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The Canadian Engineer

A weekly paper for engineers and engineering-contractors

GIANT DREDGES IN TORONTO HARBOR

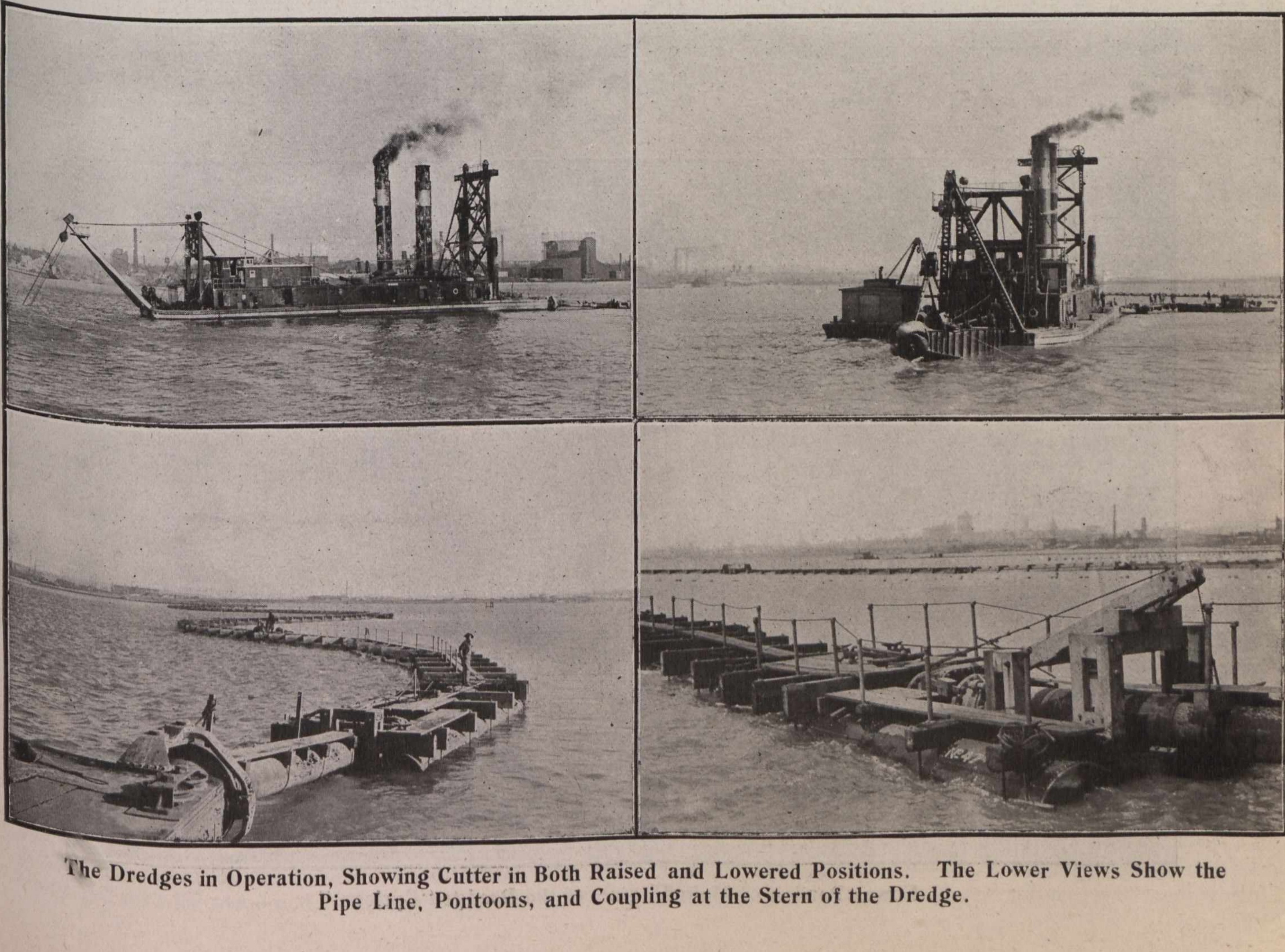
DESCRIPTION OF THE "CYCLONE" AND "TORNADO," SPECIALLY CONSTRUCTED BY THE CANADIAN STEWART COMPANY, LIMITED, FOR TORONTO HARBOR AND WATERFRONT DEVELOPMENT CONTRACTS.

THE Canadian Stewart Company, Limited, have contracts amounting to over $11,000,000 for the development of the harbor and waterfront at Toronto, under the direction of the Toronto Harbor Commissioners and the Dominion Government. One of these contracts involves the entire portion of the work undertaken by the Department of Public Works for Canada and amounts in round figures to four and one-half million dollars; the other contract is with the Toronto Harbor Commissioners and involves dredging in Toronto Bay and Lake for reclamation for new industrial and park areas to the extent of thirty-two million cubic yards. The land to be reclaimed and developed aggregates upwards of 1,200 acres.

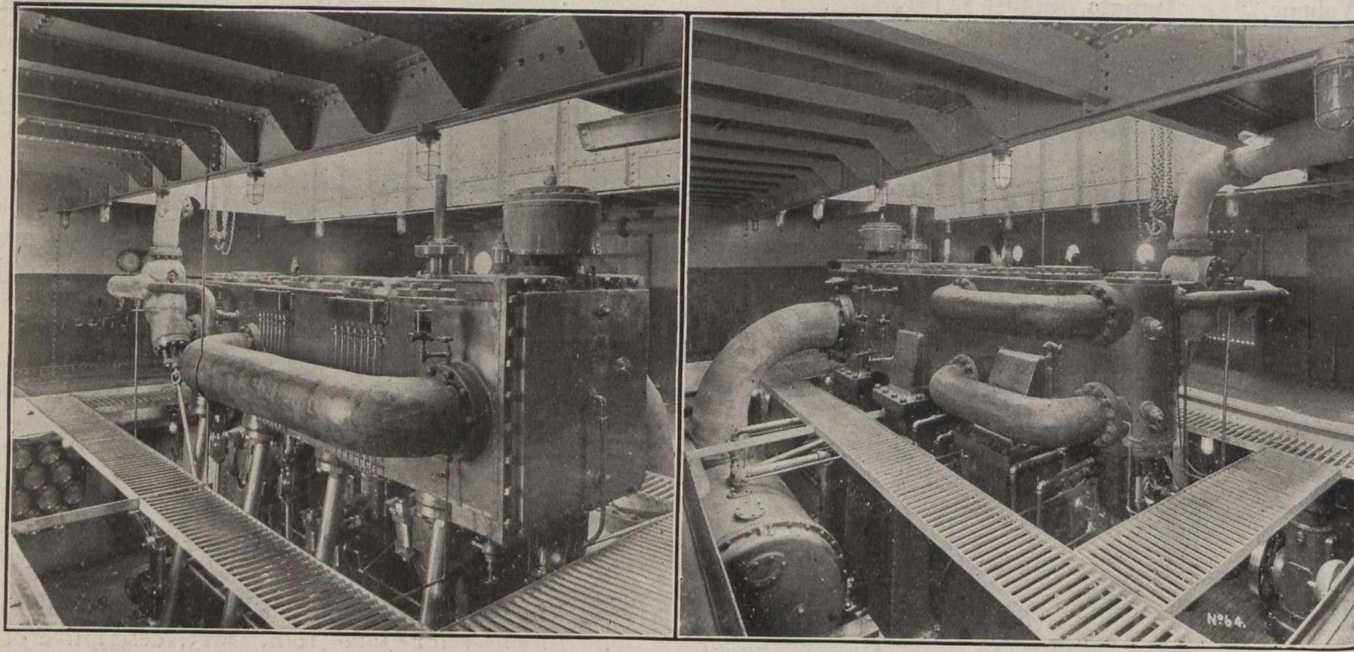
Reference to the article which appeared in *The Canadian Engineer* for June 10th, 1915, descriptive of the progress made up to that time on the $25,000,000 scheme, will enable the reader to acquire a better conception of the magnitude of these contracts.

