degree. Her reserves of timber (the last great stands in the world), with proper care, are practically inexhaustible; iron, copper, and all the metals required in manufactures are present in great abundance; her coal fields are vast, and already are being profitably worked at many points of her wide territory. Natural gas, oil, and other fuels also abound. To crown all, her water-powers are capable of indefinite expansion at moderate cost—already in her eastern provinces the horse-power developed from water runs well into seven figures. Judged from her infinite capacities in this respect alone, Canada is a potential manufacturing country of the first rank."

This trip should be the means of developing the already cordial spirit existing between the Mother Country and her leading colony. It will give these men, who are the leaders in the financial and manufacturing world, an opportunity for studying at first hand the conditions that exist in the Dominion for the establishment of branch factories, the openings for capital in industrial undertakings, and the possibilities of extending the market for British-made goods. Their reception throughout the country will be most friendly. It is difficult to foresee the far-reaching results which will flow from an intimate inspection of this nature, but it will be certain to develop the trade relations between the two countries by opening up new avenues of commerce and broadening the existing ones.

ROADS.

The question of good roads is at last receiving the attention it deserves. Our neighbors to the south of us are much farther advanced along this line than we are. Necessity has forced them to take action, and as a result, in the last few years a great deal of road construction has been done. In New York State practically all the towns and cities are united by first-class highways, and in nearly all cases these roads are built for the particular service and traffic for which they are used. In the last two years a great impetus has been given to good road construction in Canada. We believe, however, that too little attention is being paid to the choice of roadway for the particular traffic expected for it. This is a very important requisite; in fact, we would say the most important consideration at the present time in the design of a highway. Maintenance is dependent to a large extent on the kind of roadway and the class of traffic, and, unless these two things are corelated, the good roads question is liable to receive a serious setback. When the York County Highway Commission of Ontario first outlined their programme, it was expected that the better class of roads, or that class which may be termed permanent, would not be necessary. However, after consideration, the Commission has decided that on many of the main arteries of traffic leading into the city of Toronto it would be advisable to put down a more permanent road than can be secured with water-bound macadam. There is little question that these main thoroughfares will carry an immense amount of traffic over what they are at present handling, and this will mean, if the poorer type of road is used, that it will quickly disintegrate and break down under the heavy travel. The Commission has approached the city and the Provincial Government to secure funds in order that this new programme may be carried out. It is to be sincerely hoped that funds will be placed at their disposal for this work, for nothing but failure can result in the use of a type of road which is not adapted for the traffic conditions.

FLAMELESS GAS HEAT.

The supremacy of gas fuel for industrial and domestic heating purposes is amongst the revolutionary developments anticipated in consequence of recent research at Leeds University. Means have been discovered by which gases can be made to "burn" without a flame and yield temperatures that have been hitherto unattained by gaseous combustion. Details of the phenomenon of flameless heat which underlies this discovery were given before the Cavendish Society at Leeds University recently by Professor W. Bone, D.Sc., F.R.S., the professor-elect of fuel at the Imperial College of Science and Technology. These results, Professor Bone stated, were the outcome of many years' scientific research upon "the accelerating influence of hot solids upon gaseous combustion," conducted by himself and Mr. C. D. McCourt, in continuation of the investigations by many prominent scientists during the early part of last century.

The distinguishing feature of the new process is that an explosive mixture of gas and air, when caused to burn without a flame in contact with a granular incandescent solid, resulted in a large proportion of the potential energy of the gas being converted into radiant form. The advantages: (1) That combustion is greatly accelerated by the incandescent surface, and, if so desired, may be concentrated just where the heat is required; (2) the combustion is perfect, with a minimum excess of air; (3) the attainment of very high temperatures is possible without the aid of elaborate "regenerative" devices, and (4) owing to the large amount of radiant energy developed, transmission of heat from the seat of combustion to the object to be heated is very rapid.

The process has been industrially applied in two principal forms. In the first, or diaphragm method, a scientifically proportioned mixture of gas and air is passed under slight pressure through a porous screen of fireproof material. Once the surface of the diaphragm attains incandescence, the gases burned without flame on the surface of the screen. The actual combustion is confined within a very thin layer below the surface, and a wall of fire, but without flame, can be steadily maintained as long as required. Combustion is not only perfect, but is independent of the nature of the external atmosphere. This method is specially adapted to such operations as grilling and roasting, and to the evaporation of liquids from above. In the second method, a prearranged mixture of gas (or vaporized oil) is injected at high speed through a jet into a bed of granular fireproof material which surround the body to be heated. So great are the temperatures obtained by this method that the greatest difficulty is experienced in obtaining material to withstand the heat. Not only has temperatures exceeding 360° Fahr. been secured with coal gas, put the gas consumption requisite to maintain any given temperature is only about half that required in similar furnaces fired by flame contact.

If the claims for this method are fulfilled in its practical commercial application, a vast improvement in the heat efficiency of gas fuel will result. Its use under industrial conditions will be viewed with interest. The value of technical research and investigation is becoming more and more pronounced each year. A university at the present time which does not strive to aid human knowledge and endeavor by the carrying on of research for the purpose of improving industrial and manufacturing processes is not serving the best reason for its existence. There is room for vast improvement in our Canadian universities in this respect.

EDITORIAL COMMENT.

We are glad to note that the Council of the city of Toronto are considering a proposal to limit the height of buildings there to ten stories. We have commented in *The Canadian Engineer* many times on the evils resulting from the erection of high buildings. There is little justification for the existence of a building over ten stories high, and there are many reasons against their use.

* * * *

The Commission of Conservation are doing good work throughout the Dominion along many lines. It is to be hoped, however, that the Government will soon appreciate the necessity for adequate measures with regard to the question of regulation of stream flow and the provision of storage reservoirs. In the near future this question will have to be taken up; in fact, it is necessary now. Little work can be done on it, however, in a practical way until investigations covering the rainfall, run-off, and stream flow have been made, and all the available records compiled and brought up to date. Some of this work has been done by the different Provincial authorities, but the work should logically come under, and will be best done, by a central body, such as the Commission of Conservation.

STREET SPRINKLING IN ST. PAUL, MINN.*

By C. L. Annan, M. Am. Soc. C.E.

For years the citizens of St. Paul put up with unsatisfactory street sprinkling. In the earlier years the work was done by contract, the cost being roughly assessed, at considerable expense, against the property supposed to be benefited. Then, as a substitute, an annual appropriation was included, for a few years, in the general tax levy to meet the cost of springling by day labor. The result was intolerable. Finally, at the general election in May, 1908, a sprinkling amendment was submitted to the people, and in 1909 the commissioner of public works took charge of street sprinkling under this amendment.

The system inaugurated at that time has been fairly perfected, and it has been demonstrated that systematic attention to details has brought results at least commensurate with the cost.

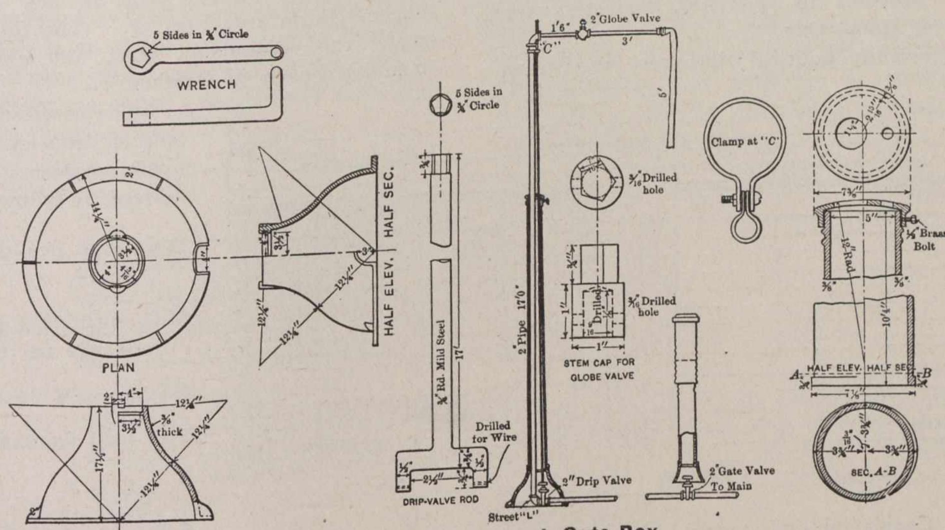


Fig. 1.—Stand-Pipe and Gate-Box.

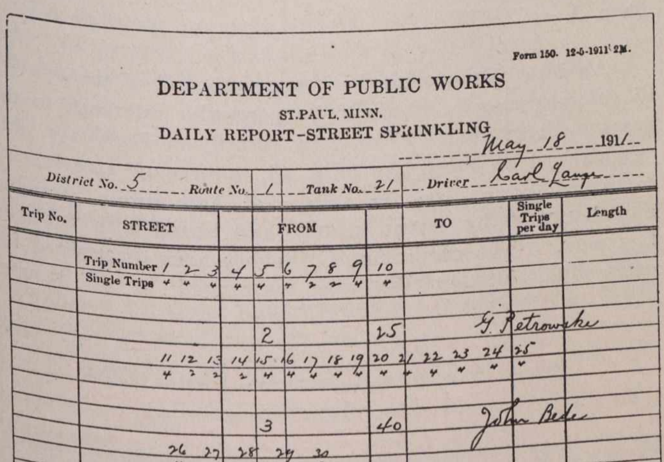


Fig. 2.

The amendment provided for an appropriation of $60,000 for the first year and an additional $40,000 for the second year. By that time the system should be smoothly running under the revolving fund fed by the assessment of the property benefited.

The third season under the new law opened with about 230 miles of streets to be sprinkled. New routes were added from time to time and a few were discontinued, resulting in a total gain for the season of about 9 miles. There is generally strong opposition to the discontinuance of a route once started.

From two to eight trips, depending on the nature of the street surface and the amount of traffic, are made each day. There are nine sprinkling districts, each under the supervision of an inspector at $75; a chief inspector or overseer at $110 is also employed. The ten inspectors report daily. The chief inspector advises and assists local inspectors and makes special examinations. The inspectors' reports are tabulated daily; all complaints are investigated, and the written reports are filed for reference. The foreman of stand-pipe construction and repair crews receives daily instructions, and the yardmaster returns a daily statement of sprinkler distribution and repairs. Careful itineraries on each team route are taken from time to time, and, in short, the head of the department is intimately informed of all details concerning equipment and operation.

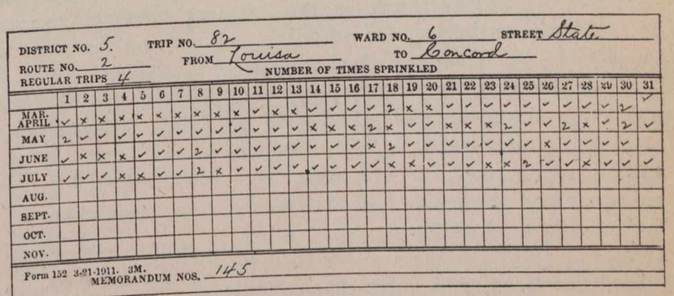


Fig. 3.

In assessing the cost of the work, the abutting frontage, number of trips per day, and length of time sprinkled, are taken into consideration. For the season of 1911, 43 assessment rates thus resulted, ranging from less than 1 cent to 11½ cents per front foot of abutting property. The cost of water is not included in the assessment, the city charter so providing.

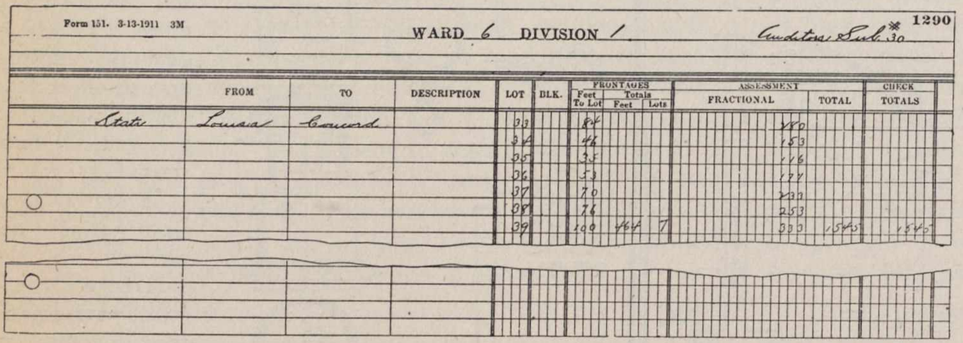
Water sprinkling of macadam was suspended early in the season by oil spraying. It was estimated that about 1/5 gallon per square yard of a 20 per cent. liquid asphalt might be applied three times during the season at a cost not to exceed that of water sprinkling for the same period. The latter part of the season being usually wet, comparatively few streets required the three coats of oil.

* Paper to be presented Sept. 18th, 1912, to the American Society of Civil Engineers, and printed in the Proceedings of the Society for May.

The sprinkling wagons are city property; 40 new and 31 second-hand sprinklers, varying in capacity from 600 to 750 gallons, were purchased in 1903. Twelve 750-gallon tanks were added in 1909, and as many more in 1910. These 95 sprinklers allowed a 10 per cent. reserve. All were in good repair after a thorough overhauling during the winter.

Teams were used for 7 days in the week at $100 per month, rain or shine, under an agreement with the Teamsters' Union. Previous to April 1st, teamsters were allowed $4 per day for actual time.

Inspectorships, formerly political sinecures, were transformed to realities. Consistent daily reports, investigations of complaints, route itineraries, and first-hand information as to condition of sprinklers and stand-pipes, require a certain amount of attention.


Form 151. 3-13-1911 3M

WARD 6 DIVISION 1 Auditors Sub. *30 1290

	FROM	TO	DESCRIPTION	LOT	BLK.	Frontages: Feet To Lot	Frontages: Totals Feet	Frontages: Totals Lots	Assessment: Fractional	Assessment: Total	Check Totals
State	Louisa	Concord		33		84			480		
				34		46			153		
				35		35			116		
				36		53			177		
				37		70			233		
				38		76			253		
				39		100	464	7	333	1545	1545

Fig. 4.

Five men at $2 and a team at $3 keep the stand-pipes in repair under the supervision of a foreman, who also attends to the maintenance of the public drinking fountains. This force also moved 16 stand-pipes from one point to another and erected 17 new ones in 1911. A stand-pipe, installed, (Fig. 1) costs about $60. The top valves are removed in October to prevent damage by freezing, and are replaced in April, an underground valve being used in March and November. There are 463 stand-pipes now in service.

The stand-pipe is quite generally regarded as a nuisance, and much opposition is met in locating it. It is not so much its unsightliness as the frequent presence near it of the heavy sprinkler, the standing horses, and the general sloppiness that makes is objectionable.

For washing ice, mixing cement, and other purposes, the stand-pipe is a great convenience to any outsider with a pipe-wrench. The water department and the police had long overlooked this kind of larceny, but a few arrests by special officers of the sprinkling department, and a few trials and convictions, now and again, somewhat abated this nuisance of mud and damaging misuse.

The method of assessing is as follows: A clerk, at $60, enters the daily report (Form 150, Fig. 2) on Form 152, Fig. 3, and indexes complaints and special orders to inspectors by number on the same form. Complaints are taken in duplicate on a general department form, the duplicate being held against the inspector until he turns in his report.

Form 152 is arranged in a check file divided into districts by tab cards of a distinctive color. The districts are subdivided into routes by cards of another color, one compartment in each district being reserved for "dead" trip slips. The current trip slips will not average more than ten to a route, so they are readily accessible, though the aggregate may be considerably more than 1,000.

Trip and route numbers may be changed on a trip slip (Form 152) but a change of limits necessitates new slips and cross-references and the consigning of the obsolete slip to the "dead" division until required for assessment purposes. All assessment forms are handled on the loose-leaf system.

Two men, at $80, are employed from March 15th to August 1st in making a transcript from the county auditor's records on Form 151 (Fig. 4) and preparing assessment sheets (Form 166, Fig. 5). The force is then doubled to make the assessment, post, and check it, the work to be completed early in October.

The assessment rate, A, per front foot of property abutting on any particular section of sprinkled street is derived as follows:

D = trips per day on the particular route,

M = sprinkling period, in months and tenths for the same route,

C = D × M (nearest integer),

F = total frontage on same route,

P = C × F,

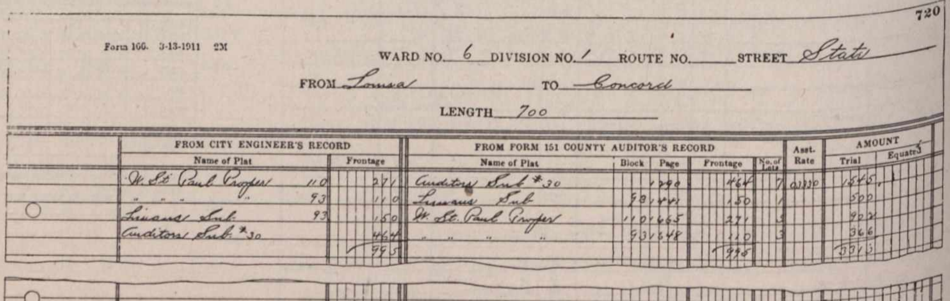
S = sum of products, P, for all routes,

T = estimated total cost of sprinkling all routes. (From the five months actual record a close estimate can be made for T).

$$R = \frac{T}{S},$$

Then A = C × R.