The dredging work is being done by the company on a unit price basis.

The contractors have constructed especially for this harbor work two hydraulic dredges which surpass in capacity any of their kind in existence. This capacity is



The Dredges in Operation, Showing Cutter in Both Raised and Lowered Positions. The Lower Views Show the Pipe Line, Pontoons, and Coupling at the Stern of the Dredge.

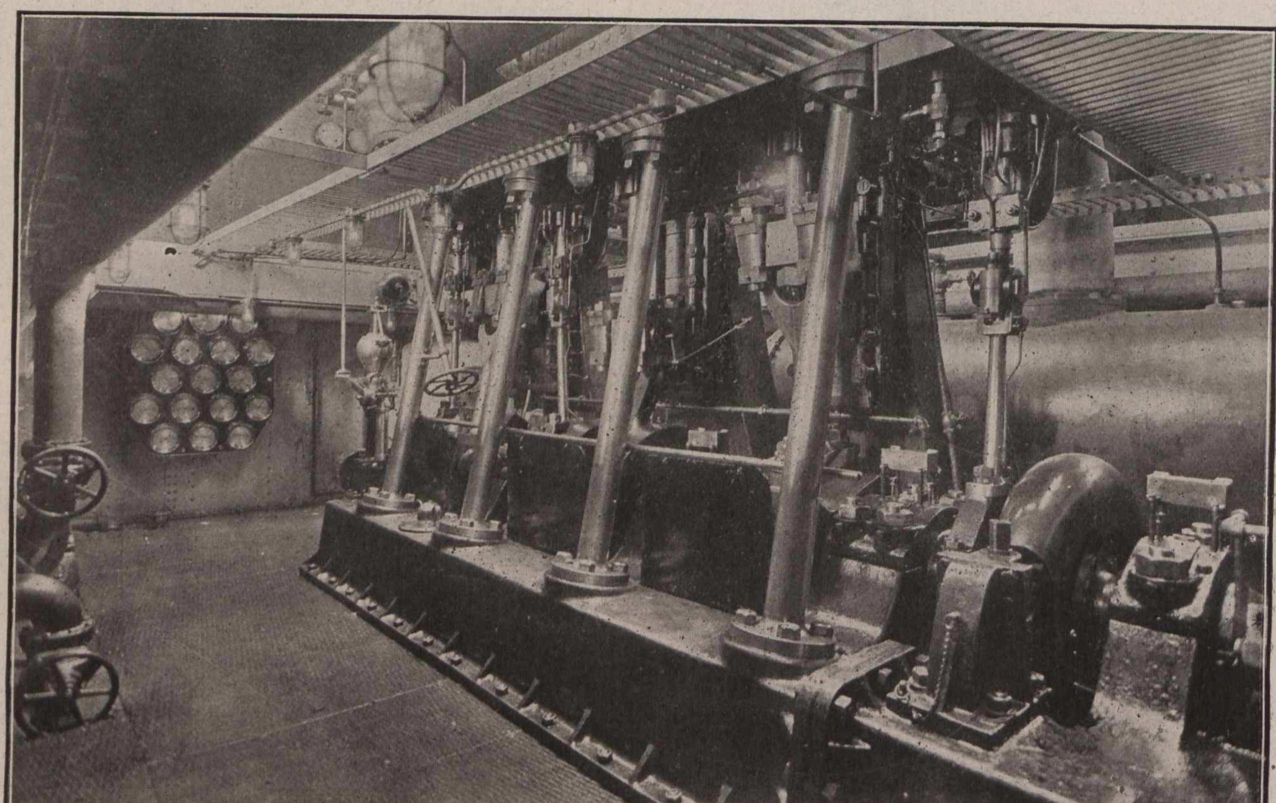


Front and Rear Views of Steam Chest of Main Engine—1,750 Indicated h.p.

well illustrated by the operations of the "Cyclone" during the month of June, which averaged 1,300 cubic yards of material per hour for the entire month, depositing at an average distance from the point of suction of one-half mile.

Both dredges being identical in design and equipment the following description applies equally to each. The illustrations here shown are of the "Cyclone," which started working November 7th, 1914, and is now engaged on the reclamation of the industrial area at the east end of Toronto Harbor. The "Tornado" was not completed in time to participate in last season's operations, but started work on May 10th, 1915, and is now engaged on reclamation of the park lands on the western portion of the development, near the mouth of the Humber River.

The hulls and deck houses on each dredge are constructed of steel and were built by the Polson Iron Works, Limited, at Toronto. The hulls are 170 feet in length, have a beam of 42 feet with a maximum depth of 12 feet 4 inches at the centre and mean draft of 7 feet; they have seven watertight compartments, besides which each of the pump rooms, engine room, boiler room and spare coal



Lower Portion of Main Engine of the Dredge "Cyclone."

bunkers are so constructed as to make them individually watertight so that any leak, burst or other trouble, which might occur, can be localized to the room in which such trouble develops. These hulls have a registered displacement of 1,550 gross tons.

On the front of each dredge is hung the ladder, 87 feet in length overall, weighing complete 120 tons and so constructed as to dig to a depth of 50 feet, at which depth the ladder makes an angle of 37 degrees with the horizontal.