An idea of the method of procedure and of the relation of volumes may be obtained by particular reference to the assessment of 1911. The daily record, on Form 152, was summarized on Form 154 (Fig. 6), embracing 1,439 sheets in twelve groups, one for each ward, each group arranged alphabetically by street names and bound with flat-head fasteners. The coefficient, C, having been determined for each slip, the 1,439 slips were rearranged in 43 groups,


Form 166. 3-13-1911 2M 720

WARD NO. 6 DIVISION NO. 1 ROUTE NO. STREET State

FROM Louisa TO Concord

LENGTH 700

City Engineer's Record: Name of Plat		City Engineer's Record: Frontage	Form 151 County Auditor's Record: Name of Plat	Block	Page	Frontage	No. of Lots	Asst. Rate	Amount: Trial	Amount: Equated
W. St. Paul Proper	110	271	Auditors Sub *30		290	464	7	0.3330	1545	
" "	93	110	Lemans Sub	98	441	150	1		500	
Lemans Sub	93	150	W. St. Paul Proper	110	465	271	5		902	
Auditors Sub *30		464	" "	93	648	110	3		366	
		995				995			3313	

Fig. 5.

corresponding to the variations of C. A five-column table was then prepared with a line for each value of C, thus:—

C	F	P	F × R	C × R
1...........	34,006	34,006	62.91	0.00185
2...........	69,252	138,504	256.63	0.00370
		and so on, to		
62...........	62,965	3,903,830	7,222.09	0.11470
	2,567,815	50,529,857	93,480.24	

The total of Column P is S. The total of Column F×R is T. R is obviously the first item in Column C×R. R being constant, there are as many values of A as there are of C and F×R, for each group is checked by the total.

The entries on Form 154 are now completed, and the slips are rearranged in ward groups. In the meantime, Form 166 has been prepared to correspond with each sheet of Form 154, of which it is an extension applied to the property to be assessed. Form 166 is arranged alphabetically. When complete, the sheets are paged consecutively from the first sheet of Ward 1 to the last sheet of Ward 12.

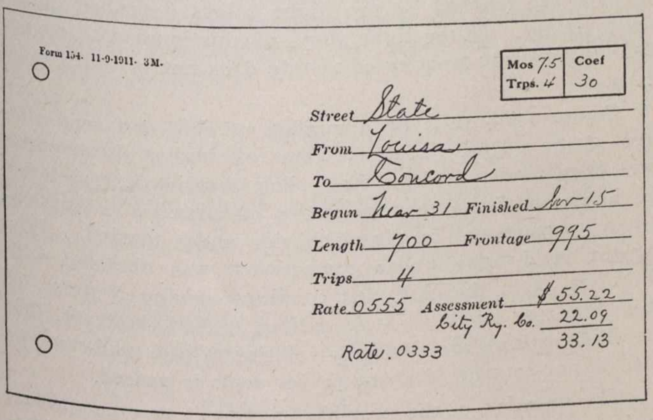

Form 154. 11-9-1911. 3M.
Mos 7.5 Coef 30
Trps. 4
Street State
From Louisa
To Concord
Begun Mar 31 Finished Nov 15
Length 700 Frontage 995
Trips 4
Rate .0555 Assessment $55.22
City Ry. Co. 22.09
33.13
Rate .0333

Fig. 6.

The assessment is finally made on Form 151, there being as many sheets of this form as there are block numbers involved on the various plates and subdivisions named on Form 166.

For instance, on page 720 of Form 166 there are four blocks of property containing lots to be assessed. There will consequently be four corresponding sheets of Form 151. These sheets are arranged alphabetically by plot names in ward groups, and they are also paged consecutively.

Page 1290 (Fig. 4) is a specimen sheet whereon the seven lots in the Auditor's Sub. No. 30, noted on the first line of page 720, are entered in detail. The 1911 assessment contained 3,472 sheets of Form 151.

The cost of making the assessment of 1910 was a little more than 2 per cent., but City Railway complications raised this ratio to more than 3 per cent. in 1911.

Early in May, 1911, the Supreme Court of the State de-

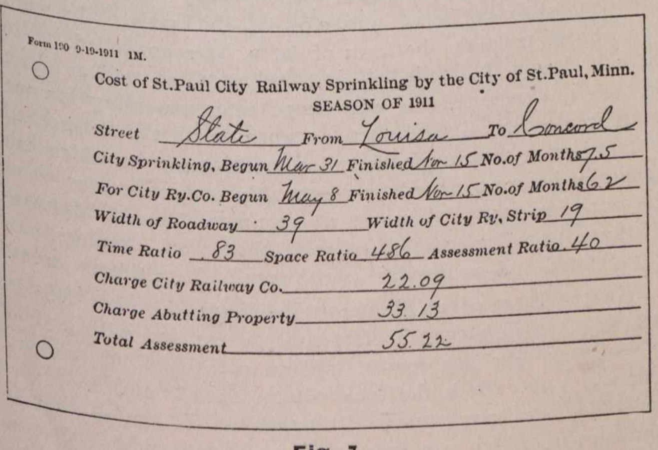

Form 190 9-19-1911 1M.
Cost of St. Paul City Railway Sprinkling by the City of St. Paul, Minn.
SEASON OF 1911
Street State From Louisa To Concord
City Sprinkling, Begun Mar 31 Finished Nov 15 No. of Months 7.5
For City Ry. Co. Begun May 8 Finished Nov 15 No. of Months 6.2
Width of Roadway 39 Width of City Ry. Strip 19
Time Ratio .83 Space Ratio .486 Assessment Ratio .40
Charge City Railway Co. 22.09
Charge Abutting Property 33.13
Total Assessment 55.22

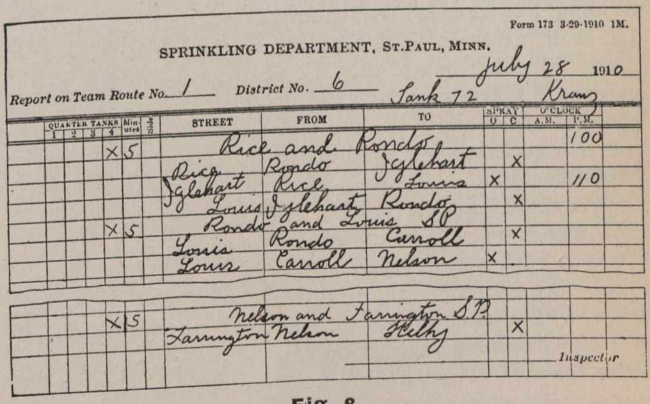
Fig. 7.

creed that the St. Paul City Railway Company must at once comply with the ordinance of October, 1909, requiring this company to sprinkle its tracks. As an immediate alternative, the company agreed with the commissioner of public works to pay the sprinkling department for doing the work. The cost of sprinkling streets traversed by the City Railway was to be prorated as to time and space from the totals of the general assessment for the same streets. Form 190 (Fig. 7) was provided for this record.

As soon as arrangements could be made, the City Railway Company sprinkled many miles of its track space with road oil.

The occasional itinerary which has been referred to has proved to be a practicable and an excellent feature. It was called for at irregular intervals, and the returns assisted in determining the efficiency of both teamsters and inspectors. Each teamster and inspector is furnished with a specific route sheet, and the care taken to equalize routes is generally appreciated and tends to the good of the service. The routes as traveled are reported on Form 173 (Fig. 8). They are platted on light blue prints. A summary is made of the number of tanks of water used and of the feet of effective and idle travel in a half day. The 45 sq. miles of sprinkling area are covered by 34 tracings (8½ by 13½ in.) on a scale of 600 ft. to 1 in., and from these tracings the blue prints referred to are made as required.

Among the many owners of the 50,000 lots, more or less, assessed, there are many complainants who desire to know the particulars, and, for the benefit of this class, a special form has been prepared. Occasionally, a correction is necessary; there were only twenty on the first assessment made under this system.


Form 173 3-29-1910 1M.
SPRINKLING DEPARTMENT, ST. PAUL, MINN. July 28 1910
Report on Team Route No. 1 District No. 6 Tank 72 Kranz

Quarter Tanks 1 2 3 4	Min-utes	Street	From	To	Sunny	A.M.	P.M.
		Rice and Rondo					100
X	5	Rice	Rondo	Iglehart	X		
		Iglehart	Rice	Louis	X		110
		Louis	Iglehart	Rondo	X		
X	5	Rondo and Louis St.					
		Louis	Rondo	Carroll	X		
		Louis	Carroll	Nelson	X		
X	5	Nelson and Farrington St.					
		Farrington	Nelson	Selby	X		

Inspector

Fig. 8.

The assessment for each ward is cross-checked and balanced to a cent. A concluding word may be said as to the daily reports, Form 150 (Fig. 2). Each section of street has its trip number. The small figures under the trip numbers show the number of trips actually made for the day. Under Route 4 it will be noted that Trip No. 31 lacks the sub-number. The explanation immediately follows. To write "31" is equivalent to writing "Indiana Avenue, from South Robert Street to Hyde Street." On May 18th Trip No. 31 was divided. A portion of it (No. 84) being transferred from Route 4 to Route 7.

Each inspector keeps a consecutive list of last numbers in his district and can thus assign a new number when necessary.

MOVEMENT TO IMPROVE INDUSTRIAL CONDITIONS IN EASTERN CANADA.

Colonel Vince, who is a member of the public utilities commission of New Brunswick, has stated that natural gas will revolutionize industrial conditions in the province, if it is found in sufficient quantities to supply St. John and other places as it does Moncton at the present time. Borings are being continued in the oil region in Albert county and will probably also be made in King's county.

THE ALLOYS OF ALUMINUM AND ZINC.

At a recent meeting of the Institution of Mechanical Engineers, Dr. Walter Rosenhein and Mr. S. L. Archbutt, of the National Physical Laboratory, presented the Tenth Report to the Alloys Research Committee of the Institution on the "Alloys of Aluminum and Zinc."

The principal results obtained in the investigations described in the present (Tenth) Report to the Alloys Research Committee are briefly summarized as follows:—

(1) The Constitution of the Alloys.—This is only briefly dealt with in the report, since a full account of the metallographic study of the aluminum-zinc system has already been published elsewhere. The new equilibrium diagram arrived at by the authors is reproduced, showing the occurence of reactions and the formation of a definite compound (Al_2Zn_3) whose existance had not previously been established. From the equilibrium diagram it appears that all the alloys containing more than 40 per cent. of zinc undergo transformation at a temperature of 256 deg. C. (493 deg. Fahr.). As regards the alloys at and near the aluminum end of the series, the new equilibrium diagram establishes their "solidus curve" or temperature of complete solidification, and also exhibits certain minor transformations which, although shown not to be due to a change in the pure aluminum-zinc system, always occur in commercial alloys at temperatures near their melting-point. The alloys containing less than 40 per cent. of zinc are shown to be simple homogeneous solid solutions, although it is possible that the inversion of 256 deg. C. also occurs at this end of the series. When cast in chill moulds, the microstructure of these alloys exhibits the sharply "cored" structure usually found in rapidly cooled solid solutions having a long range of solidifications. In sand-castings this coring is less sharply defined and the whole microstructure is on a larger scale. The "cores" are entirely removed by prolonged annealing at such a temperature as 400 deg. C. (752 deg. F.), but they are removed rapidly and completely by the rolling process. Photomicrographs of the hot-rolled alloys, especially after annealing, containing up to 25 per cent. of zinc, exhibit the typical polyhedral structure of a perfectly homogeneous solid solution, although the scale of the crystals varies considerably according to the exact mode of treatment which the material has undergone.

The Study of the Cast Alloys.—Tensile tests on sand and chill-castings of a series of alloys covering the entire range of the binary system are given, both in tabular and graphic form. The tensile strength of sand-castings shows a steady increase up to a concentration of 50 per cent. of zinc, when an ultimate stress of 18.7 tons per square inch is reached; there is then a slight fall of strength with further increase of zinc-content, followed by a rise to a second maximum near 75 per cent. of zinc, a concentration which corresponds approximately to the composition of the compound Al_2Zn_3. The highest ultimate stress reached is 18.9 tons per sq. in. The table and curve representing the results of tests on chill-castings is some what different in type, three maxima being observed, namely, the first at 30 per cent. of zinc with an ultimate stress of 17.9 tons per sq. in., the second at 50 per cent. with 21.6 tons per sq. in., and the third at 75 per cent. with 20.1 tons per sq. in. The yield-points for both sand and chill-castings are recorded as observed, but the observations were found to be somewhat uncertain in the case of the cast alloys.

In discussing the results of tensile tests on the present series of alloys the authors have used the term "Specific Tenacity," to denote a quantity which is proportional to the tensile strength and inversely to the specific gravity; this has been calculated by dividing the ultimate stress of a given alloy in tons per sq. in. by the weight of a cubic inch in pounds. The quotient is the breaking load in tons of a bar of the material whose cross-section is such as to make the weight of the bar 1 lb. per in. length. From the point of view of tensile strength alone this figure may be regarded as representing the value of any structural material, and allows of comparisons on a correct basis between materials of widely different specific gravity, such as these light alloys and steel. In the cast alloys the specific tenacity is found to reach its maximum for both sand and chill-castings in an alloy containing approximately 26 per cent. of zinc. The value attained is just over 150, as compared with a maximum value of 126 reached by the light alloys described in the Ninth Report. In the light alloys of aluminum with copper alone the specific tenacity of casting does not exceed a value of 99.

Compression tests on a number of chill and sand-castings of the alloys, including some of higher zinc-content, have been made. These tests show that in general terms the behavior of the castings under compression is approximately proportional to their behavior under tension. The highest yield-stress under compression was obtained with alloy No. 55 in the chill cast condition, giving a stress of 22.96 tons per sq. in. It is curious to find, however, that the chill-castings are decidedly inferior to the sand-castings until a zinc-content of about 50 per cent. is passed.

The question of the possible "ageing," or even gradual spontaneous disintegration of the aluminum-zinc alloys has also been studied in connection with the sand-cast material, tensile tests of some of the alloys being repeated on specimens which had been kept for over fifteen months, but no signs of any change were observed.

Study of the Wrought Alloys.—Billet of the alloys containing up to and including 26 per cent. of zinc were cast at the Laboratory and were rolled and drawn to various sizes, including wire and sheet, at the Milton Works of the British Aluminum Company. Hot-rolling was found possible with all these alloys, but not with an alloy containing 30 per cent of zinc.

Tensile tests on a representative series of alloys lying between the limits of composition just named were made on material in the form of (1) bars hot-rolled to 1¼ in. diameter, (2) bars hot-rolled to ⅞ in. diameter, (3) bars hot-rolled to ½ in. diameter, (4) bars cold-drawn to 13/16 in. diameter, (5) bars drawn with annealing to 13/16 in. diameter, (6) cold-drawn wire 0.1285 in. diameter, and (7) sheet of 0.14 and 0.07 in. thickness. In addition, the material in the form of ⅞ in. bars hot-rolled, 13/16 in. cold-drawn, hot-rolled ½ in., and wire, as well as sheet of both thicknesses, was also tested after annealing for one hour at 400 deg. C. The tensile tests on all the hot-worked material gave very uniform and consistent results which can generally be represented by reasonably smooth curves when the data are plotted against zinc-content. The yield-points in these tests, as contrasted with those on castings, are well-defined and as regular as the results for ultimate stress.

In the form of 1¼ in. hot-rolled bars, the alloy No. 26 attains a tensile strength of 27 tons per sq. in., with a yield point of 25 tons per sq. in. and an elongation of 16.5 per cent. on 2 in. Both the tensile tests on 1¼ and on ⅞ in. hot-rolled bars give curves of ultimate stress plotted against zinc-content which are very similar to one another, but it is a striking feature of these alloys that the curve for the smaller section lies above that for the larger only up to a zinc-content of about 12 per cent.; above that concentration the 1¼ in. bars give higher ultimate stresses than the ⅞ in. bars. The results of tests on still smaller sizes of material, even including the hard-drawn wire, show corresponding results, although the crossing-point of the respective curves differs from one size of material to another. The general conclusion is demonstrated that the beneficial effect of "work" on these alloys diminishes steadily with increasing zinc-content, until the 25 and 26 per cent. alloys are reached, in which we find that the highest ultimate stress is always given by the 1¼ in. hot-rolled bars. These alloys, richer in zinc, therefore, present the unusual property that cold-drawing a bar from 1¼ in. to 13/16 in. diameter, although it raises both yield-point and elastic limit and lowers elongation and reduction of area, actually reduces the ultimate stress.