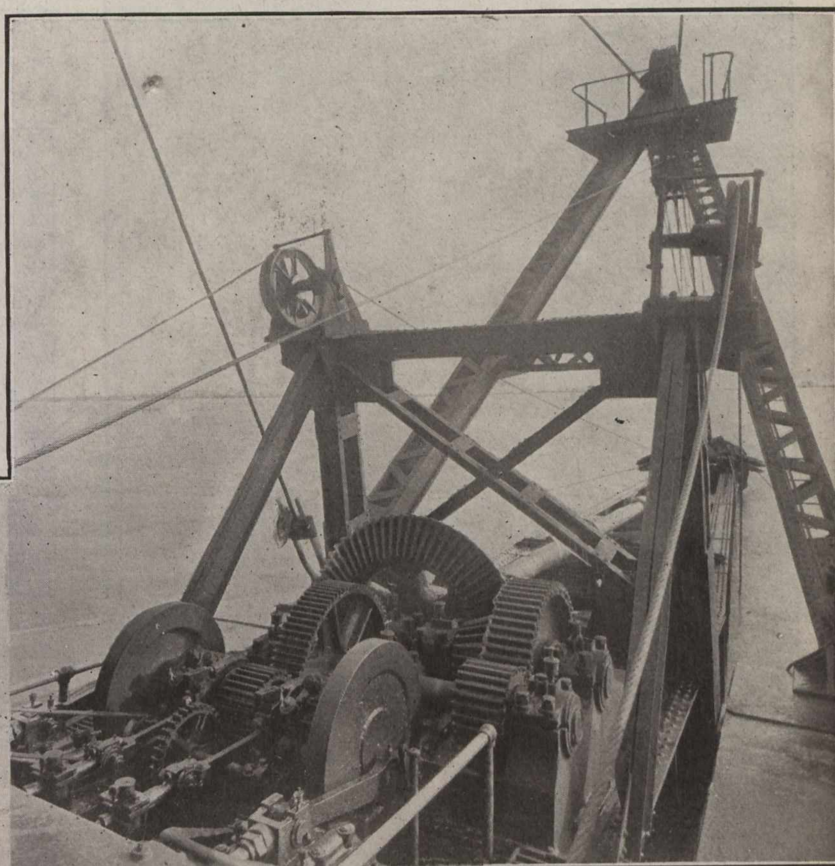
On the upper deck, immediately aft of the ladder is located the lever room from which the entire machinery of this floating industry is operated by the means of 21 levers, and by speaking tube and bells to the main engine room.

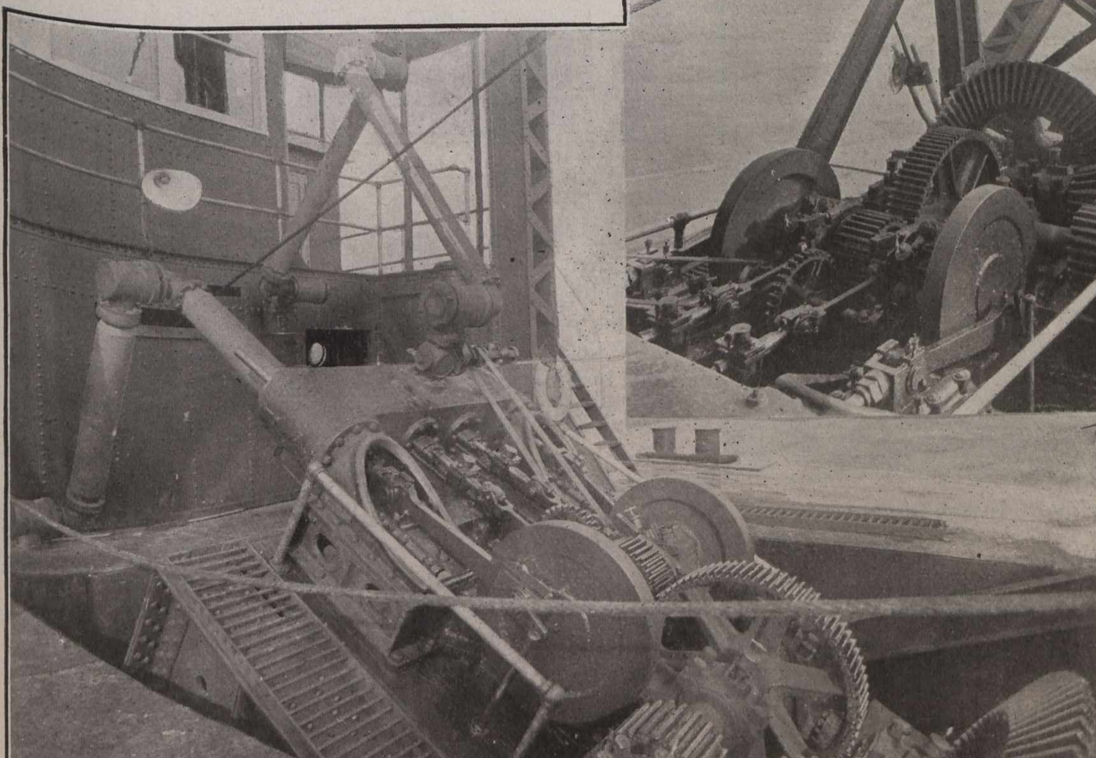
Immediately below the lever room is the pump room wherein is located the engine and three cable drums used for swinging the dredge and raising the ladder. This equipment is on the main deck and at the forward end of the pump room aft of the swinging engine, etc., and resting on the bottom of the boat is the main centrifugal pump 12 feet in height overall, which turns an impeller having a periphery speed of one mile per minute. The diameter of the pump runner is 96 inches.

Immediately aft of the pump room is located the engine room. The engine was built by the New York Ship Building Company, is a triple expansion, the diameter of the cylinders being 18¼, 28 and 46 inches, with stroke of 20¼ inches operating at rate of 225 revolutions per minute and has indicated horse-power of 1,750. The low-pressure cylinder is equipped with a Lufkin assistant cylinder for operating the valve. The engine is directly connected with the pump and is of the type generally used in the United States torpedo boats, as are the four Babcock & Wilcox marine type boilers. Three of these boilers are required for the operation of the dredge, leaving the fourth for reserve. The boiler room is also equipped with an hydraulic ash ejector. The boiler room is immediately aft of the engine room.

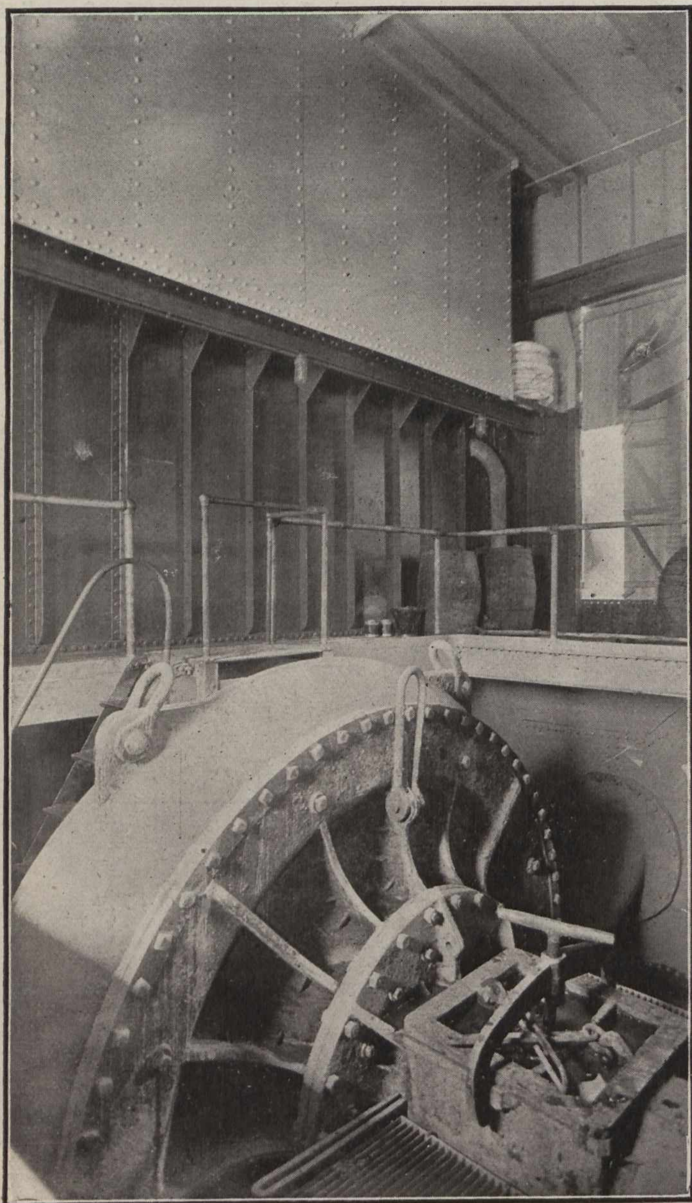
In addition to the main engine, there is in the engine room duplicate marine steam generator sets for generating electricity for use on the dredge which is well lighted throughout, and also has two powerful search lights for use in making repairs on the pipe line, ten pumps to provide circulation in the condensers, bilge pumps, water ballast pumps, etc. A condenser is provided for the main engine and separate condenser for the auxiliary machinery.

On the main deck aft of the boiler room is located four drums and a Lambert hoisting engine. These drums are used for raising spuds on which the dredge is swung and for the control of two stern anchor lines onto which the dredge drops back in case of a heavy blow, and which

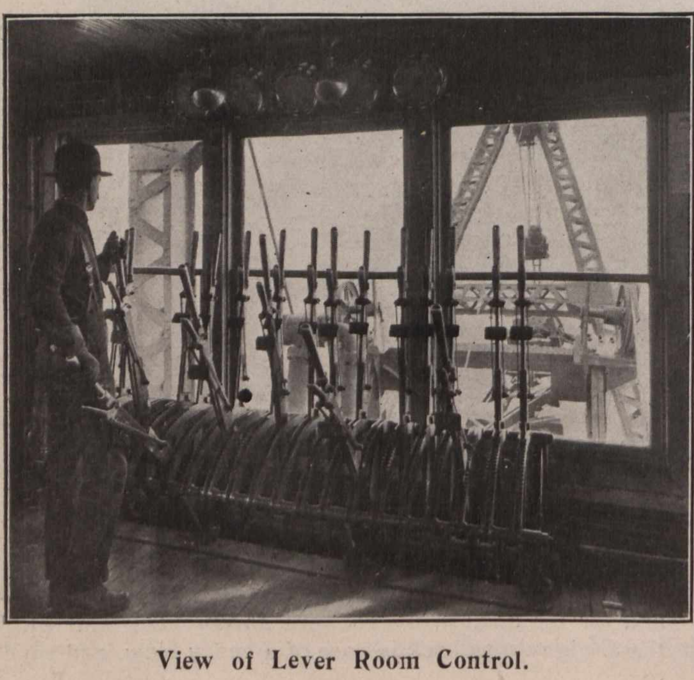




Views of the 150-h.p. Cutter Engine and Transmission Gearing.



Main Pump Under Installation.

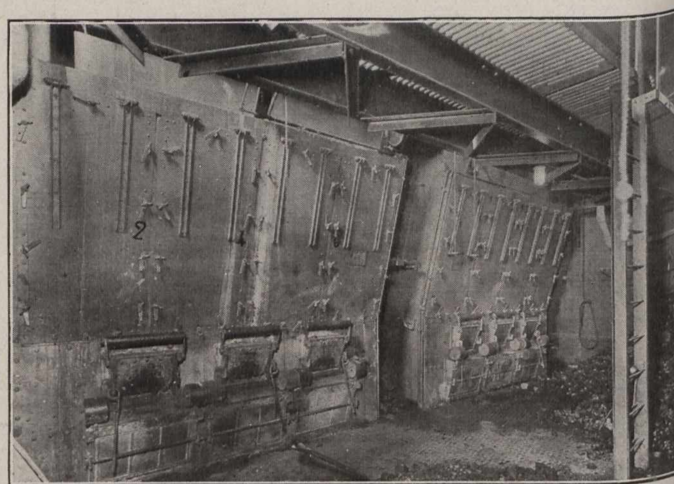


View of Lever Room Control.

are also used for swinging the dredge on in case of trouble with the spuds.

The main pump is placed at right angles to the centre line of the dredge, the discharge being from the bottom and the side, and the discharge pipe running through a bulkhead at the side of the pump room. A right angle turn is made at this point and the discharge pipe continues through the dredge and out at the stern, where is located the double ball and socket joint which permits of a swing of 90 degrees.

From the dredge to the shore the discharge is carried in pontoon pipe having inside diameter of 24 inches and



View of Boiler Room in the "Cyclone" Dredge.

length of 60 feet, with a Parker ball and socket coupling, which connection permits of the high pressures carried on this pipe line. They assume a maximum of 75 to 80 pounds per square inch.

These dredges were designed and completely equipped by the owners, the Canadian Stewart Company, Limited, under direct supervision by their officers.

LAURENTIDE ACTIVITIES ON THE ST. MAURICE RIVER.

Between 800 and 1,000 men are engaged this summer on the improvements at Grand Mére of the Laurentide Company, Limited. The extensions include, besides a new ground-wood pulp mill, a power development designed to ultimately supply 180,000 h.p. In the present development, however, 120,000 h.p. are proposed.

The undertaking was described in *The Canadian Engineer* for October 22nd, 1914. At that time it was expected that at least three 20,000 h.p. units would be ready for operation before winter. However, when the war broke out, operations were temporarily suspended. Arrangements were carried out early in the spring to finance the completion of the work, and this work has been going along quietly but steadily since then. It is now expected that by the end of the year this part of the development will be in operation and the old and new mill equipped with electric motive power apparatus, replacing, in the case of the old mill, direct hydraulic drive.

Practically 3,500 miles of railway lines have been constructed in Saskatchewan since 1905, states a report prepared by the provincial department of railways at Regina. In ten years railway mileage in the province has been almost quadrupled.

HEAVY TRAFFIC ON ROADS AND ITS REGULATION.