The condition (excluding wire) of highest tensile strength, together with the yield-stress and elongation corresponding to that condition, are given for a series of typical alloys in Table 1.

Table 1.

No. of the Alloy (also per cent. Zn)	Condition for Highest Ultimate Stress	Ultimate Stress	Yield-Point	Elongation on 2 inches
		Tons per sq in.	Tons per sq. in.	Per cent.
5	⅞-in. hot-rolled bar	8.94	7.4	26
9	½-in. hot-rolled bar	11.17	6.98	38*
11	½-in. hot-rolled bar	13.78	9.42	35*
13	13/16-in. cold-drawn bar	14 73	12.80	19.5
17	1¼-in. hot-rolled bar	19.85	13.20	22
20	1¼-in. hot-rolled bar	22.64	17.3	20.5
26	1¼-in. hot-rolled bar	27.09	25.00	16.5

* On 1 inch.

The tensile tests on annealed material were undertaken principally to ascertain whether the peculiar effects of "work" mentioned above persisted after annealing, and the results are discussed with reference to the resulting micro-structures. It was found that the "hot-rolled" materials exhibited a considerable amount of deformation in their constituent crystals, and that this deformation was entirely removed by annealing, although the scale of the resulting structure differed widely according to the treatment which each specimen had received. In general terms it was found that the tensile strength of the annealed materials was not strictly proportional to crystal size, but that the more severely worked material always exhibited better results after annealing than less severely treated metal. The highest ultimate stress in annealed material of the present series of alloys was obtained from alloys No. 20 in the form of annealed cold-drawn wire, the value being 21.1 tons per sq. in., but it must be noted that the higher alloys of the series (Nos. 25 and 26) were not included in all the tests on annealed material.

The tests on wire and sheet gave results which have already been referred to in connection with the effect of work and of annealing. Sheets were rolled from alloys Nos. 15 and 20; the former rolled well, but the latter cracked somewhat at the edges. The tensile tests show considerable variations as regards yield-points between longitudinal and transverse tests, although these are obliterated to a considerable extent after annealing. The yield-stresses, however, gave very erratic results, and this is probably to be ascribed to slight surface cracking of the metal. In the cold-rolled condition, alloys No. 20, in the form of sheet 0.07 in. thick, gives an ultimate stress of 23 tons per sq. in., but there is little or no elongation in this condition. After annealing the ultimate stress falls to 18 tons per sq. in., but the elongation reaches 10 per cent. on a longitudinal and 6.25 per cent. on a transverse test.

As regards the tests on the alloys in the form of wire, it was found possible to obtain even alloys Nos. 25 and 26 in this form, but the results given by these were disappointing, since they were lower than the tests obtained with 1¼ in. hot-rolled bars. In the annealed condition, however, these wires give results which appear to be promising; thus No. 19 gives an ultimate stress of 21 tons per sq. in. with 17.7 per cent. of elongation. It is interesting to note that the tests on annealed wire exhibit a well-defined maximum in tensile strength at or near a concentration of 20 per cent. of zinc.

Tensile tests at high temperatures were made on a series of the alloys in order to ascertain the effect of zinc-content on the rate of loss of strength of these alloys with increasing temperature. Most of the alloys were tested up to 200 deg. C. (392 deg. Fahr.), but in two cases considerably higher temperatures were employed (up to 595 deg. C.). In every case it is found that there is a rapid fall in the yield-stress and ultimate stress with rising temperature, even 50 deg. C. producing a marked effect. The rate of loss of strength varies according to the composition of the alloy; thus at 100 deg. C. the alloys containing up to 13 per cent. of zinc have lost about 36 per cent. of their tensile strength at the ordinary temperature; the alloys containing from 15 to 17 per cent. show a loss of 44 to 52 per cent., but this figure again diminishes to 26 per cent. for alloy No. 26. These relative rates of loss are confirmed at higher temperatures. At still higher temperatures the strength of the alloys becomes exceedingly small, but they exhibit a remarkable degree of ductility as measured by elongation and reduction of area; the latter in some cases is so great that the fracture is drawn down to a sharp point, while the elongation in one instance reached 133 per cent. Forging tests, however, show that this extreme ductility exists only under "static" loads, and that the alloys which draw out to the fine points in the testing machine are broken into small fragments if struck sharply with a hammer at the same temperature.

The elastic properties of the alloys have been determined both for the hot-rolled and cold-drawn materials. They exhibit a satisfactory elastic behavior and show well-defined elastic limits, which increase regularly with the zinc-content and consistently with the ordinary yield-point determinations. The elastic moduli of all the alloys are almost identical, lying near the value 9×10^6, a low value which may prove a disadvantage for certain possible uses of the alloys.

Torsion tests have been carried out on specimens cut from the alloys in the form of 1¼ in. hot-rolled bars, comparison of the results with those of tensile tests shows that the torsional strength, although it increases considerably with increase of zinc-content, yet does not increase as rapidly as the tensile strength. The ratio of the maximum stresses under the two forms of test falls from 1.10 for alloy No. 9 to 0.76 for alloy No. 25.

The hardness numbers of the alloys, again in the form of 1¼ in. hot-rolled bar, have been determined by the Brinell method under loads of 1,000 and 3,000 kg. respectively and by the Shore scleroscope. The proportionality between the hardness numbers and tensile strength is found in these alloys to be only of a general kind, the shapes of the respective curves being notably different.

Compression tests have also been made on the wrought alloys. The results are in strict conformity with those of tensile tests, although the compression yield-stresses are always slightly higher than those found in tension.

Dynamic tests have been carried out on the alloys both with the machines designed for that purpose at the National Physical Laboratory under the direction of Dr. T. E. Stanton, and also by the kindness of Professor J. O. Arnold at the University of Sheffield. The tests made at Teddington include direct alternations of stress, repeated-bending impact and single-blow impact.

The tests in alternations of direct stress give a series of results for the safe range of alternating stresses for the alloys, and this curve lies considerably below that of the static elastic limits. These ranges, although low when compared with the ordinary tensile test results, yet indicate a very decided advance on other light alloys which have been described in the Ninth Report. The best of those alloys (of aluminum with copper and manganese) showed a safe range of 9.4 tons per sq. in., while the best of the present series has a range of 12.0 tons per sq. in.

Alternate-bending impact tests made with a weight of tup of 4.71 lbs. and heights of fall of 1.0 in. and 0.71 in. respectively. Both sets of tests give curves of very similar shape which show that after 15 per cent. of zinc the resistance to this test is strictly proportional to the zinc-content of the alloy. Of the present alloys, No. 9 shows a resistance practically equal to that found in the best of the light alloys described in the Ninth Report (about 600 blows with a fall of 0.71 in.), while the best alloy of the present series (No. 25) required 3,400 blows for fracture. This power of resisting repeated impact is particularly noteworthy in view of the fact that the aluminum-zinc alloys are frequently spoken of as being weak under shock.

Single-blow impact tests, made on the Izod machine, show that the work absorbed by fracture reaches a maximum for a zinc-content lying between 15 and 20 per cent. This is in accordance with the fact that such tests are affected by both tensile strength and ductility, so that the increased tensile strength of the alloys containing more than 20 per cent. of zinc is more than outweighed by their lower ductility so far as this test is concerned. As compared with the light alloys previously studied, the present series are decidedly superior, although the difference is not so marked as under some of the other tests.

Under Professor Arnold's alternate-bending test, the alloys gave remarkably uniform results, but the curve of number of alternations endured falls rapidly with increase of zinc. Professor Arnold remarks that the resistance of these alloys to his test varies from ⅛ to ¼ that of the heat-treated best mild structural steel. It is interesting to note, in comparing the results of the three last-mentioned forms of dynamic test, that the curves representing their results are closely related to the curves of ultimate stress and elongation or reduction of area as shown by tensile tests. Thus the repeated-bending impact tests give a curve which is closely proportional to that of ultimate stresses, while the results of Professor Arnold's tests are proportionate to the ductilities of the alloys as shown by elongation or reduction of area. The single-blow impact tests, on the other hand, appear to be proportional to the sum of these two properties.

In view of the results of all the mechanical tests the authors arrive at the conclusion that an alloy containing about 20 per cent of zinc probably represents the best combination of properties obtainable in the simple binary aluminum-zinc series.

Corrosion tests on specimens of these alloys exposed to the sea have been carried out for a period of over 500 days, and the results show that the rate of loss of weight under such exposure increases with increase of zinc-content. The actual rate of loss, however, is not as great as might have been anticipated, varying, when allowance for the difference of density is made, from 1½ times that of Naval brass to 1½ times that of Muntz metal. The authors, however, regard their corrosion tests as purely preliminary, since the alloys were used in the cast state, while subsequent study suggests that annealed material would show considerably less corrosion. The method of measuring corrosion by loss of weight is also regarded as inadequate for the study of these alloys, and further corrosion tests are being undertaken.

A general feature of some importance in connection with all the alloys described in the present report, and particularly with those containing from 10 to 30 per cent. of zinc, is the great facility with which they can be worked by machine tools of all descriptions, in most cases without the use of any lubricant. Turnings of exceptional length and strength have been obtained from several of these alloys. The machined surfaces retain their brightness in the air of the laboratory for many months without protection of any kind.

Attention is directed to the Appendix, in which the authors give a preliminary account of the properties of a tenary alloy of aluminum with zinc and copper (alloy No. 25/3) containing approximately 25 per cent. of zinc and 3 per cent. of copper. This alloy, which can be rolled hot, although special care is required in dealing with it, gives remarkable results under mechanical tests. An ultimate stress of 34 tons per sq. in. has been attained with this material, while its resistance to repeated-bending impact is over 4,500 blows, as compared with 3,400 of the best of the binary alloys. Tabulated results of tests made on this alloy are given, but a fuller discussion of its properties is postponed until a systematic study of these ternary alloys has been completed.

ELECTRICALLY OPERATED VALVES.

By H. M. Gassman.

Valves of 24 in. diameter and larger are usually operated other than by hand, for the reason that generally such valves must be closed in a very short time, which is impossible by hand operation, and also because such valves are frequently located in out-of-the-way places, and are more conveniently controlled from some operating point more or less remote from the valves.

As large valves usually control very important service connections it is essential that the electrical equipment of these valves be dependable. To guard against failures the valves should be inspected and tried out regularly, particularly where they are likely to remain in one position for long periods.

The power required to open a valve is a maximum when starting the valve from its seat. After the gate has been opened, say, one-fourth, comparatively little torque is required to complete the operation. The proportion of starting to running torque varies with the construction of the valve, the amount of corrosion and the condition of the valve seat. When closing hydraulic valves under pressure, the starting and running torques are comparatively small until the valve is about three-quarters closed. From that point on, the pressure on the gate increases approximately as a square of the decrease in the opening; consequently the torque at closing in such cases increases rapidly, but does not reach the value of the starting torque required to open the valve under the same pressure conditions.

To overcome the sticking of the valve when it is to be opened, the drive is sometimes provided with a lost-motion device, so as to give a hammer blow when starting the valve from its seat. With alternating-current motors such lost motion also allows the motor to develop a high speed, and, therefore, a greater torque before starting the valve from its seat.

Unless some provision is made for limiting the torque of the motor or controlling the circuit when closing the valve, it is possible to jam and injure the mechanism of the valve, making further operation difficult. A slip gear

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* From a paper delivered at the Pittsburg meeting of the American Institute of Electrical Engineers, April 25th to 27th.

cannot be used for this purpose, as the slipping torque in opening will be practically the same as when closing, unless the gear be designed to act in the closing direction only.

Where compactness is a consideration the motor is rigidly attached direct to or on an extension of the valve casing. The motor and drive should be so arranged that there will be ample room for hand operation. An inclosed motor is preferred on account of exposure to dampness, water and flooding, enclosing being permissible without affecting the size of the motor, owing to the intermittent service. Terminals and wiring also must be protected against water and any mechanical injury which might result while repairs are being made to the valve.

A valve should not be overpowered by a motor, for the reason that there is considerable risk of damaging the valve, and should not be underpowered, because it increases the chance of failure when the conditions are extraordinary. The correct size of motor for the valve will very with the duty and the general conditions under which the valve operates.

Where there is any choice of system, the direct current is preferred in order to secure the advantages of a series-wound motor, giving a high starting torque and increased speed under light load. The commutator and brushes, however, are apt to give trouble in damp or wet locations. The alternating-current motor best adapted to valve operation is the squirrel-cage type because of its simplicity. The motor should be designed with a high resistance rotor to increase the starting torque.

For equivalent performance—that is the same assurance against failure of the motor to operate the valves—the alternating-current motor should be from 20 to 40 per cent. larger than the direct-current motor. In such applications motor efficiency does not enter, but operating efficiency does, and, therefore, it is economy to put on motors of greater capacity than would be actually required under ordinary conditions.

For remote control the ideal arrangement is one which permits of automatically starting and stopping the motor by simply throwing a switch or controller, and one that makes it impossibe to start the valve in the wrong direction and wreck some part of the valve or mechanism.

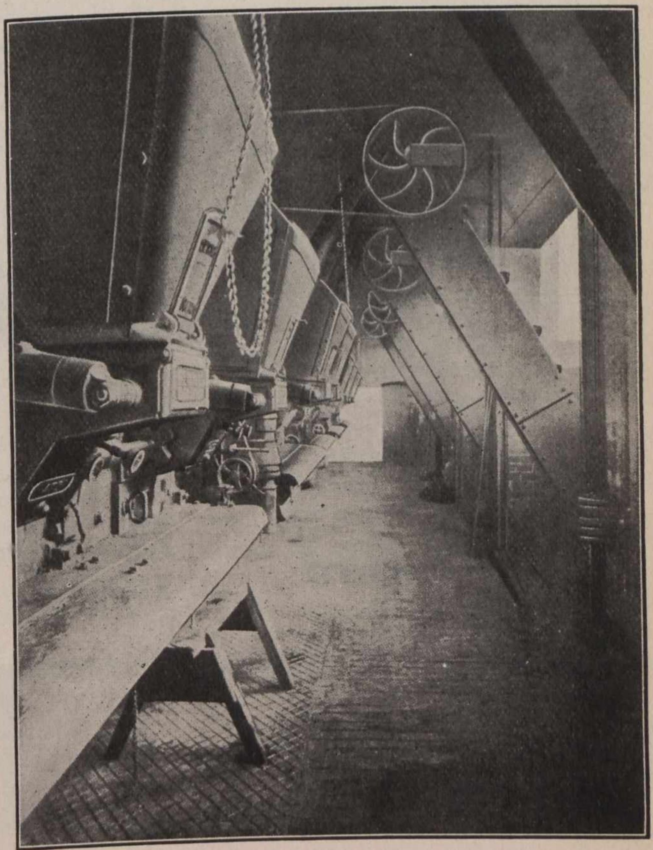
Where valves require direct-current motors larger than can be thrown directly across the line without resistance, such resistance should be designed to give the maximum torque required to open the valve and be retained permanently in circuit. As the motor speeds up, due to a decrease in load, a step of sufficient resistance should be inserted in series with the motor to prevent excessive speed at light load, to slow down the motor as the torque increases near the closing point, and to limit the torque finally should the valve seat itself before the motor is disconnected from the circuit. There are various schemes for obtaining this result with a two-point reversing drum controller or with a pilot switch control in combination with shunt and series-wound contactors. In either case, limit switches should be provided at each end of the travel.

For alternating-current motors the same general scheme can be used, as this type of motor will not increase in speed appreciably with change in load, but the resistance in the stator circuit will also have the effect of limiting the torque in closing the valve.

The limit switches can be designed to handle the motor current instead of the contactor exciting current. For small valves the limit switch is sometimes omitted and the motor allowed to increase its torque to the point of operating an overload circuit-breaker. Such an arrangement, however, is not fool-proof, in that it allows the operator to start the gate in the same direction at the end of its travel.

THE ALEXANDRA (NEWPORT AND SOUTH WALES) DOCKS AND RAILWAY.