THE following paper, dealing with the problems attending heavy traffic, relates particularly to questions of weights of loads and their distribution on the axles. These are questions that should be receiving more attention in Canada. The Province of Ontario has before it at present the Henry bill, introduced at the last session of the Legislature. This bill, which was summarized in *The Canadian Engineer* for April 15th, 1915, provides for a regulation of vehicle loading that will undoubtedly save the Ontario Government and municipalities a good deal of money in road maintenance and repair charges. The following paragraphs, from a paper by Mr. E. J. Elford at the recent National Road Conference in London, throws considerable light on the broad subject. Undoubtedly there is little wisdom in building roads that are not suited to the traffic requirements, or of neglecting to regulate the traffic on good roads after they are built.

The author submits that the question is one which should be looked at as a business proposition, that the main consideration should be, not whether traffic of the description referred to is advantageous, damaging, beneficial or costly to local interests, but whether, and if so to what extent, it is, in the broadest sense, "good business" for the nation, either directly or indirectly.

It is generally agreed that for good or ill, and whether we like it or not, mechanical highway traffic has come to stay, and although it is possible by legislation, and by that obstructive inertia which is often one of the most useful weapons of highway and other public authorities, to retard its development and limit its scope to a serious extent, it has already acquired too much vitality to be easily killed.

As a road engineer the author has had his share of the annoyance and discouragement of seeing good macadam roads spoiled in a very short time by heavy motor traffic, and he has much sympathy with those who are burdened with the responsibility of miles of macadam roads which have in recent years become subject to this class of traffic, and who are without the funds necessary to provide suitable surfaces, and in many cases sufficient foundations, to meet the new conditions.

It is not surprising that under such circumstances many should be found who hold strong views as to the desirability of applying stringent restrictions to this class of traffic. In many cases the localities upon which fall the cost of maintaining roads to carry an ever-increasing volume of such traffic reap absolutely no direct benefit, and there is grave danger that unless the burden can be eased considerably, the feeling of resentment which arises from the existing unfair conditions may bring about results which may seriously cripple important industries and impede national progress. The effect of such a result upon national interests would no doubt far outweigh the cost of providing roads suitable and sufficient for modern traffic.

The author cannot, however, agree with those who demand that all roads should be made suitable for all traffic, as this would be extravagant and unnecessary, but in his view such roads as are reasonably necessary to enable the industries of the nation to be carried on with a high standard of efficiency should be provided. He submits, however, that the nation should find the additional funds required to provide what is necessary in the national interests.

It is obvious that the latter proposition involves some measure of control of mechanical traffic, but if such control is based upon a broad, business-like view of the question, it should occasion no obstruction to industry or hardship to individual commercial interests. Much of the present trouble arises from the unreasonable use of roads and lack of proper regulating powers. For instance, it is obviously not in the national interest that a contractor, in the hope of saving $100 by using motor lorries in the place of horse-drawn vehicles for carting the materials required for a contract, should be allowed to do $5,000 worth of damage to a road quite adequate for ordinary traffic, and which, apart from this one job, is unlikely to be required to again carry mechanical traffic of sufficient weight or volume to cause any appreciable damage. Again, it is not in the national interest that heavy motor traffic should be allowed to ruin residential roads when other roads capable of carrying this class of traffic have been provided and can be used without serious inconvenience.

It is well known that in many localities heavy motors have, without warning, adopted a route over roads unfit for such traffic, which roads have, in consequence, been quickly cut to pieces and, after the highway authority has reconstructed them at great cost, the traffic has been transferred to an entirely new route, where the process has been repeated. Other examples of unreasonable wear could be given, but the foregoing are sufficient to indicate the importance of devising some means by which the use of highways by heavy motor traffic may be properly regulated.

In addition to regulations of this character it is also desirable that the existing regulations as to the construction, loading, and speed of heavy motors should be revised. The author suggests that the regulations relating to vehicles are by no means so important as those relating to the user of the highways by such vehicles, and he is of opinion that the most satisfactory solution of the problem will be found in the direction of the provision of sufficient suitable roads to meet the reasonable requirements of the traffic and by so regulating the user of roads by heavy motors as to prevent undue damage. In these circumstances it may be found desirable, in the national interests, to reduce rather than increase the stringency of the existing regulations relating to heavy motor cars, and to regulate the vehicles themselves to such an extent only as may be required for public safety, and to prevent unnecessary damage to reasonably good roads.

Mr. Elford suggests the constitution of a Central Government Department to enter upon a very extensive system of road reconstruction to conform with the unavoidable heavy traffic. Having regard to the advantages which would accrue to owners and users of heavy motors of all kinds by the reduction of tractive effort required, decreased wear and tear of vehicles, etc., as a result of the provision of good substantial roads with clean, smooth surfaces, it would not be unreasonable that they should be called upon to bear directly some proportion of the cost of the necessary road improvements, and the author suggests that this might be secured by a graduated tax on each vehicle.

Regulations as to Vehicles.—The question of regulations in reference to the construction, speed, and loading of heavy motors is of considerable importance if it is assumed that a large proportion of the roads of the country necessary for heavy motor traffic are to remain indefinitely in their present condition with surfaces of ordinary macadam and similar low-grade material. On the other hand, the author submits that if some such scheme for the improvement of roads required for heavy traffic as that already outlined is adopted, this question becomes one of quite secondary importance. The following remarks are based upon the latter assumption.

In the author's opinion the most destructive factors so far as roads are concerned are high speed and small wheels, combined with heavy loading. Even exceptionally heavy loads on wheels of large diameter and reasonable width, travelling at a slow rate, cause very little damage to macadam roads in fair condition, except immediately after a frost, whereas fast traffic on small wheels and with much lighter loads soon causes considerable damage.

It must, moreover, be borne in mind that the better and more regular the surfaces of the roads the smaller the damage, even with this type of traffic, and the damage increases at an alarming rate as the surface becomes worn and uneven.

Given, therefore, a foundation of sufficient strength to carry the weight of traffic brought upon the road, and a wearing coat of material which will retain a smooth and even surface, the factors referred to will not greatly affect the rate of wear.

Under these circumstances it appears to the author that the present restrictive regulations might, to a large extent, be repealed, and that the construction, speed, and loading might be taken into consideration in framing the graduated tax previously suggested. In his opinion more would be gained by encouraging manufacturers to design vehicles which are least likely to cause damage, and carriers to use them in the least objectionable manner, by a direct monetary concession than by imposing arbitrary restrictions which might interfere unduly with important industries.

The author suggests a system of taxation somewhat on the lines of the following formula:—

Standard wheels, 36 inches in diameter.

Tires, non-resilient.

W = greater axle weight (tons).

W^1 = smaller axle weight (tons).

S = maximum speed (miles per hour).

T = annual tax in respect of greater axle weight.

T^1 = annual tax in respect of smaller axle weight.

$T + T^1$ = total annual tax.

A = 5s., B = 1s. 3d. when maximum weight of loaded vehicle does not exceed 7 tons.

A = 6s. 8d., B = 1s. 8d. when maximum weight of loaded vehicle does not exceed 12 tons.

Total tax to be reduced by 15s. for every 1 in. increase in diameter of wheels over 36 ins., in respect of each pair of wheels so increased in diameter.

Total tax to be increased by 30s. for every 1 in. decrease in diameter of wheels under 36 in., in respect of each pair of wheels.

The effect aimed at by this suggested basis of taxation is the encouragement of even distribution of weight, moderate speeds and loading, and of the use of large diameter wheels, without unduly restricting the use of any vehicles which may be necessary for the proper and efficient development and carrying on of any industry.

The following table gives typical examples of the application of the formula:—

Maximum weight of loaded vehicle.	W	W¹	S	T	T¹			Total tax.		
				£	£	s.	d.	£	s.	d.
7 tons	4	3	10	10	1	17	6	11	17	6
	6	1	10	15	0	12	6	15	12	6
12 "	6	6	6	12	3	0	0	15	0	0
	6	6	9	18	4	10	0	22	10	0
	9	3	6	18	1	10	0	19	10	0
	9	3	9	27	2	5	0	29	5	0

It is suggested that the width of the tire should be proportionate to the maximum load upon and the diameter of the wheels, on the lines of the present regulations.

There appears to be considerable difference of opinion as to the relative amount of damage caused by steel and rubber-tired wheels. It cannot be disputed that rubber-tired motor 'buses are most destructive to ordinary macadam roads, and they also appear to have a damaging effect on roads of higher grades.

The author suggests that the cause of this is probably to be found mainly in the high speeds and small diameter wheels employed. This phase of the question appears to be one which might very usefully form the subject of special investigation.

It is generally agreed that cross-bars should not be allowed on steel tires, but that, if the grip with smooth tires is insufficient, the surface of the tires themselves should be grooved.

The author suggests that all questions as to the construction, etc., of heavy motors is one which should be investigated and considered by a joint committee of road engineers, manufacturers, and users, who should report to the authority empowered to make regulations affecting vehicles of this character.

In conclusion, the author would again emphasize the importance of taking a broad view of the subject. Industrial competition after the war may very likely be as keen or keener than ever, and it is an undoubted fact that improved transport facilities mean increased national prosperity.

PRODUCTION COSTS IN MINING.

It is almost impossible to establish a standard unit of production costs in mining, as is possible in other lines of industry because of meeting new conditions all the time, and because the supervision of efficiency experts or foremen cannot be constant as in a factory, where a great many men are working close to each other in the same room. It is pointed out by the Mining and Engineering World that in well-developed mines where the ore is regularly blocked out, and sufficient reserves are in sight for all requirements for some time to come, and where a certain known tonnage has to be mined month by month, it may be possible to approximate future production costs, such approximation being subject to all the hazards of mining. Such a well-developed mine is an exception rather than the rule; consequently in the majority of mines the bookkeeper or accountant plays a very important part in any scheme for increasing the output or lowering the cost of production. Each individual mine will have to work out its own efficiency plans, for except with big companies who operate more than one property, a comparison of the detailed costs of the different branches of mining will not help much, even if one could get them.

EXAMINATION OF EXPLOSIVES WITH A VIEW TO SAFETY IN THEIR USE.

THE United States Bureau of Mines gives very careful consideration to the explosives used in blasting operations. In a recent bulletin it publishes a list of some 130 brands that it considers under the name of "permissible explosives." This signifies that the brands have successfully passed certain tests made by the bureau and that each may be used in accordance with the conditions prescribed by it. It is specified, however, that even the explosives that have passed those tests and are named in this list as permissible explosives are to be considered as permissible explosives only when used under the following conditions:—

1. That the explosive is in all respects similar to the sample submitted by the manufacturer for test.

2. That detonators—preferably electric detonators—are used of not less efficiency than those prescribed, namely, those consisting by weight of 90 parts of mercury fulminate and 10 parts of potassium chlorate (or their equivalents).

3. That the explosive, if frozen, shall be thoroughly thawed in safe and suitable manner before use.

4. That the quantity used for a shot does not exceed 1½ pounds (680 grams), and that it is properly tamped with clay or other non-combustible stemming.

It must not be supposed that an explosive that has once passed the required tests and has been regarded as permissible, is always thereafter to be considered a permissible explosive, regardless of its condition or the way in which it is used. Thus, for example, an explosive named in the permissible list, if kept in a moist place until it undergoes a change in character, is no longer to be considered a permissible explosive. If used in a frozen or partly frozen condition, it is not when so used a permissible explosive. If used in excess of the quantity specified (1½ pounds), it is not, when so used, a permissible explosive. And when the other conditions have been met, it is not a permissible explosive if fired with a detonator of less efficiency than that prescribed.

Moreover, even when all the prescribed conditions have been met, no permissible explosive should necessarily be considered as being placed permanently on the permissible list, for the bureau reserves the right, on fuller information concerning the conditions which lead to safety, to revise this list, but any permissible explosive when used under the prescribed conditions may properly continue to be considered a permissible explosive until notice of its withdrawal or removal from the list has been officially published.

Furthermore, the manufacturers of a permissible explosive may withdraw it at any time when introducing a new explosive of superior qualities. And after further experiments and conferences the bureau may find it advisable to adopt additional and more severe tests to which all permissible explosives may be subjected, in the hope that through the use of such explosives only as may pass the more severe tests the lives of miners may be better safeguarded.

The published list of the bureau gives the name of the brand, the class to which it is designated, the required efficiency of the detonators to be used, the unit deflective charge, the rate of detonation in a 1¼ x 8-inch cartridge, and the name of the manufacturer.

The unit deflective charge is determined by the ballistic pendulum, and is expressed in grams of the quantity of explosive that is required to swing the pendulum mortar the same distance as one-half pound (227 grams) of the standard 40 per cent. "straight" nitroglycerin dynamite of the Pittsburgh Testing Station. Many observers have expressed the opinion that the "coal-getting" strength of permissible explosives is represented better by the results of this test than by the results of any other single test yet devised.

The rate of detonation gives, in feet per second and meters per second, the relative velocity of detonation of the explosives. The adaptability of a permissible explosive to a particular coal-mining condition depends greatly on its rate of detonation. For certain work in which a shattering effect is desired, as in driving through or "brushing" rock, or in producing coal for coke making, the explosive reaction should be rapid, and for such work permissible explosives having a high rate of detonation should be selected. Similarly, for shooting down a soft friable coal to produce lump or steam coal, a permissible explosive should be selected that detonates slowly and hence gives a more prolonged pressure. In medium hard coal an explosive having an intermediate rate of detonation may be expected to be most suitable.

Although these relations usually hold, they do not always, because coals differ in hardness and coal beds differ in the number and position of the joints, partings, and shale bands. Such facts have to be considered in selecting an explosive for mining coal.

An explosive having a very low rate of detonation is not always the best for mining a soft friable coal, because some of its energy may be lost by its gases escaping through cracks and fractures in the bed. Under such conditions an explosive having an intermediate rate produces the most economical results.