The progress of Newport is a record of almost marvellous development and expansion. Newport is to-day the largest and most important town in the county of Monmouth, and it is a great deal more than that. It is one of the busiest and best equipped seaports in Europe, and is, moreover, located in one of the most "growing" districts in the world. Newport is, of course, an important industrial centre, with large ironworks and other manufacturing undertakings. The principal industry is the mining and exporting of coal. In a recently issued booklet on the port and its products, the writer graphically describes the uses to which the famous South Wales and Monmouthshire coal is put. He says: "The battleships of the world are bunkered with coal which has sailed down the Bristol Channel from Newport and her sister ports. This coal has

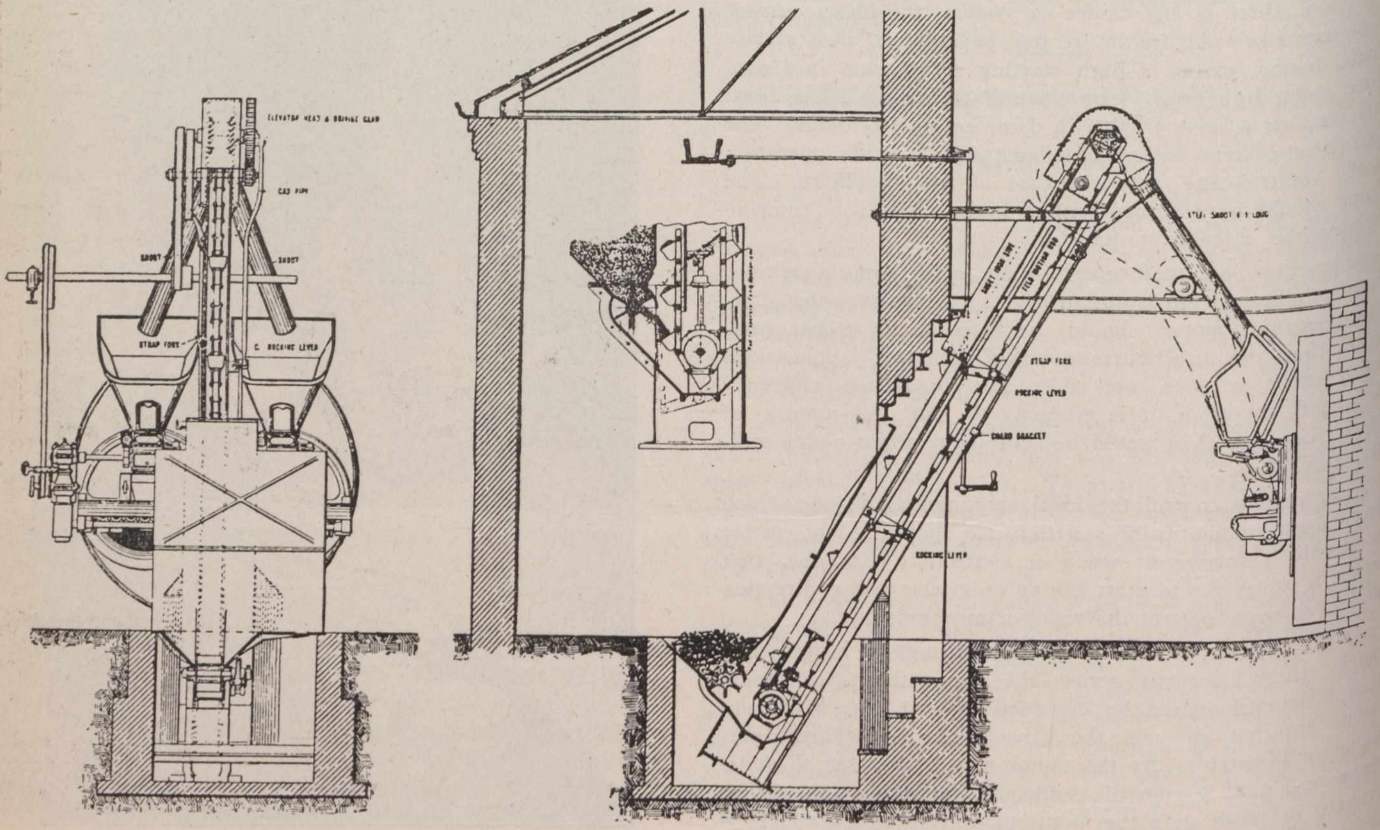


A Range of "Bennis" Stokers in the Boiler-House of the Alexandra Docks, Newport, Monmouthshire, England.

burned in all the naval battles of recent years, has been fired into a warship's furnaces by Royal hands, and has played its all-important part in the records won by leviathan liners."

The story of Newport's progress is worth reading, from the making of the first Newport dock of insignificant dimensions, and intended for coasting traffic, to the present time, when, as an ocean port of first importance, it demands attention and elicits admiration. Since 1905 it has been growing rapidly; 48 acres have been added to the deep water area, and a further 27 acres are waiting the admission of water as soon as the new deep water entrance dock is completed. This lock will be the largest of its kind in the world, measuring 1,000 feet long by 100 feet wide, with a depth of water on the outer cill at high water spring tides of no less than 45 feet, and 35 feet at high water neaps. Everything in connection with the lock will, as might be expected, be on a comparatively colossal scale, including the gates and operating machinery. The completed portion of the dock is 3,700 feet long on the north side, while its maximum width is 1,050 feet. The south side of the dock is occupied by a concrete quay wall, a length of 2,250 feet having been equipped with a number of hydraulic cranes and an extensive transit warehouse, while the north side of the extension is equipped with four fixed coal hoists, erected on four concrete towers. The coal hoist structures rise to a height of about 100 feet above the coping of the piers; have a lift of 60 feet, and are capable of accommodating wagons of a gross weight of 23 tons, while provision has been made in the hydraulic cylinders to enable wagons up to 30 tons gross to be dealt with when required.

It is not intended to give here any detailed description of these huge docks, known as the Alexandra (Newport & South Wales) Docks and Railway. It is desired, however, to indicate the vastness of the undertaking which points to the enterprise of Viscount Tredegar, chairman of the Alexandra Docks Co., John Macaulay, Esq., general manager, and those associated with them in the scheme so ably carried out. As an instance of the care that has been exercised in all departments of the company's works to install only appliances best fitted to produce the desired results, mention must be made of the boiler-house. Steam is, of course, the "raison d'être" of every boiler-house, in spite of the fact that many boiler-house chimneys seem to suggest it is the emission of black smoke. In the boiler-house of the Alexandra Docks Company cheap steam is produced with the regularity of day and night. By cheap steam is implied steam that is manufactured from low-grade, low-price fuels, and that is steady and reliable in output. It must, moreover, be made without smoke. The accompanying illustration shows a range of five Lancashire boilers, fitted with "Bennis" stokers and self-cleaning compressed air furnaces manufactured by Ed. Bennis & Co., Limited, Little Hutton, Bolton, Eng., Canadian representative G. H. Tod, Toronto. The diameter of the flues in three of the boilers is 2 ft. 9 in., and in two of the boilers 2 ft. 11 in. The load carried is that of a hydraulic pumping station. Two tests were carried out here; one prior to the installation of the mechanical stokers, when the boilers were hand-fired; the other when the machines had been fitted. The latter was made on behalf of the Dock Company, by the staff of the British Engine, Boiler & Electrical Insurance Co., Ltd. The stoker-makers were represented. The duration of the tests was 7½ and 8 hours respectively. In the first trial three boilers were used; in the second trial two only were fired. The boilers are identical in design, with a diameter of 7 feet, and a length of 28 feet. The heating surface of each boiler is 823 square feet and the grate area 33 square feet, giving a ratio of heating surface to grate area of 24.94-1. Natural draught was employed in both tests. The fuel used was small Welsh coal, and there was no formation of smoke in either test. The draught at the back of the boiler for the stoker trial was 0.35 in., for the hand-fired trial it was not recorded. In the more recent test no attempt was made to press the boilers to their maximum capacity. One boiler only was kept at full power, while the second was regulated to suit the station load. Had the second boiler been brought up to the level of the first, the consumption of coal per square foot of grate per hour could have been raised to 30 lb., and still have shown good efficiency, with the fuel and draught employed. The comparison of the results of the two tests shows a substantial saving in the coal bill for the mechanical method, as the following statement makes clear. With the stokers the extra water evaporated, as from and at 212° Fah. per boiler per cent. was 84.3. The extra water evaporated, as



Alexandra (Newport and South Wales) Docks and Railway Co.

"Bennis" elevators lifting the coal to the shoots through which the fuel passes into the hoppers of the machine stokers. The elevators work in conjunction with the stokers, each is fitted with a rotary feed which renders choking of the buckets by over-supply impossible, and obviates any wrench from the chain.

from and at 212° Fahr. per pound of coal per cent. was 17.5, and the reduction in fuel costs per 10,000 lb. evaporated per cent. was 14.9. These results have been well maintained in actual practice.

THE DEVELOPMENT OF LOGGING MACHINERY.*

By R. E. Boehck.

Operations, generally known as "logging," are those parts of the lumberman's business connected with the cutting of the trees, their transportation and final delivery at the sawmill. They cease to be logging operations after the tree is in the mill, then the work of the millman begins. In the olden days when cities were few and small, there was little need for large lumber corporations such as exist to-day. Most of the lumber was cut by portable mills, in the following manner.

A small sawmill was rigged up in the forest and trees were cut down near the mill in a radius of perhaps a mile and were drawn to the mill by mules or horses. After a clearing was made, the mill would be taken down and moved along to another place about two miles away where it was again set up; these mills were small and their output no larger than the needs of the country demanded. Larger or stationary mills were, with very few exceptions, placed along the banks of rivers, and then a different method for logging was generally employed. The trees were cut and the logs assembled in various places along the river front. When, for instance, a long slope reached down to the water edge, a landing would be built near the bottom of the embankment and then after the slope has been cleared of trees; it would be used as a natural rollway, the logs being slid down to the landing where they were placed in high piles. This appears to be a very simple operation, but in most cases it was very hazardous and dangerous work. In this way the woods were partially cleared. Near the rivers the yield of timber was good, but further inland only the easy accessible places were worked and in different locations no attempt was made to reach the trees. There was little necessity to spend much time by going far from the river's edge, as timber was plentiful in those days. The mills were located near the river on some natural pond or small lake, which was connected with the river by a small canal. The river near the entrance of the canal was usually "dammed" and the logs coming down the river were guided through the canal into the logpond. There they would lie assembled, ready for use in the mill, sometimes several millions of them, comprising a year's work for a mill of average size.

After a while the logging machine made its appearance. It did not, however, change the method of logging for some time. It was used to replace horses and mules and do the work in less time. A portable hoisting engine was employed, provided with one drum. The engine was "anchored" to the ground, that is, fastened to a nearby tree or stump by means of a cable and the wire cable of the drum was drawn into the woods perhaps a thousand feet by several men, there to be fastened to a tree which had been cut down. Then the operator opened the throttle of the engine and the log was drawn toward it. This type of engine was called the "donkey engine"; it is still in use to some extent by smaller concerns, especially on the Pacific Coast.

The next step in advance was the development of a machine to simplify river logging. A powerful drum, driven by steam, was built and placed upon a barge or scow. The drum would hold perhaps a mile of heavy steel cable. The barge was fastened to the river's edge and the rope drawn into the woods. Several tongs were attached to the end of the cable. These machines would draw several logs at a time. This system has the name of pullboat logging. It increased considerably in value when Baptist cones came into use (which are wrought-iron cone-shaped contrivances, named after the inventor, fitted over the tongs on the end of the pulling rope.) As these cones glide easily over any reasonable obstruction in the way, they prevent the breaking of the cable through a blocking of the logs by obstruction.

Soon it became necessary to make such timberland, situated further away from the river, accessible, as the demand for timber became larger. This was done by the introduction of the logging railroad.

With the laying of tracks through the woods, it became necessary to find some way of loading the logs onto cars. This finally was accomplished when a logloader made its appearance. In the beginning this machine was a single drum affair, very simple and slow in its operation. Like most great inventions, it was lacking final perfection and development. It was placed on the side of the tracks. A location was chosen so that it was not more than a few feet away from a suitable tree, which was to serve as a mast. A cable was strung from the mast, at a height of perhaps 30 to 40 feet across the tracks, to the ground and was there fastened to a stump. This cable formed an incline for a pulley which was operated by the drum of the loading engine. Suspended from the pulley was a pair of tongs or slings which served as a means to fasten the log. This having been done, the pulley and log were hoisted upward on the incline until it was over the car. Then it was guided into place by a man on the car. Occasionally it would roll to the ground and the operation had to be gone through once more. In such a case the position of the man on the car was not enviable. A quick jump off the car to the side opposite that of the falling log was usually the only way out of danger.

A decided improvement in logging is the skidder. It bears this name because it drags or skids the logs on the ground toward the railroad. So far all the pulling out into the woods of the empty cable had to be done by hand or animal power. With a train waiting to be loaded and more logs needed by the mill, a way had to be found to do more work with the logging machine. This was finally accomplished by making a two-drum engine, where a larger drum with a heavy cable hauled in the load while a lighter cable on the other drum drew the empty cable into the woods. To accomplish this operation, a pulley is "shackled" to a tree stump, perhaps a thousand feet or more away from the engine. Over this pulley or sheave the lighter cable passes and is then fastened to the end of the hauling-in-cable. When a log is hauled in, the lighter cable travels along, unwinding from the drum until the log reaches the engine, it is stretched out to the pulley over it, and back to the engine again. After the log has been detached, it is wound up on the drum, pulling the heavy cable out toward the pulley. Then another log is attached to the heavy cable and the operation repeated. It can easily be seen that the lighter cable must be twice as long as the hauling cable.

In order to avoid too many logging railroads, very often a skidding machine is placed near the end of the reach of the first skidder cable, not far from the aforesaid pulley. This machine is generally known as the "yarder." Its duty consists of pulling logs to a place where they can be reached by the skidder, which in turn brings them to the railroad. In this way the line of operation can be extended by adding more yarders and the ground can be cleared from two or three miles on each side of the railroad. This is considered

*A paper presented at a meeting of the American Society of Engineer Draftsmen, held on 16th May, 1912, in New York City and St. Louis, Mo.

a good way, as it limits the number of logging tracks, and, of course, those that must be laid can be kept in better condition.

Still another type of logging machine is termed "Roading Engine." It is very similar to the ground skidder but is built for long hauls. It has exceedingly large drums, the main hauling cable being generally about 4,000 feet long. In using this type of engine, it is necessary to build a road for the logs to travel on. This road is mostly built from small trees, which otherwise have little value. A haul of 4,000 feet takes at the very least fifteen minutes. In order to gain time, the outhaul drum is geared up much faster, thus pulling back the empty cable is accomplished in about one-half of the time.

At this stage much had been accomplished and a great deal of heretofore unworkable timberland was opened. But all these machines were of little use in any place where the logs could not be drawn along the ground, like in swamps and over mountains. Some of our best timber, like cypress, spruce and hemlock, grow almost exclusively in swamps, while others, like pine, oak, etc., grow in rugged mountainous regions; therefore, after considerable experimenting, an entirely new method was introduced. Instead of drawing the logs along the ground, they were lifted high and carried clear of any obstructions toward their goal-line. This is done by the cableway skidder, which consists of a cable suspended between two supports, the headspar, part of or near the skidder, and the tailtree in the woods, from 700 to 1,000 feet away. Upon it travels what is termed the skidding carriage. The main cable, after passing over the tailtree, is fastened to a stump and is its own guy, with a similar arrangement on the headspar end of the cable. Provision is also made to take up the sag in the outstretched cable, either by a block and fall or by a separate drum on the engine. Two drums are required for logging, just as in the case of the ground skidder. The carriage is sent out into the woods, and when the desired log is reached it is attached to a pair of tongs or a sling on the end of the inhaul rope, which passes through a sheave wheel on the carriage. The carriage remains stationary, the outhaul rope holding is in place until the log is hoisted to the necessary height. Then the carriage is drawn in and the log is dropped near the skidder, handy for the loading engine to place on the waiting car. An improvement has been made on this type of skidder in late years, by adding a third drum the slackpulling drum, which takes up the unavoidable slack in the in-and-outhaul cable.

The advantages of such a cableway skidder, setting aside the fact that it is the only machine which can be used in swamps or mountains, are quite numerous, as only one headspar is required. With this as a centre, the ground is cleared at a radius from 750 to 1,000 feet, according to ground conditions and size of main cable employed. The tailtree, of course, has to be changed from time to time. As a rule it is more economical to have two main cables; while one is being used, the other is rigged up for the transfer of the carriage. This takes a few minutes and gives the engine operator time to oil the machinery. As soon as this is done, the logging operation may begin on the new line. While work is carried on there, the first main cable, now not in use, is being set up on another tailtree by a gang of men called the "riggers," and this will be ready for use when the logs along the cable which is in use have been removed. This operation is repeated until a circle around the skidding engine has been cleared, after which the machine is moved along to a new setting. In most cases the machine is permanently placed on a heavy steel car, with swinging axles, and on reaching the point where the setting is to be made, it is raised off the tracks by screw hydraulic jacks, then the axles are turned and the whole car placed on a set of temporary tracks at right angles to those of the logging railroad. In this way the skidding car is rolled off the logging tracks, staying parallel with them, but making room for the logging cars to pass. Thereafter the ropes are carried out and preparations are made for hauling the logs.