Classes of Permissible Explosives.—In order that the user of explosives may know the nature and characteristic component of each of the permissible explosives, and that he may be able to select an explosive to meet a specific requirement, the designation and characteristics of each class are given below:—

Class 1, ammonium-nitrate explosives.—Here belong all the explosives in which the characteristic material is ammonium nitrate. The class is divided into two sub-classes. Sub-class *a* includes every ammonium-nitrate explosive that contains a sensitizer that is itself an explosive. Sub-class *b* includes every ammonium-nitrate explosive that contains a sensitizer that is not in itself an explosive. The ammonium-nitrate explosives of sub-class *a* consist principally of ammonium nitrate with small percentages of nitroglycerin, nitrocellulose, or nitrosubstitution compounds which are used as sensitizers. The ammonium-nitrate explosives of sub-class *b* consist principally of ammonium nitrate with small percentages of resinous matter or other non-explosive substances used as sensitizers.

All of the ammonium-nitrate explosives readily absorb moisture from the atmosphere, and great care should be taken in storing them or in using them in damp places. They are not suitable for use in wet mines. If in such mines a cartridge of an ammonium-nitrate explosive is opened and its contents exposed for only a few hours to the damp atmosphere, the explosive may deteriorate and later fail to detonate completely. The ammonium-nitrate explosives when stored in well-ventilated magazines for only a few months have shown signs of deterioration. For this reason the ammonium-nitrate explosives should be obtained in a fresh condition and should be used as soon as possible after their receipt. When fresh, these explosives, if properly detonated, have the advantage of producing only small quantities of poisonous and inflammable gases, and are adapted for mines that are not unusually wet, and also for mines and working places that are not well ventilated.

Class 2, hydrated explosives.—To class 2 belong all explosives in which salts containing water of crystallization are the characteristic materials. The explosives of this class are somewhat similar in composition to the ordinary low-grade dynamites, except that one or more salts containing water of crystallization are added to reduce the flame temperature. They are easily detonated, produce only small quantities of poisonous gases, and most of them can be used successfully in damp working places.

Class 3, organic nitrate explosives.—To this class belong all the explosives in which the characteristic material is an organic nitrate other than nitroglycerin. The permissible explosives listed under class 3 are nitrostarch explosives. They produce small quantities of poisonous gases on detonation.

Class 4, nitroglycerin explosives.—To class 4 belong all the explosives in which the characteristic material is nitroglycerin. These explosives contain free water or an excess of carbon, which is added to reduce the flame temperature. A few explosives of this class contain salts that reduce the strength and shattering effect of the explosives on detonation. The nitroglycerin explosives have the advantages of detonating easily and of not being readily affected by moisture. On detonation some of them produce poisonous and inflammable gases equal in quantity to those produced by black blasting powder, and for this reason they should not be used in working places that are not well ventilated.

REINFORCED CONCRETE RAILWAY SLEEPERS.

The increasing cost of wood is mainly responsible for the introduction of reinforced concrete as a substitute for wooden sleepers. In a paper published late in 1913 in "De Ingenieur," The Hague, M. Von Jockin outlines the development of sleeper-design in various countries, and dwells on the difficulty of securing sufficient bearing-area under the rail to prevent crushing of the concrete, and under the sleeper to prevent crushing of the ballast. The questions of stiffness and economy by reducing the sectional area of the sleeper in the centre are touched on. It is shown that increased stability to the track is secured by widening the sleeper under the rail; this prevents the latter from rocking under the live-load. This construction leads to the reintroduction of longitudinal sleepers. The author points out that the former objections to longitudinal sleepers no longer apply where concrete is used, for the following reasons: (1) By employing concrete sufficient width can be given to the sleeper-bottom to prevent the crushing of ballast; (2) the natural qualities of concrete are such as to give sufficient stiffness with a minimum cross-section; (3) drainage of the track can be secured by leaving openings in the sleeper, which can only be effectively done where reinforced concrete is used; with wood or iron the sleeper would be seriously weakened. Further advantages, such as prevention of creeping, durability and accessibility, are mentioned. This type of construction has been successfully tried in Holland and Java.

DEMAND IN GREAT BRITAIN FOR IRON AND STEEL PRODUCTS.

THE weekly bulletin issued by the Department of Trade and Commerce at Ottawa calls especial attention to the demand for iron and steel in Great Britain. Mr. J. E. Ray, Canadian trade commissioner at Birmingham, reports that in his district, during the last few weeks over thirty firms have inquired for constructional steel, rods, wire nails, etc., and according to iron exchange reports, in spite of the large orders placed with United States firms, buyers are experiencing great difficulty in obtaining supplies. The time is certainly opportune for Canadian manufacturers to send their representatives into the district, men who have a thorough technical knowledge of their subject.

Mr. Ray states in his report that a sample steel rod had just been received from Canada, that it had been thoroughly tested by one of the large steel firms near Birmingham and reported upon favorably. Furthermore, the quotation accompanying the sample was competitive.

Although the following tables are lengthy, they are quoted as illustrating the principal kinds of manufactures imported, the values and countries of origin. Special attention should be paid to European sources of supply, some of which have now ceased and others considerably diminished.

Metals and Ores, and Manufactures Thereof.

Iron: wrought, in bars, angles, rods, and sections—

	1913-14.
Russia	£ 2,827
Sweden	445,908
Germany	308,388
Belgium	593,642
France	2,000
Other foreign countries	11,490
Total from foreign countries	£1,364,255
Total from British Possessions	
Total	£1,364,255

Iron or steel: hoops and strips—

Sweden	£ 38,332
Germany	330,266
Netherlands	3,150
Belgium	76,805
United States	157,496
Other foreign countries	1,530
Total from foreign countries	£ 607,579
Total from British Possessions	£ 165
Total	£ 607,744

Tubes and pipes and fittings, wrought—

Sweden	£ 17,029
Germany	462,566
Netherlands	2,508
Belgium	69,526
France	4,790
United States	80,900
Other foreign countries	17,562
Total from foreign countries	£ 654,881
Total from British Possessions	£ 6,925
Total	£ 661,806

Ship, bridge, boiler, and other plates and sheets not under ⅛-in. thick—

Germany	£	633,916
Netherlands		10,456
Belgium		272,356
United States		54,175
Other foreign countries		2,183
Total from foreign countries	£	973,086
Total from British Possessions		
Total	£	973,086

Wire (including uninsulated electric wire)—

Sweden	£	3,109
Germany		367,616
Netherlands		5,386
Belgium		117,787
United States		54,519
Other foreign countries		1,336
Total from foreign countries	£	549,753
Total from British Possessions	£	2,770
Total	£	552,523

Wire rods—

Sweden	£	124,177
Germany		379,085
Belgium		144,423
Other foreign countries		471
Total from foreign countries	£	648,156
Total from British Possessions		
Total	£	648,156

Manufacturers of, unenumerated—

Sweden	£	43,773
Norway		7,773
Denmark (including Faroe Isles)		6,687
Germany		598,971
Netherlands		24,632
Belgium		215,050
France		67,162
United States		200,277
Other foreign countries		5,077
Total from foreign countries	£	1,069,402
Canada	£	12,915
Other British Possessions		473
Total from British Possessions	£	13,388
Total	£	1,082,790

COBALT ORE SHIPMENTS.