Another type sets the skidder high on a structure of either steel or wood, which straddles the track and leaves room for logging cars to pass underneath. This is not moved off sideways, as it is not in the way of cars. It is also provided with a set of jacks, generally four, and when it becomes necessary to move to the next setting, it is raised about six inches by means of the jacks, which leaves just enough room for a specially constructed car to run under. Then it is allowed to settle down on the car, the jacks pull up the remaining supports, and the machine is free from the ground, resting entirely on the car, ready to be moved by the locomotive to the next setting.

With all these developments of the skidder, it became important to improve also the loading apparatus. In other words, a loader had to be designed, capable of loading logs as quickly as they were skidded. If these two machines do not balance each other in efficiency and speed, the merits of one is naturally lost through the incompetence of the other, and therefore the loader had to be brought up to the top notch by various improvements. Several styles of loaders, distinctly different from each other, but equally efficient, are now in use. They have a swinging boom for loading, not unlike that of the well-known derrick. One type is built on a turntable, the boom itself does not raise or lower, it merely swings sideways, picks up a log and then swings back again over the track to the desired location, where the log is dropped.

Barring accidents and under average conditions, one of these modern skidding and loading outfits is capable of bringing from 40,000 to 50,000 feet of timber to the mill each day of ten working hours; higher figures have been reached in favorable territory. A sawmill with a daily capacity of 200,000 board feet of lumber would need four or five of these outfits to keep it supplied with logs at all times. The expense is only felt in the initial outlay, the operating expenses of a skidding plant being considerably lower than with any other method employed, and its advantages over other systems are numerous. By far the most important is the following one—it keeps the logs out of the water and therefore it keeps them clean, and clean logs bring with them a great saving in saws. If we realize that a steel band saw costs about $5,000, we understand what that means to the practical business man. By the old way of dumping the logs into a river, some of the best logs, extremely close fibred hard wood, would not float, but sink to the bottom, there to rot, and fortunes have been lost in this way by many lumber companies.

The conditions under which logging operations are carried on, vary greatly, one system may be well adapted for a certain location, but may be a failure elsewhere. The locality must be studied very carefully, and due consideration must be given to the kind and quality of the timber, the density of the trees, the condition and topography of the ground and what difficulties might arise in building a logging railroad; whether trestles have to be erected or rivers bridged. In some cases we may be confronted by a timber average of 2,500 feet per acre, while another may have 25,000 feet for the same amount of ground. It is clear even to the unexperienced that a very quickly and easily portable outfit must be selected to meet the conditions of the first case stated, as the machine will have to be on the go nearly all the time, not much timber being cut in each setting. Then again in mountains we would employ a different method from that which we would use on level ground or in swampy land. The sawing of lumber is a detail easily arranged for, but the getting of the logs is a problem which requires ingenuity of a different sort. The locomotives must be sufficiently powerful to handle a number of cars, and at the same time not too heavy for the track and grades.

Very recently, in fact only a few months from the date of this writing, the General Electric Company has entered into the logging machine business as a competitor to the manufacturers of the steam engines by building electrically driven apparatus. Already they have installed a few outfits.

MAGNETIC OBSERVATIONS.

The subject of Terrestrial Magnetism has received a great deal of attention within recent years among the civilized countries of the world. Magnetic surveys are being conducted in several countries. The United States have now very complete information over their whole country and are able to publish a fine isogonic map. For some time past we have felt the need of such a map for the district covered by our own work and have received numerous enquiries from others for the same. This office is most advantageously situated to gather this information. Having a large staff of surveyors in the field every year, scattered over a large area, we are able to collect in a short time and at no additional expense a large amount of magnetic information. All surveyors employed by the day are required to take these observations. The magnetic needles now supplied are especially designed for this work and with few exceptions are very sensitive. Through the courtesy of Mr. R. F. Stupart, the director of the Meteorological Service, the compasses are all tested by the officer in charge of the Magnetic Observatory at Agincourt and the index correction determined. Where the needles are found to be anything but first class, a new compass is furnished the surveyor.

In the reduction of the observations to a common epoch we are very much handicapped by the absence of a magnetic observatory in the territory covered by the observations. Two of the staff of this division were placed at widely separated points in the Northwest this past season taking hourly declination readings for a whole month. These observations were afterwards plotted and compared with the daily photographic trace of the declinometer at Agincourt. Investigation of the results appear to show that the reduction of our declination observations by means of the Agincourt records is well worth the trouble, the precision of the resulting declination being apparently increased about two and one-half times. It is realized, however, that this is really not much more than a makeshift, and that what we require for proper reductions are the records of an observatory in the Northwest. This matter is now under consideration by the director of the Meteorological Service, who states that he may possibly be able to establish one there this coming season.

Declination returns for 1910, received to date	987
Previous returns	1,104
Total returns to date	2,091
Declination observations, 1910, for comparison with Agincourt	908
Dip observations, 1910	94
Total force observations, 1910	72

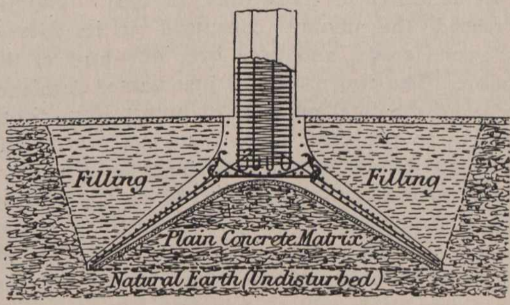
(From the report of the Topographical Surveys Branch, Department of the Interior).

HOLLOW-CONE FOUNDATIONS IN REINFORCED CONCRETE.

A novel method of constructing foundations in reinforced concrete has recently been devised by M. Considère, and described in London Engineering, which, it is claimed, shows considerable economy, both in material and in the cost of construction, over the ordinary methods now in use. The fundamental idea is the formation of a thin cone of reinforced concrete having a base area sufficient to limit the unit load on the ground to whatever figure may be thought desirable, the apex of the cone forming the point of support to the column itself. The amount of excavation for the foundation is also economized, as the earth beneath the cone is not disturbed, but is left roughly in the form of a pyramid. A glance at the illustration will, however, make clear the construction, the method of which is the following:—On the surface of the pyramid formed in the ground a few inches of plain concrete are deposited, and this forms the matrix for the cone of reinforced concrete. The cone is circular in plan, so that the thin covering of concrete has the form of an inverted saucer.

As an example of one of these cone foundations actually completed, one may be selected having on it the exceptionally heavy load of 612 tons in a newly-built boiler-house in France. The allowable pressure on the soil was 5,000 lb. per sq. ft., so that the required base area of the cone was 275 sq. ft., and the diameter 18 ft. 8 in. The angle of the generatrix of the underside of the cone with the horizontal was 30 deg.

It is hardly necessary to say that great care has to be exercised in designing these cones, for the vertical load from the column produces not only a bursting pressure on the cone, which varies in intensity from the apex to the circum-



Sketch Showing Arrangement of Foundation in Place.

ference, and which has to be carried by a proper number of circular rings pitched at varying distances, but, in addition to the primary bursting effect, there is a compression varying also in intensity from the apex downwards, to withstand which the concrete must be of sufficient thickness at each point. Adequate concrete and steel must also be provided to prevent the column from perforating the top of the cone by shearing it through vertically. These considerations, however, do not affect the practical construction, which is simple, no temporary shuttering being required.

It is understood that although the method has been invented and perfected by M. Considère for only a short time, a number of important buildings have already been erected on these foundations, among them being a new dock warehouse at Havre, where the column loads are 195 tons; a boiler-house near Paris, with column loads of 612 tons; and a warehouse at Alexandria, with column loans of from 140 to 180 tons. All the English rights are controlled by the Considère Construction Company, Limited, 5 Victoria Street, Westminster, S.W.

CONSUMPTION OF PULPWOOD.

Over 95 per cent. of Canadian mills cut the pulpwood used by them from their own limits and consequently ross the wood themselves. Hence the given pulpwood consumption refers only to wood manufactured into pulp in Canadian mills, and includes only wood of domestic origin. There are seventeen mills on the lists of the Forestry Branch of the Department of the Interior from which no returns were received in 1910, but in nearly all cases these firms are newly incorporated or are known to be shut down, either temporarily or permanently. The quantity and value of the pulpwood industry, as compiled by Mr. H. R. Macmillan, may be considered a trustworthy estimate.

The fifty-one mills reporting used, in 1910, 598,487 cords of wood. There were exported in a raw state 943,141 cords, and for the first time pulpwood was imported into Canada to the extent of $49,322.

Although 23,642 cords of wood, or 3.8 per cent., less was used in 1910 than the year previous, the average price per cord has increased the value of the pulpwood industry by $121,074 over its value in 1909. The decrease in the quantity is due to the temporary closing of one or two large mills. This year the price of pulpwood recovered from the decline seen in 1909, when the price was only $5.57 per cord, and is about the same as in the year previous. The price was $6.07 in 1908 and in 1910 was $6. In 1910, also, 29,196 more tons of pulp were produced than during 1909, owing to an increase this year of some 145 lbs. in the amount of pulp produced per cord of wood.

Quebec is the premier pulpwood province of Canada because of its extensive spruce and balsam fir forests suitable for pulpwood, abundant and cheap water-power and plentiful supply of labor. The twenty-five mills in Quebec reported the consumption of 57 per cent. of the total for Canada, or 22,820 cords more than in 1909. Ontario likewise increased the amount consumed in its fifteen pulp mills by 23,200 cords, and used over one-third of the total consumption. The two provinces just named furnished over 92 per cent. of the total quantity of pulp. Nova Scotia consumed nearly 20 per cent. more than last year, while New Brunswick used barely one-fifth as much as in 1909. Thus Nova Scotia surpasses New Brunswick as a pulpwood province. New Brunswick in 1909 contributed 14.2 per cent. of the total; this year it was only 2.2 per cent.; this resulted mainly from the closing of one large plant. The province of British Columbia is still experimenting in pulpwood manufacture, and the negligible amount used in this province is for test purposes only.

Quebec is the one province in which the price of pulpwood was less in 1910 than 1909, the price falling off 35 cents per cord. The increase in the price of pulpwood throughout Canada is largely due to Ontario, in which province pulpwood was worth $7.02 per cord, or $1.30 more than during the previous year. Pulpwood was also more expensive this year in Nova Scotia and New Brunswick. Pulpwood from Nova Scotia, at $4.59 per cord, was cheaper than in any other province.

The decrease in the amount of pulpwood used in 1910 chiefly affected the use of spruce—45,800 cords less of this species being used in 1910 than in 1909. Although still over 75 per cent of the total pulpwood consumption, the proportion is gradually becoming less. In 1908 spruce formed 87 per cent. of the total, in 1909 83 per cent., and in 1910 78.6 per cent. The loss is all seen in New Brunswick, in which province 71,000 cords less of spruce was used this year than in 1909.

Balsam fir is a species of wood which is increasing in importance as a pulpwood. In 1910 twenty per cent., or 20,380 cords, more balsam fir was used than in 1909, and it is steadily gaining for itself a higher position among the important pulpwood species. In 1908 it formed 12 per cent. of the total, in 1909 16 per cent., and in 1910 20 per cent.

Another species which is gradually but surely becoming more important is hemlock, over five times as much being used in 1910 as during 1909. Hemlock was reported as a pulpwood for the first time in 1909, and this year it was used to a greater extent than poplar, thus becoming the third species in importance among pulpwoods.

The use of poplar fell off one-quarter, as only 3,608 cords of this wood were used in 1910. Jack pine has not been reported as a pulpwood since 1908. Before that time it was used considerably by two large mills, but has proven unsatisfactory.

The average price of the different species used is the cost to the mill-owner, and so includes varying logging expenses and a wide difference in transportation charges. A considerable proportion of the pulp-mill owners have their own timber limits, and to them the cost of pulp logs is merely the cost of carrying the limit and the transportation charges. Other operators buy in the open market and add transportation charges also.

Thus the prices quoted are the purchase price under different conditions and do not show the relative value of the different woods for pulp manufacture.

The effect of an excessive hauling distance is demonstrated in Ontario, where the price of spruce and balsam fir in 1910 was $7.01 and $7.22 respectively. The high price of balsam fir and the increased demand for this species proves its suitability for manufacture into pulpwood. Spruce was the most expensive species at $6.05, or 64 cents more than in 1909. During 1910 the price of balsam fir fell to the amount of 55 cents, to $5.71. Hemlock remained at about the same price for the two years and is still the cheapest species. In 1909 it was $4.51, and in 1910 $4.43. Poplar has increased 11 cents during the year, the price being $5.92 during 1910. The cheapest pulpwood bought was a small quantity of poplar in Nova Scotia, which cost $3 per cord. Balsam fir in Ontario at $7.22 was the most expensive wood used in Canada for pulping.

During 1910, no slabs nor sawmill waste was reported as being converted in woodpulp. This is an economy practiced in other countries, and by neglecting it Canada is losing greatly. It has been conservatively estimated that if all useful logs left in the bush by lumbermen, large-sized branches, slabs and other mill waste from the lumber industry in Canada had been conserved and converted into pulpwood in 1910, the annual output of pulpwood would have been increased, and not a single acre need have been cut over for logs to make wood-pulp only. During 1909, in the United States, 6 per cent. of the total pulpwood consumption was from slabs and mill waste. If economy had been practiced to the same extent in Canada during the year 1910, as much pulp might have been produced without cutting one additional pulp log as is manufactured from 36,000 cords of wood. This is considerably more pulp than Nova Scotia produced during 1910. The sooner such practical economy and utilization of waste commences, the longer will Canada have an adequate supply of pulpwood.

A PECULIAR ACCIDENT.

It is seldom that a steam engine fails to obey the action of the throttle, yet such was the fate of the steamer "Mildred" which, while approaching the lock gates of the canal at Buckingham, Que., became unmanageable and went over the dam. The water flooded the steamer, the boilers exploded and a cargo of cement was lost.

THE INTERNATIONAL ROADS CONGRESS OF 1913.

The third International Roads Congress will be held in London from Monday, June the 23rd to Saturday, June the 28th, 1913. These congresses will in future be held triennially. The first was held in Paris in 1908, and the second in Brussels in 1910. Their object is to collect, discuss, and circulate all the latest practical and scientific knowledge with regard to the construction and maintenance of highways. The congress of 1913 is held on the invitation of the British Government and is under the patronage of His Majesty King George V. The honorary presidents of the congress are the Right Hon. the Chancellor of the Exchequer and other members of H.M. Government, and the vice-presidents include the Right Hon. the Lord Mayor of London; members of both Houses of Parliament; Chairmen of County Councils; Mayors of Cities and Boroughs; presidents of learned societies, and of associations of local authorities, engineers, automobilists, cyclists, and of other organizations interested in the improvement of the roads. Over thirty Governments have intimated to the British Minister of Foreign Affairs their intention of taking part officially in the congress.

In view of the great advance effected in the methods of road construction and maintenance in recent years by the extension of the use of bituminous binding material, and the numerous experiments that have been made and data accumulated since the last congress, there is no doubt that the discussion of the various questions to be submitted to the congress will make the London meeting a notable event in the history of road engineering.

The two previous congresses aroused great interest among engineers, surveyors, automobilists, and manufacturers of road-making materials throughout the world, and a number of very valuable papers were contributed by the world's leading authorities on various subjects connected with the construction of roads.

Having regard to the rapid development of road construction in Canada these congresses cannot fail to prove of very great benefit and interest to those responsible for the good condition of the public highways in this country, and it is to be hoped that in view of the numerous opportunities for inspection of works and sites in England the number of Canadian delegates and members of the congress will be large.

The congress of next year will receive and consider a number of papers and reports by the leading authorities throughout the world on the maintenance of roads, their foundations and proper drainage, the prevention of dust and mud, the laying of light railways and tramways on roads, the choice of surfacing materials, the influence of weight and speed of vehicles on roads and bridges, the conditions that should be filled by horse or mechanically propelled vehicles in order that they may not damage or suffer damage from the roads, etc.

The chairman of the local Organizing Committee is Sir George S. Gibb, chairman of the Imperial Road Board. Sir Charles D. Rose, Bart., M.P., is treasurer, and Mr. W. Rees Jeffreys (secretary of the Road Board) is honorary secretary.

Excursions have been planned to various places of interest, including Windsor Castle, where His Majesty the King has intimated his intention of entertaining the delegates to afternoon tea. Receptions will be given to the members of the congress by the Lord Mayor and Corporation of the City of London at the Guildhall, by the committee of the Royal Automobile Club in their palatial premises in Pall Mall, and by the Institution of Civil Engineers in their new premises which they are now building at Westminster.

An exhibition of road machinery, materials and appliances used in road construction is being organized in connection with the congress, and in view of the fact that a very large attendance of foreign delegates is expected, in addition to engineers and surveyors from all parts of the United Kingdom, the exhibition will, it is expected, prove of great practical commercial value.

Membership of the congress is open to all, the individual membership subscription being £1, and that for associate members, i.e., wives and children, is 8/4.

Either of these subscriptions entitles the member to take part in all excursions and entertainments connected with the congress, whilst the full membership subscription entitles the subscriber, in addition to taking part in the proceedings of the congress, to receive the daily agenda published during the congress and a copy of the full report of the discussions and decisions, in addition to the complete set of the various papers on different subjects sent in by the members. As these papers comprise reports by leading authorities in all parts of the world, of experiments and recent data obtained in road engineering, etc., they are therefore of the highest value and interest.

Mr. W. Rees Jeffreys, the honorary secretary, is now in America endeavoring to secure a large attendance of engineers from this side. He arrived in New York on June 4th, and after spending a couple of weeks in the principal cities of the United States, will arrive in Toronto on June 27th. While in Canada he will visit Niagara Falls, Ottawa, Montreal and Quebec.

ENGINEERING OPPORTUNITY IN CHINA.

Rev Dr. T. E. Egerton Shore has received a cablegram from Dr. O. L. Kilborn in Chengtu, China, capital of the province of Szechwan, west China, asking that a teacher in mining engineering be secured for the Chinese Government School in Chengtu. This teacher will be supported by the Provincial Government at a salary of $2,100 (gold), together with traveling expenses each way—the salary to date from the time of arrival in Chengtu and the contract to be for a period of one year, with the probability of its extension beyond that time.

The cablegram states that this teacher is required at once and that a splendid opportunity presents itself from the standpoint of Christian influence in a government institute.

Dr. Shore will be glad to hear from anyone who may be interested in this opportunity. His address is the Methodist Mission Rooms, 33 Richmond Street West, Toronto.

THE LJUNGSTROM STEAM TURBINE.

The Ljungström turbine is the latest development in the field of steam turbines of the reaction type. As described in Engineering of London, it consists essentially of a radial flow machine. The steam is admitted between two disks, and in its passage from the centre to the circumference it passes between concentric blading rings carried alternately by the two disks. In the usual design both disks revolve, driving their shafts at equal speeds. To each shaft is coupled an electric generator. Since the relative speed of the blade is twice as great as in the standard reaction turbine of equal diameter and peripheral speed, equal efficiency may be obtained with only one-quarter as many rows of blades. Since there is no long casing with fixed blading, the risk of distortion trouble is largely eliminated. This also permits an almost unlimited degree of superheat, which, together with the reduction of gland and other losses, tends to give the machine a high efficiency.

PERSONAL.

MR. J. RUSSELL ELLIS has been appointed to the position of assistant engineer for the municipality of Regina.

MR. S. D. EGAN, of Toronto, has been appointed to the position of superintendent of the municipal railway system of Regina.

MR. W. H. ELSON has been appointed superintendent of two of the interurban divisions of the British Columbia Electric Railway, Limited, Vancouver, B.C.

MR. J. B. RANNIE has been appointed traffic agent of the British Columbia Electric Railway, Limited, Vancouver, B.C., in charge of the company's system in Vancouver and suburbs.

MR. ALLAN PURVIS has been appointed manager of the interurban lines of the British Columbia Electric Railway, Limited, Vancouver, B.C. The position of local manager of interurban divisions has been abolished.

COMING MEETINGS.

AMERICAN WATER WORKS ASSOCIATION.—June 3rd 8th. Annual Convention at Louisville, Ky. Secy., J. M. Diven, 271 River St., Troy, N.Y.

CANADIAN ELECTRICAL ASSOCIATION.—June 19th-21st. Annual meeting at Ottawa, Ont. Sec'y, T. S. Young, 220 King St. West, Toronto, Ont.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.—June 26th-28th. Annual meeting at Boston, Mass. Sec'y, H. H. Norris, Cornell University, Ithica, N.Y.

ONTARIO MUNICIPAL ASSOCIATION.—Annual convention will be held in the City Hall, Toronto, on June 18th and 19th, 1912. Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ont.

THE UNION OF CANADIAN MUNICIPALITIES.—August 27, 28 and 29. Meeting at City Hall, Windsor, Ont. Hon. Secretary-Treasurer, W. D. Lighthall, K.C.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Second Annual Meeting to be held in Toronto, Sept. 16, 17 and 18.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE: Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, S. J. Chapleau, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings,

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving: Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, W. Alan, Kennedy; Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre; Address P.O. Box 1290.

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-jack; Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION.—President, Chas. Hopewell, Mayor, Ottawa; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson, Sask.

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta. · Secy-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President, W. Sanford Evans, Mayor of Winnipeg; Hon. Secretary-Treasurer, W. D. Lighthall, K.C., Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secy-Treasurer, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, Mayor Mitchell, Calgary.; Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALTIES.—President, Reeve Forke, Pipestone, Man.; Secy-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang; Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler, Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewit, General Manager Consumers' Gas Company, Toronto; J. Keillor, Secretary-Treasurer, Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President, J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. A. E. Barlow, Montreal; Secretary. H. Mortimer Lamb, Windsor Hotel, Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary, James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto, President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa; Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp; Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5. Beaver Hall Square, Montreal.

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WESTERN CANADA IRRIGATION ASSOCIATION.—President, Wm. Pierce, Calgary; Secretary-Treasurer, John T. Hall, Brandon, Man.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary, W. H. Rosevear, 115 Phœnix Block, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc.
Printed forms for the purpose will be furnished upon application.

PLANS AND SPECIFICATIONS ON FILE.

The following Plans (P.) and Specifications (S.) are on file for reference only unless otherwise noted at the office of The Canadian Engineer, 62 Church Street, Toronto:—

Bids close		Noted in issue of
6-10	Electrical equipment, Vernon, B.C. ....(S.)	5-16
6-17	Electric Generating Station Equipment, Bassano, Alta. ....(S.)	5-30
6-10	Cement sidewalks, Maple Creek, Sask. (P & S.).	5-30

(Vernon specifications are on file at The Canadian Engineer Offices, Winnipeg and Montreal; Mather, Yuill & Company, Limited, Consulting Engineers, Vancouver, B.C.)

(Bassano specifications also on file at the office of The Canadian Engineer, Montreal, and the Engineers, Messrs. Bowring & Logan, 322 Donald St., Winnipeg).

(Maple Creek plans and specifications on file at The Canadian Engineer Office, Winnipeg, Man.)

TENDERS PENDING.

In Addition to Those in this Issue.

Further information may be had from the issues of The Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Bassano, Alta., electric generating machinery	June 17.	May 30.	74
Berlin, Ont., waterworks improvements	......	May 23.	72
Edmonton, Alta., pile wharf	June 17.	May 23.	60
Fredericton, N.B., wharf	June 6.	May 16.	60
Lethbridge, Alta., paving	June 14.	May 30.	61
Moose Jaw, Sask., light standards	June 14.	May 30.	62
Moose Jaw, Sask., retaining wall and sidewalks, Collegiate Institute	June 5.	May 16.	60
Maple Creek, Sask., sidewalks	June 10.	May 30.	74
Newmarket, Ont., school building	June 15.	May 30.	62
Oshawa, Ont., concrete sidewalks	June 8.	May 30.	72
Ottawa, Ont., station and other buildings	June 14.	May 30.	72
Ottawa, Ont., dredging Murray Canal	June 5.	May 30.	62
Ottawa, Ont., coaling stations	May 31.	May 9.	72
Ottawa, Ont., mail contract	June 21.	May 23.	76
Ottawa Ont., designs for monument	Oct. 1.	Apr. 18.	60
Ottawa, Ont., fishing protection vessel	June 17.	Apr. 18.	74
Ottawa, Ont., design and construction of steamship	June 30.	May 16.	76
Port of Quebec, Que., proposals for drydock	July 2.	Apr. 18.	60
Point Grey, B.C., plans for university	July 31.	Feb. 7.	60
Quebec, Que., leasing of waterpowers	June 26.	May 2.	72
Saskatoon, Sask., garbage incinerator	June 25.	May 2.	74
St. Catharines, Ont., S. S. building	June 10.	June 30.	62
Toronto, Ont., cribs; retaining wall	June 5.	May 30.	74
Toronto, Ont., bridge construction	June 8.	May 30.	74
Toronto, Ont., concrete abutments	June 8.	May 30.	74
Tisdale, Sask., storm water sewers	June 15.	May 30.	62
Toronto, Ont., bridge construction	June 6.	May 23.	72
Toronto, Ont., concrete abutments	June 5.	May 23.	72
Toronto, Ont., concrete breakwater	June 6.	May 23.	72
Vancouver, B.C., bridge construction	July 8.	May 30.	74
Vernon, B.C., electrical equipment	June 10.	May 16.	72
Vernon, B.C., cast-iron pipe	June 10.	May 23.	60
Vernon, B.C., valves and hydrants	June 10.	May 23.	60

TENDERS.

Battleford, Sask.—Tenders for the installation of a steam heating system for the Battleford Town Hall, will be received up to noon of June 10th, 1912. Plans and specifications can be seen at the Builders' Exchange, Winnipeg and Saskatoon, and at the office of J. P. Marshall, secretary-treasurer, Battleford.

Brantford, Ont.—Tenders will be received until noon of June 15th, 1912, for the furnishing of about 6,000 feet of reinforced concrete sewer pipe, varying in size from 30 inches to 45 inches. Specifications may be seen at the office of the City Engineer. T. Harry Jones, City Engineer, Brantford. (See advt. in The Canadian Engineer).

Kerrisdale, B.C.—Tenders for the supply of about 8 miles of steel pipes, varying in diameter from 4 to 18 inches, will be received until June 24th, 1912, by H. Floyd, Clerk Municipal Council, Kerrisdale, B.C. Particulars may be obtained at the office of the engineers, Cleveland and Cameron, 506 Winch Building, Vancouver.

Lachute, Que.—Tenders for the construction of an iron bridge over the North River, in the parish of St. Jerusalem, County of Argenteuil, will be received until June 10th, 1912. Plans and specifications can be examined in the office of J. E. Valois, secretary-treasurer, municipality of the council of the parish of St. Jerusalem, Lachute, Que.

Lawrenceville, Que.—Tenders for the construction of an iron bridge over the black river in the village of Lawrenceville, Que., will be received until the 15th of June, 1912. Plans and specifications can be examined at the office of Zoel Gervais, secretary-treasurer. municipality of village of Lawrenceville, Que., at which place tenders will be received.

Ottawa, Ont.—Tenders will be received up to noon of July 3rd, 1912, for the purchase of the Canadian Government steamer "Kestrel." Full particulars may be obtained from the Officer in Charge, H.M.C. Dockyard, Esquimalt, B.C. G. J. Desbarats, Deputy-Minister, Department of the Naval Service, Ottawa. (See advt. in The Canadian Engineer).

Ottawa, Ont.—Tenders for the construction of a public building at Kemptville, Ont., will be received at the Department of Public Works, Ottawa, until June 13th, 1912. Plans, etc., can be obtained at the post office, Kemptville, and at the Department, R. C. Desrochers, secretary.

Ottawa, Ont.—Tenders for the construction of a post office building at Maisonneuve, Que., will be received at the office of R. C. Desrochers, Secretary, Department of Public Works, Ottawa, until Monday, June 17th, 1912. Plans, etc., may be obtained on application at the office of Mr. C. A. Reeves, architect, 58 St. James Street, Montreal, and at the post office, Maisonneuve; also at the Department of Public Works, Ottawa.

Ottawa, Ont.—The Department of Public Works, Ottawa, will receive tenders until June 5th, 1912, for interior fittings, post office, Mount Forest, Ont. Plans, etc., to be seen on application to Mr. J. Hunter, Clerk of Works, Mount Forest, Ont.; Mr. T. A. Hastings, Clerk of Works, Postal Station F, Toronto, and at the Department of Public Works, Ottawa.

Ottawa, Ont.—Tenders will be received up till noon of Wednesday, July 17th, 1912, for industrial sites situate on an island lying east of the village of Caughnawaga, and joined to the mainland by the embankment of the Canadian Pacific Railway, and adjacent to the city of Montreal, containing 61.4 acres. Full information may be obtained upon application to Lorenzo Letournear, Assistant Indian Agent, St. Constant, Que., or to J. D. McLean, Assistant Deputy and Secretary, Department of Indian Affairs, Ottawa.

Ottawa, Ont.—Tenders for dredging required at Yarmouth, in the Province of Nova Scotia, will be received up to June 13th, by R. C. Desrochers, Secretary, Department of Public Works, Ottawa. Specifications can be obtained on application to the secretary.

Ottawa, Ont.—Tenders for the construction of a breakwater wharf at Carr's Brook, Colchester County, N.S., will be received by the Secretary of the Department of Public Works, Ottawa, until June 27th, 1912. Plans, etc., can be obtained at the Department and at the offices of H. A. Russell, Esq., District Engineer, Halifax, N.S.; E. G. Millidge, Esq., District Engineer, Antigonish, N.S., and on application to the Postmaster at Carr's Brook, N.S.

Ottawa, Ont.—Tenders for the construction of a pile bent wharf at Boswell, Division of Nelson, Kootenay District, B.C., will be received until July 2nd, 1912. Plans, etc., at the offices of G. A. Keefer, Esq., District Engineer, New Westminster, B.C.; on application to the Postmaster at Victoria, B.C., and the office of R. C. Desrochers, Secretary, Department of Public Works, Ottawa.

Ottawa, Ont.—Tenders for the construction of a drill hall at Gananoque, Ont., will be received by the Director of Contracts, Department of Militia and Defence, Ottawa, up to noon of June 22nd, 1912. Full particulars may be obtained at the offices of the Officer Commanding the 8th Field Battery, Gananoque, Ont.; the Officer Commanding the 3rd Division, Kingston, Ont., and the Director of Engineer Services, Department of Militia and Defence, Ottawa.

Port Arthur, Ont.—Tenders for paving on Cumberland and Algoma Streets will be received until June 24th, 1912. Further information, as to plans, etc., may be obtained from the City Engineer. J. J. Hackney, Commissioner Utilities, Corporation Offices, Port Arthur. (See advt. in The Canadian Engineer).

Regina, Sask.—Tenders will be received until noon of June 14th, 1912, for the supply of about 350 tons of reinforcing steed bars, 145 tons of R. I. joists, 6,000 barrels of Portland cement, and castings for the proposed Torhill Reservoir. Plans, etc., may be obtained from R. O. Wynne-Roberts, Consulting Engineer, Regina. (See advt. in The Canadian Engineer).

Regina, Sask.—Tenders for the construction of Torhill reinforced concrete circular reservoir and for works incidental thereto, will be received up to noon of June 21st, 1912. Plans, etc., may be obtained from R. O. Wynne-Roberts, Consulting Engineer, Regina. (See advt. in The Canadian Engineer).

Regina, Sask.—Tenders will be received up to June 15th, 1912, for the erection of a four-room brick school building at Buchanan, Sask. Plans may be secured from Messrs. Storey and Van Egmond, architects, Regina; and from H. P. Albert Hermanson, secretary-treasurer, Buchanan School District, Sask.

St. Thomas, Ont.—Tenders for the construction of sewers and for the supply of sewer pipe, will be received until June 19th, 1912. Specifications and plans can be seen at the office of the City Engineer. (See advt. in The Canadian Engineer).

Toronto, Ont.—Tenders for the terra cotta work, fireproofing and roofing of the new Government House, Chorley Park, Rosedale, Toronto, will be received up to noon of Monday, June 10th, 1912. Plans and specifications can be seen at the Department of Public Works, Toronto. H. F. McNaughten, secretary.

Toronto, Ont.—Tenders for steam heating, etc., in connection with the main drainage pumping station will be received up to noon of Tuesday, June 18th, 1912. Plans and specifications may be seen at the office of the City Architect, City Hall, Toronto. G. R. Geary, (Mayor), Chairman Board of Control, City Hall, Toronto.

Vancouver, B.C.—Tenders for the supply of the following pipe will be received until June 12th, 1912:—

10,000 ft. 24-in. inside measurement, steel pipe, 3-16 plate.
30,000 ft. 24-in. inside measurement, steel pipe, ¼ plate.
10,000 ft. 24-in. inside measurement, steel pipe, 5-16 plate.
4,000 ft. 18-in. inside measurement, flexible joint cast-iron pipe. Plans and specifications can be obtained at the office of Messrs. Hermon & Burwell, Rm. 12, Inns. of Court, or at the office of James Stuart, Esq., City Purchasing Agent, City Hall, Vancouver.

Vancouver, B.C.—Tenders for the supply of 10,000 feet of 24-in. steel pipe and 4,000 feet of 18-in. flexible joint C.I. pipe will be received up to noon of June 12th, 1912, by James Stuart, City Purchasing Agent. Plans and specifications to be seen at the office of Messrs .Hermon & Burwell, Inns. of Court Building.

Victoria, B.C.—Tenders for the erection and completion of a large one-room schoolhouse at Diamond Crossing, in the Newcastle Electoral District, B.C., will be received up to noon of June 12th, 1912. J. E. Griffith, Public Works Engineer, Department of Public Works, Victoria.

Winnipeg, Man.—Tenders will be received up to noon of June 10th, 1912, for the construction of a Normal School in the city of Brandon. Plans, etc., may be seen at the office of the Provincial Architect, 261 Fort Street, Winnipeg, or on application to W. H. Shillinglaw, Esq., Brandon. R. P. Roblin, Acting Minister of Public Works, Winnipeg.

CONTRACTS AWARDED.

Brandon, Man.—Messrs. Geo. H. Archibald Co., Ltd., Winnipeg, are the contractors for the rebuilding of the Maple Leaf Milling Company's elevator, which was destroyed a short time ago by fire. The elevator will have a capacity of 120,000 bushels.

Calgary, Alta.—Contracts have been awarded for six new schools to be built in the city, the total cost of which will be \$335,500. The following are the names of the builders to which each particular contract has been awarded: Sunalta school awarded to Doyle and Thomas, to cost \$124,000; school on the Ramsey estate to T. R. Yeager, to cost \$124,000; addition to the Victoria to J. A. McPhail, \$63,000; Park Hill, J. A. McPhail, \$15,500; two cottage schools awarded to H. Lougheed and H. Church, respectively.

Edmonds, B.C.—The contract for the extension to the high level reservoir on Capitol Hill, from which the entire water supply of the municipality is to be drawn, was awarded to Messrs. A. L. Olts & Co., of Vancouver, at \$11,045.92; and the contract for the low level reservoir in D. L. 158, to supply River Road and South Burnaby generally, was let to G. H. Webster, of Vancouver, at \$13,062.50.

Fredericton, N.B.—The Messrs. McVay have received the contract for the construction of an arch culvert over Lane's Creek, Carleton County. They have also secured the contract for the building of a new school building of concrete blocks at St. Andrews, the contract price being about \$25,000.

Fredericton, N.B.—Contracts were awarded by the Quebec Contracting Company to sub-contractors for twenty-one miles of the work on the Saint John Valley Railway between Fredericton and Woodstock. The contracts are for the clearing, grubbing and grading, and are awarded as follows:—

To L. B. Smith and E. L. Merrithew, from mile 7 to 16½.
To Collins, Labelle & Prey, from mile 16½ to 20.
To W. and C. R. MacDonald, from mile 27 to 32.
To J. A. Wheaton & Son, St. John, from mile 32 to 35.

The contract for the construction of the fencing and telegraph lines between Fredericton and Woodstock has been awarded to T. R. Campbell, of Salisbury.

Fredericton, N.B.—Contracts for the construction and equipment of the Palmer-McLellan Shoepack Company's plant have been signed and calls for the expenditure of about \$35,000. The John Palmer Company are also commencing operations for the construction of their new plant near the Hartt Boot & Shoe Company's factory.

Kerrisdale, B.C.—The Kerrisdale and Magee districts sewerage contracts has been awarded to Messrs. McLean & Co., at \$156,000.

Barrett Specification Roofs

On the "Concrete City."

IN the illustration below, the Turner Construction Company of New York, has brought together in a scale drawing an accurate representation of most of the important modern concrete buildings which they have erected during the past nine years, at an approximate cost of $12,000,000.

It is an imposing display of best types of modern construction—"*a concrete city*" indeed—scientifically designed for maximum service at minimum cost and minimum maintenance.

It is significant that 95 per cent. of the entire roof area is covered with the Barrett Specification type of roofing. The figures are as follows:

Barrett Specification type of roofs	1,490,523 sq. feet
Plastic Roofings	14,714 sq. feet
Slate Roofings	21,640 sq. feet
Tile Roofings	5,619 sq. feet
Ready Roofings	38,381 sq. feet
Copper Roofings	6,355 sq. feet
All other kinds	7,448 sq. feet

It is important to remember that while all these buildings were constructed by the Turner Construction Company, the specifications were drawn by a large number of architects and engineers.

Barrett Specification Roofs were almost unanimously selected for one reason only, namely that they would give *better* service at *lower cost*, than any other roof covering.

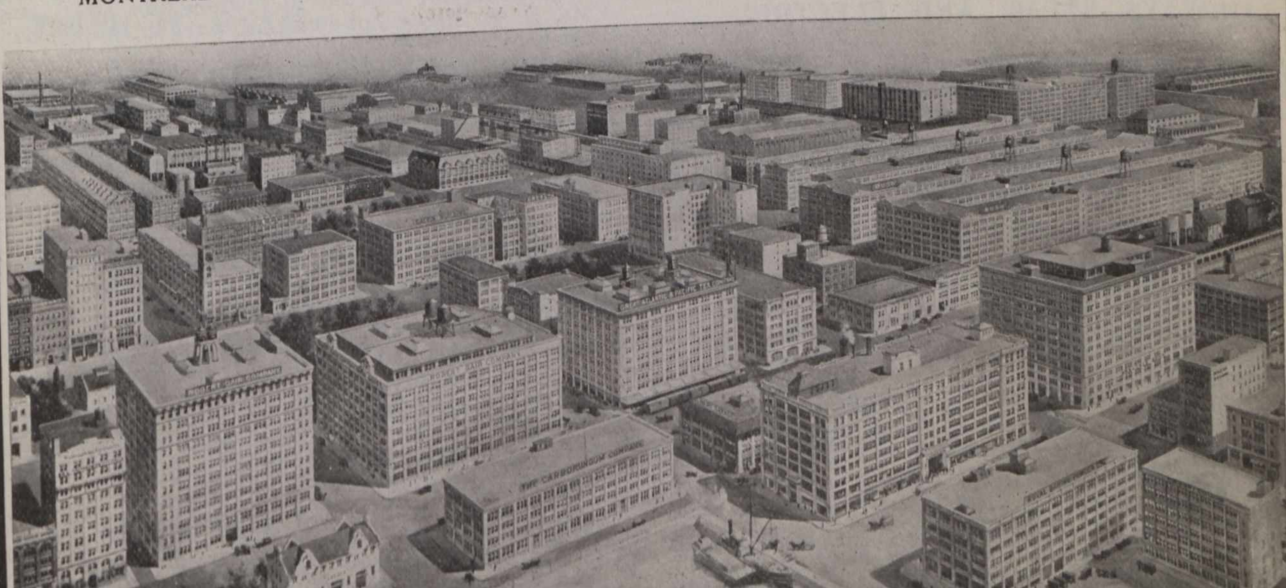
Barrett Specification Roofs require no painting or similar attention—in other words, there are no maintenance costs. They will last upwards of 20 years without any care.

The superior economy of Barrett Specification Roofs justifies their adoption not only on big first-class concrete buildings, but on every flat roofed building from a tenement to a skyscraper—from a small mill to a modern manufacturing plant costing millions. But be sure it's a real Barrett Specification Roof. The only way to be sure is to incorporate The Barrett Specification in full in your plans.

Copy of The Barrett Specification free on request. Address our nearest office.

THE PATERSON MANUFACTURING CO., LIMITED

MONTREAL TORONTO WINNIPEG VANCOUVER ST. JOHN, N.B. HALIFAX, N.S.



Kincardine, Ont.—At a meeting of the County Road and Bridge Committee at Port Elgin, it was decided to award the contract for the reconstruction of the Denny's Bridge to Messrs. Hunter Bridge & Boiler Company, of Kincardine, their price being $7,800.

Newcastle, N.B.—The contract for the construction of the new Court House has been awarded to Messrs. John McDonald and Henry Ingraham, whose joint tenders was for $31,000, which includes wiring and plumbing.

Stratford, Ont.—The Stratford Bridge and Iron Company have been awarded the contract by the County Councils of Wellington and Grey, for the steel work of O'Dwyer's bridge at $1,875.

Toronto, Ont.—Messrs. J. E. Webb Co., General Contractors, Fisher Street, Toronto, have been awarded the contract for the building of the St. Lawrence Starch Factory at Port Credit. Main building is 480 x 100; five stories; brick stack, 150 ft. high; size inside of flue is 8 ft. square. The materials used are brick, concrete and steel.

Vancouver, B.C.—Messrs. Waterhouse, Church & Kerr, New York, have secured the contract for building the new Canadian Pacific Railway depot at Vancouver. It will cost $1,400,000. The company will also build a tunnel in the downtown section to relieve the conjestion of traffic. Railway crossings will be abolished and overhead bridges built, the whole involving a total of several million dollars.

Vancouver, B.C.—The Canadian Pacific Railway has awarded to Culletin Bros., of Spokane, a contract for the construction of ten miles of the east coast division of the E. & N. Railway, on Vancouver Island. Their work will extend north from McBride Junction near Nanaimo. Another ten-mile section from Courtenay south, in the direction of Campbell River, was recently let to Mr. C. E. Hoard, of Victoria. Between this contract and the Culletin work is a gap of sixty miles, the construction of which will likely be undertaken later in the year.

Vancouver, B.C.—Messrs. Kelling & Co., have been awarded the contract for heating four schools in this city, the tender submitted being $26,500.

Vernon, B.C.—The contract for the construction of approximately 50,000 feet of combined sidewalk and curb, has been awarded to Messrs. B. C. Craintoid, Ltd., of Vancouver, for $13,394.50.

Walkerton, Ont.—The Saugeen Electric Light and Power Company, and the Walkerton Light and Power Company, have awarded the contracts for the repairs on the Southampton dam, and also on the one at Walkerton, both of which were put out of commission by the spring floods. The weir at Southampton is to be completed in ten weeks, and the one here within three months. The owners of both dams are Messrs. Robertson and Roland, of Walkerton. The probable loss at Walkerton is about $10,000, and at Southampton $5,000.

RAILWAYS—STEAM AND ELECTRIC.

Saskatoon, Sask.—The municipal council have decided to present a by-law calling for the construction of a street railway to the ratepayers for decision. The Stone and Webster Engineering Corporation have made an offer to construct the line and finance the same for the period of twelve months in exchange for civic bonds to the value of $500,000.

LIGHT, HEAT AND POWER

Barrie, Ont.—The ratepayers voted in favor of the hydro-electric by-law which called for an expenditure of $7,000.

Kingston, Ont.—Mr. R. S. Kelch, of Montreal, is preparing a report for the municipal council on the power question, and will have the same ready for presentation in the course of a few days.

Moose Jaw, Sask.—The city of Moose Jaw has accepted the proferred assistance of Saskatoon, and the council have asked for the plans of Saskatoon's new power house. R. M. Thompson, who was responsible for the plans of the new building, will go into the matter there with the city council of Moose Jaw. Meantime with the assistance of machinery supplied by the Robin Hood Milling Co., of that city, a limited amount of power is being obtained to give the city a partial water supply, and to care for the absolute necessities requiring electrical power. It is understood that the city will go ahead at once with the construction of a new power plant.

Scotstown, P.Q.—The power plant of this municipality was swept away when a dam belonging to the Emberton Lumber Company gave way.

GARBAGE, SEWAGE AND WATER.

Berlin, Ont.—The ratepayers will be asked to vote on a proposed expenditure of $100,000 on a new sewage system. Mr. Peiper is chairman of the Municipal Sewage Committee.

Exeter, Ont.—The ratepayers voted in favor of spending the sum of $5,000 for improvements of the sewage system.

Fort William, Ont.—Mr. T. Aird Murray has recommended that a new 24-inch main be constructed immediately to the reservoir. The cost of this will be about $75,000. Other improvements to the water supply which he has suggested will cause an expenditure of about $350,000 if carried out as he has planned.

Moose Jaw, Sask.—A large pump, the property of the Saskatchewan Flour Mills, has been installed in the pit of the old power plant and is giving a satisfactory service. The supply is being taken from the Moose Jaw River and forced through the filter beds before entering the mains.

Simcoe, Ont.—The ratepayers voted their approval to the expenditure of $36,000 for a sewage system.

Vancouver, B.C.—The Municipal Board of Works received tenders for the construction of lateral sewers on Twelfth, Thirteenth, Fourteenth and Fifteenth in the vicinity of Oak and Yukon Streets, as follows:—

Romano Pinto & Co.	$31,500.00
LaPlaca Brothers	22,479.00
Ledingham & Cooper	32,746.00
McGarry Company	29,000.00
Kennedy Brothers	28,849.00
D. A. Anderson	22,778.95
David Timiro	21,097.80
Bruce & Ford	39,900.00

The tenders were all referred to the City Engineer for report.

BUILDINGS AND INDUSTRIAL WORKS.

Calgary, Alta.—Applications for the erection of three apartment houses are being considered by the municipal architect. The owners of the buildings are Mr. George Calhoun, Mr. J. W. Dafoe, and Messrs. Scott and Hartfront. The total cost of these buildings will be about $140,000.

Creston, B.C.—The Canyon City Lumber are making arrangements for a plant to manufacture small fruit boxes. Mr. D. W. Briggs, of Portland, Oregon, is president of this company.

Fort William, Ont.—The management of the Benson Starch Works of Edwardsburg, are considering the erection of a plant on Island No. 2 near this city.

Fort William, Ont.—The management of the Great Wire Fence Company of Winnipeg, have opened negotiations with the Industrial Bureau that may end in the erection of a plant in this city.

Hamilton, Ont.—The Steel Castings Syndicate will erect a $300,000 plant in this city. C. W. Sherman, of Buffalo, N.Y., is the manager of this new concern.

Lethbridge, Alta.—Messrs. C. Roy Strotz & Company, of Winnipeg, have had preliminary work commenced in the matter of erecting a factory in this city.

Moose Jaw, Sask.—The plans of the proposed Young Women's Christian Association Building, show a four-story building of brick and stone.

Port Arthur, Ont.—A report states that certain interests are making preparation for the erection of a ten-story office building.

Saskatoon, Sask.—The management of the Queen's Hotel have had plans prepared for alterations which will make their building five stories in height.

Sherbrooke, Que.—The Jenckes Machine Company have decided to enlarge their plant. The additions consist of a ma-

chine shop, 300 x 50 ft., and a boiler shop 300 x 60 ft. It was announced some time ago that one new shop would be built, but the company has now decided to build two shops.

Stratford, Ont.—The management of the R. M. Ballantyne Company have approved plans which will enlarge the present factory to double capacity.

Toronto, Ont.—Messrs. H. P. Eckardt & Co. will erect a six story warehouse at a cost of $75,000.

Toronto, Ont.—There is a probability of the congregation of the Kew Beach Presbyterian Church erecting a new church building or enlarging the present structure.

Waterloo, Ont.—The ratepayers voted in favor of a by-law granting a loan of $10,000 to Chas. Kreutzger, for the erection of a box factory.

Welland, Ont.—The management of the Welland Machine & Foundries are preparing plans for an enlargement of their plant.

Welland, Ont.—Plans are prepared for extensive additions to the Page Hersey pipe mills, consisting of a large addition to the tube plant and the construction of a pattern shop and a pattern storage building.

West Toronto, Ont.—The management of the Russell Motor Car Company have had plans prepared for the erection of a four story machine shop, 170 x 60. The cost of this work is estimated at $100,000.

West Toronto, Ont.—The management of the Canada Foundry are erecting a plant for the manufacture of ornamental iron work.

Weyburn, Sask.—The Saskatchewan Creamery Company has had plans prepared for the erection of their plant.

BRIDGES, ROADS AND PAVEMENTS.

Barrie, Ont.—The ratepayers voted in favor of spending the sum of $25,000 on the construction of permanent roadways.

Greenfield Park, P.Q.—The council of this municipality, which is near Montreal, will co-operate with the parish of Longueuil in the construction of a permanent highway under the Good Roads Act.

Ottawa, Ont.—The Deputy-Minister of Railways and Canals, Mr. A. W. Campbell, has suggested that the Ottawa East bridge be removed, should a new structure be erected across the canal.

Trail, B.C.—The new steel bridge erected across the Columbia River at this point has been finished, and is now open to the public. This bridge is a portion of the highway now being constructed to Christina Lake, and when this is completed a very fine scenic district will be open to tourists.

Vancouver, B.C.—The Board of Works received tenders for street paving as follows: wood block pavement on Cambie Street, Robson to Smythe:—

Romano Pinto & Co.	$7,900
LaPlaca Brothers	7,867
B. C. Granitoid Company	8,113
McAdam Construction Company	7,400
Delbridge & Peterson	7,510
Ledingham & Cooper	7,994
T. R. Nickson & Co.	8,150

Wood block pavement on Homer Street, R[illegible] Smythe:—

McAdam Construction Company	$43,000
Delbridge & Peterson	43,545
Ledingham & Cooper	46,279
T. R. Nickson & Co.	44,125
LaPlaca Brothers	46,673
Romano, Pinto & Co.	45,650
British Columbia Granitoid Company	46,447

Stone block pavement, lane east of Granville Street from Davie to Pacific:—

T. R. Nickson & Co.	$10,901
Ledingham & Cooper	10,290
B. C. Granitoid Company	[illegible]
LaPlaca Brothers	10,208
Romano Pinto & Co	10,440

The City Engineer will report on these.

Windsor, Ont.—The ratepayers endorsed the by-laws calling for the expenditure of $30,000 for new sidewalks and $1,700 for the erection of a new public lavatory.

FIRES.

Moose Jaw, Sask.—The municipal power house was destroyed by fire. The property is valued at $242,587.

Saskatoon, Sask.—A fire which broke out in the offices of the telephone exchange caused considerable financial loss to the telephone company.

Wainwright, Alta.—$75,000 damage was caused to the business section of this town by fire.

CURRENT NEWS.

Bassano, Alta.—An order has been placed from Calgary for 60 miles of pipe to be used in conveying natural gas from the wells at Bow Island to the city. It is expected that the gas will be available in the city about July 1st.

Eastern Canada.—The Commissioners of the St. John and Quebec Railway have purchased a motor boat and an automobile for the use of the surveying parties working on the lines of this railway.

Medicine Hat, Alta.—The municipal Engineering department have completed plans for a subway to be constructed under Toronto Street, and the council are giving the matter serious consideration. The Board of Works will consult with the officials of the Canadian Pacific Railway in the matter.

Red Deer, Alta.—The ratepayers will vote on a by-law calling for the expenditure of certain sums to provide a motor combination wagon fire hose and other fire fighting equipment.

Toronto, Ont.—The municipal Hydro-Electric Department have opened a store in the business section of the city for the purpose of demonstrating electrical appliances for use on the current supplied by the city.

TRADE ENQUIRIES.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending May 18th, 1912:—

A London firm who specialize in certain paint oils desire to appoint Canadian agents. A member of the firm will be in Montreal and Toronto in June, and could interview interested parties.

A Liverpool firm desire to be placed in communication with Canadian manufacturers of lump charcoal.

A Glasgow firm would like to hear from Canadian buyers of pumice stone and pumice powder.

A Scottish correspondent is in the market for supplies of clean tin cuttings such as are produced in die stamping from sheet tin.

A London firm make inquiry for the name of the Canadian manufacturer of "Ontario" cotton duck.

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending May 24th, 1912:—

A Birmingham firm of consulting and inspecting engineers are open to act for Canadian firms who may be placing orders in Great Britain for machinery and engineering appliances generally.

The Hamburg branch of a London merchant firm desire to get into touch with Canadian bran shippers, especially those represented in Europe.

A Hamburg firm desires to import linseed from Canada, and would like to hear from shippers in the Dominion.

From the branch for City Trade Inquiries, 73 Basinghall Street, E.C.:—

A North of England company manufacturing ready-made bungalows and other buildings wish to extend their trade to Canada.

A London firm of chemical merchants ask to be placed in touch with Canadian manufacturers of acetic acid, of which they seek supplies. They are also interested in acetone, and any other chemical products suitable for the English market.

A London company who are in the market for supplies of white enamelled cornice poles, and also of rings, and ball and spear ends to suit, invite samples and quotations from Canadian manufacturers.

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.

16477—May 9—Directing G.T.R. to within 90 days from date of Order install improved type of electric bell at crossings of Ontario and Erie Sts., Stratford, Ont., 20 per cent. from Railway Grade Crossing Fund.

16478—May 9—Approving location of Algoma Eastern Ry. Station at Espanola, in Twp. of Merritt, Ont. Rescinding Order 16426, April 12, 1912.

16479—May 10—Directing that in Canadian Freight Classification the following articles be transferred from their present positions to the second-class rating applicable to "Musical Instruments List," and that they be also included in the "Musical instruments, all kinds, not otherwise specified, carloads, minimum 12,000 pounds," namely: gramaphones graphophones, phonographs, records; application, Berliner Gramophone Co., Montreal, Que.

16480—May 7—Approving location of G.T.P. Ry. station to be erected at mileage 119 east of Prince Rupert, B.C.

16481—May 8—16482—May 10—Granting certificates to G.T.P. B.L. Co. correcting errors in right-of-way plans Biggar-Calgary Branch, etc.

16483—May 8—Approving location of Algoma Central and H.B. Rys. terminal station at Sault Ste. Marie, Ontario.

16484—May 9—Authorizing C.N.O. Ry. to cross two highways in Twps. of Clarendon and Litchfield, County Pontiac, Que.

16485—May 9—Authorizing C.N.R. to cross and divert highways in city of Moose Jaw, Sask.

16486—May 8—Approving location of James Bay & Eastern Ry. (C.N.R.) station grounds at St. Prime, Que.

16487—May 10—Approving location of Kettle Valley Ry. Co. from mileage 65 to 76, northwest of Midway, B.C.

16488—May 6—Authorizing C.P.R. to take lands for purpose of diverting Scarlett Rd. and St. Claire Ave., Toronto, Ont.

16489—May 8—Extending until Oct. 16, 1912, time for completion by C.P.R. of siding for city of Moose Jaw, Sask., authorized by Order 15115, Oct. 16th, 1911.

16490—May 9—16491—May 7—Authorizing Campbellford, Lake Ont. & Western Ry. (C.P.R.) to construct its Glen Tay to Cobourg Line at mileage 24.8 from Glen Tay, across tracks of Kingston and Pembroke Ry., interlocking plant to be installed; and at mileage 88.09 over tracks of Central Ontario Ry. in town of Trenton, Ont., by overhead structure.

16492—May 6—Approving location of G.T.P. B.L. Co. station at mileage 25, Cutknife Branch, Saskatchewan.

16493—May 7—Relieving C.P.R. from further protecting crossing third west of Kemptville Jct., Ontario.

16494—May 2—Appointing William Barrett, Judge of the County Court of County of Bruce, Referee, to fix amount of damages sustained by claimants re overflow of Saugeen River caused by bridge of Walkerton & Lucknow Ry. Co. (C.P.R.) at Walkerton, Ont.

16495—May 10—Relieving Vancouver, Victoria & Eastern Ry. from erecting and maintaining fences from Laurier to Danville, B.C.

16496—May 11—Authorizing C.P.R. to construct spur for Cockshutt Plow Co., Ltd., at Regina, Sask.

16497—May 10—Directing that no cars be allowed to stand on any siding within at least 50 ft. of crossing of C.P.R. at Neepawa, Manitoba.

16498—May 10—Approving revised location of G.T.P. B.L. Co. station grounds at Bashaw, Alberta.

16499—April 13—Authorizing G.T.P. Ry. to construct "wye" in Sec. 5, Twp. 42, Range 24, west 3rd M., at mileage 600, Sask.

16500—May 11—Authorizing Midland Ry. of Canada (G.N.R.) to join its industrial spur tracks with industrial spur of C.P.R. leading to works of Canada Malting Co., Ltd., Winnipeg.

16501—May 10—Directing Brandon, Sask., and H. B. Ry. (G.N.R.) to construct transfer track to connect with C.N.R. at Minto, Manitoba.

16502—May 11—Authorizing C.P.R. to construct 5 branch lines or spurs for the Dryden Timber & Power Co., Ltd., Dryden, Ont.

16503—May 13—Directing that G.T.P. Ry. be subject to a penalty of $100 per day from date of this Order that work required by Order No 15735 of January 2nd, 1912, remains uncompleted.

16504—May 13—Extending time for commencement of construction of subway until June 15th, 1912, by city of Montreal, over C.P.R. at Park Ave. Order 16359, April 23, 1912.

16505—May 13—Approving revised location of G.T.P. B.L. Co. Regina-Moose Jaw Branch, mileage 0 to 2.1, Saskatchewan.

16506—May 13—Extending for 30 days from date of this Order time for completion of siding authorized by Order 15317, Nov. 10th, 1911, G.T.R.

16507—May 13—Approving Victoria & Sidney (G.N.R.) Ry.'s Std. Freight Tariff of Maximum Tolls in British Columbia.

16508—May 13—Authorizing C.N.R. to construct bridge across Bow River on its Calgary-Vegreville Extension.

16509-10—May 13—Approving revised location of C.N.O. Ry. (Ottawa-Capreel Line) through Twp. of Field, Dist. of Nipissing, mileage 254.53 to 256.2 from Ottawa; and C.N.O. Ry. (Sudbury-Port Arthur Line) through unsurveyed territory in the Dist. of Thunder Bay, mileage 399.21 to 404.46, from Sudbury Junction.

16511—May 11—Authorizing C.N.O. Ry. to cross 6 public roads in Twp. of Foley and McDougall, Ontario.

16512—May 13—Authorizing C.P.R. to construct spur for W. T. Rawleigh Medican Co., Winnipeg, Manitoba.

16513—May 10—Enjoining C.N.R. from interfering with road allowance authorized by Order 14440, July 28, 1911, and to drain borrow pits within 30 days, under penalty of $10 per day, on farm of David Hay, Kinnoull, Alberta.

16514—May 14—Naming delivery of city of Kelowna, B.C. (Express).

16515—May 11—Authorizing G.T.P. B.L. Co. to construct its Tofield-Calgary Branch across highway at mileage 30.

16516—April 10—Approving location of Campbellford, Lake Ontario & Western Ry. (C.P.R.), Glen Tay to Cobourg line, from mileage 58.5 to 68.

16517—May 11—Authorizing C.P.R. to construct spur for Eddy Bros. & Co., Ltd., at Blind River, Ontario.

16518—May 13—Directing that no car or locomotive be allowed to stand on siding, crossing King St., or at Nipissing St., within 50 ft. each way, at Sturgeon Falls, Ont., C.P.R.

16519—May 13—Directing C.P.R. to within 90 days from date of this order install electric bell at Wilson Street, about 1 mile north of Perth Station, Ontario; 20 per cent. from Railway Grade Crossing Fund.

16520—May 15—Restraining C.N.R. and Midland Rly. Co., (G.N.R.), under penalty of $100 after May 20, 1912, from carrying out any provisions of agreement prior to its sanction by the Governor-in-Council upon recommendation of the Board. Re operating of trains of the Midland and G.N.R. Co.'s from International Boundary to Winnipeg, Man., over C.N.R.

16521—May 13—Authorizing municipality of Cap de la Magdeleine to construct highway over C.P.R. at Boulevard Forget.

16522—May 14—Authorizing C.N.O. Ry. to cross by overhead structure public road between Lots 10 and 11, Con. 2, Ottawa, Front, Twp. Nepean, Ont.

16523—May 13—Approving location of C.P.R. station at Springside, Sask.

16524—May 13—Relieving C.P.R. from further protection of crossing at North Glencoe, Windsor Subdivision, Ont.

16525—May 14—Refusing application of K. and P. Ry. for approval of plans, etc., of Godfrey Station, Ontario.

16526—May 14—Directing that C.P.R. construct farm crossing pending completion of public crossing for John Brill, of Boulder and Harry Sawyer, of Revelstoke, B.C.

16527—May 15—Approving Standard plan for 20-foot arch of St. John & Quebec Rly. Co.

16528—May 15—Approving G.T.P. Standard Freight Mileage Tariff, C.R.C., No. 9, to apply from Prince Rupert east, 170 miles, to Carnaby, B.C.

16529—May 15—Extending until 1st September, 1912, time for installation of interlocking plant near Chaudiere Jct., by C.N.R., near Ottawa, Ont.

16530—May 15—16531—May 14—Authorizing C.N.O. Ry. to construct bridge over Duchesney Creek, in Twp. of Commanda, Dist. of Nipissing, and across Little Sturgeon River, Twp. of Beaucage, District of Nipissing, mileage 243.5 from Ottawa.

16532—May 13—Approving location of Campbellford, Lake Ontario and Western Ry. (C.P.R.) at mileage 79.5 from Glen Tay to westerly boundary of town of Trenton, Ont.

16533—May 14—Approving location of C.P.R. station at Jaffray, B.C.

16534—May 15—16535—May 14—Authorizing C.P.R. to reconstruct Red River Bridge, Winnipeg Terminals, and bridge 57.1 on its Cascade Subdivision, B.C.

16536—May 14—Directing C.P.R. to within 90 days to install electric bell at crossing 1¼ miles west of Claremont, Ont. 20 per cent. from Railway Grade Crossing Fund.

16537—May 17—Approving changes and alterations in vicinity of Dufferin Bridge in the city of Ottawa, by C.P.R.

16538—May 17—Authorizing G.T.R. to construct spur for British Canadian Canners, Ltd., Bowmanville, Ontario.

16539—May 15—Authorizing C.P.R. to construct two spurs for Western Canada Flour Mills Co., town of Goderich, Ont.

16540—May 17—Authorizing Guelph Radial Ry. to cross C.P.R. on York Road, Guelph, Ont.

16541—May 17—Directing G.T.R. to within 90 days install electric bell in village of Lynden, Ont. 20 per cent. from Railway Crossing Fund.

16542-43—May 18—Authorizing C.P.R. to reconstruct bridge No. 5.7 on Kippawa Subdivision, Lake Superior Division, and to use and operate bridges 10.4 and 36.5, Farnham, S.D.

16544—May 15—Approving location of Windsor, Essex & Lake Shore Railways new siding, freight shed and station at Essex, Ont.

16545-46—May 18—Authorizing G.T.R. to construct siding for Bechtels, Ltd., near Waterloo, Ont., and for St. Lawrence Starch Co., Ltd., at Port Credit, Ont.

16547—May 20—Authorizing C.P.R. to construct spur for Ontario Rock Co., Ltd., Twp. of Belmont, Ct. Peterboro, Ont.

16548—May 20—Authorizing C.P.R. to reconstruct bridge 94.8, Moose Jaw, S.D. Rescinding Order 15687, December 27, 1911.

16549-50—May 20—Recommending to the Governor-in-Council agreements between C.N.R. and Midland Rly. Co., of Manitoba, (G.N.R.), for operation as joint section from International Boundary to Woodward Avenue, Winnipeg, Man., and permitting above-named companies to operate joint section for thirty days from date when if not approved by Governor-in-Council permission shall cease.

16551—May 20—Approving location of Central Railway Co. of Canada from C.P.R. line near McAlpine station at mileage 7.2 to G.T.R. line near South Indian Station at mileage 38.165, County of Russell, Ontario.

16552—May 21—Authorizing Joseph Battle, Thorold, Ont., to construct chute underneath G.T.R., Stuart St. Station Yd., Hamilton.

16553—May 20—Directing G.T.R. to install electric bell at crossing of 3rd Con. in Twp. of Stamford, Ont. 20 per cent. from Railway Grade Crossing Fund, to be installed by Aug. 1st, 1912.

16554—May 20—Approving location of Kettle Valley Ry. Co., from mileage 4.80 to 19.56, and 19.56 to 38.99, west of Penticton, B.C.

16555—May 20—Authorizing Vancouver & Lulu Island Ry. (C.P.R.), to construct second track across 11 roads and streets in municipality of Point Grey, Province of British Columbia.

16556—May 17—Refusing application of Canadian Press, Ltd., requiring G.N.W. and Western Union Tel. Co., to provide special tolls for press service similar to C.P.R., and directing C.P.R., G.N.W., and Western Union to restore the rate of 25c. per 100 words for "Press Specials" in the Maritime Provinces, effective by 17th June, 1912.

16557—May 21—Authorizing G.T.R., G.B. & S. Ry. (C.P.R.), and C.N.O.R. to operate trains over interlocking plant at Atherley Jct. without stopping account interlocker completed.

16558—May 20—Approving express collection and delivery limits for town of Grand Falls, N.B.

16559—May 20—Directing G.T.P. B.L. Co. to place crossing on Mr. E. D. Sworder's property at Balcarres, Sask., in proper condition for tram traffic; penalty, $25 after June 30th, 1912.

16560—May 21—Authorizing C.P.R. to divert Government Road on its Waldo Branch at mileage 9.92, British Columbia.

16561—May 20—Authorizing C.P.R. to reconstruct bridges 66.77, 19.7 and No 6 on Cartier, S.D., Havelock, S.D., and on Orford Mountain Branch, Eastern Division.

16562—May 21—Authorizing James Bay & Eastern Ry. (C.N.R.) to construct bridge across River a l'Ours, in Township of Ashuapmouchouan, County of Lake St. John, Que.

16563—May 20—Approving location of C.N.Q. Ry. station and baggage room at 16 Island Lake, Ct. Argenteuil, Que.