The following are the shipments of ore, in pounds, from Cobalt Station for the week ended July 23rd, 1915:—

Nipissing Mines, 50,545; Peterson Lake Silver Mine, 63,665; Mining Corporation of Canada (Cobalt Lake Mines), 87,120; Dominion Reduction Company, 88,000; Chambers-Ferland Mining Company, 56,080; McKinley-Darragh-Savage Mines, 147,940. Total, 493,350 pounds, or 246.6 tons.

Casey Cobalt Mines, 58,500.

The total shipments since January 1st, 1915, are now 17,492,534 pounds, or 8,746.2 tons.

VERTICALLY vs. HORIZONTALLY FRAMED MITERING LOCK GATES.

Mitering lock gates belong, generally speaking, to either the horizontally framed or the vertically framed types. The advantages of the latter for certain conditions are brought out in an article by Malcolm Elliott of the Corps of Engineers, U.S. Army. The article, which appears in the August number of Professional Memoirs, describes as follows the two types and the manner in which each carries the loads to which it is subjected.

A horizontally framed gate is one which resists the water pressure by means of a series of horizontal members more or less uniformly distributed from the bottom of the gate to the top. Each horizontal member receives the load on its own portion of the gate and is supported at one end by a corresponding member of the opposite gate leaf and at the other end by the lock wall.

The so-called "vertically framed" gate resists the water pressure in an entirely different manner. In this type the loads are carried by a series of vertical girders more or less uniformly distributed throughout the length of the gate. These vertical girders are supported at the bottom by a sill anchored into the floor of the lock, and at the top by a horizontal member which is in turn supported in the same way as are the horizontal members of a horizontally framed gate.

Fig. 1 shows a gate in its mitered position and may represent either the top horizontal member or a vertically framed gate or any horizontal member of a horizontally framed gate. The loads on the gate cause a combined direct thrust and bending in the horizontal members. It will be found that in all cases the stress in the upstream flange increases from either end of the gate to a maximum at the centre and that the compression in the downstream flange decreases from the ends and may become negative—that is to say, a tensile stress at the centre. In practice the flange angles at least and, usually, one cover plate extend the entire length of a girder. It will usually be found, therefore, that there is some part of the downstream flange where the metal present is much greater than required for the stresses at that part. A part of the downstream flange will be superfluous, therefore, as far as the flange stresses alone are concerned.

This apparent waste of metal can be avoided by building the horizontal member in the shape of a circular arch. Fig. 2 shows a gate of this shape. If the points of contact at the miter and quoin ends are located on the centre line of the arch it easily may be proved that the thrust is evenly distributed throughout the cross-section of the arch at any point in the gate and is constant throughout the entire length of the gate. In fact, the arch thrust is the same in amount as would be the tension in a pipe of the same radius subjected to internal pressure. On account of the absence of combined bending and direct stresses, the arch type is more economical than the straight girder type as far as weight is concerned. There are, however, other things beside weight to be considered in choosing the best type of gate.

The foregoing remarks apply to any horizontal member of a lock gate, whether it be the single top member of a vertically framed gate or the horizontals of a horizontally framed gate. With the horizontally framed gate, each girder or arch carries a load depending upon its depth below the surface of the water and the width of sheathing it supports. With a vertically framed gate, the loads on the horizontal member are the reactions at the upper ends of the vertical girders. Fig. 3 shows the conditions of loading for this type of gate. The load on the top horizontal member, per unit of length, is equal to $\frac{62.5}{6h}(h_1^3 - h_2^3)$. When the upper pool is at the top of the gate and there is no lower pool acting, this expression becomes $62.5\frac{h^2}{6}$, which is one-third of the total water pressure on the gate. The other two-thirds of the pressure is carried to the sill.

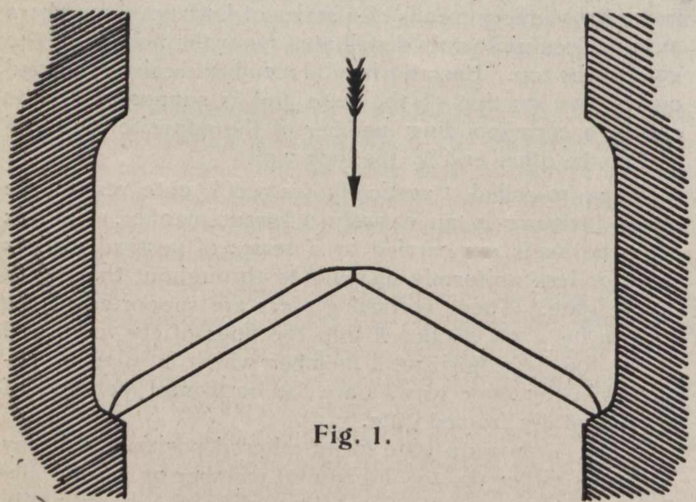


Fig. 1.

The most important points to be considered in the choice of type for any particular gate are cost and efficiency, and of these it may be said, the cost of a gate is a relatively small part of the cost of the whole lock, whereas its efficiency is a very important factor in the lock's successful operation; and, therefore, no saving in cost on the gates is justified if it impairs their efficiency. On the other hand, it is just as true that if a saving can be made on the cost of the lock gates without impairing

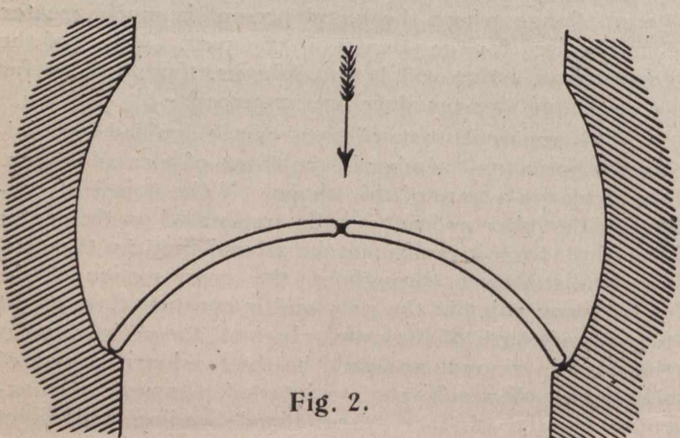


Fig. 2.

the efficiency of the structure, the saving is justified even though it should amount to only a small percentage of the cost of the lock.

In comparing the relative costs of two types of lock gates the following elements should be considered: (1) the weight of the gate, (2) simplicity of design and ease of erection, and (3) the cost of that part of the walls and sills which is influenced by the design of the gate.

The advantage in weight for the two types for any particular lock can best be determined by making rough designs and comparing them. An inspection of the two types leads to the conclusion that for gates which are long in proportion to their height, vertical framing will weigh less, and that as the height is relatively increased the difference becomes less, until the two types will weigh alike and a further increase in height will result in an advantage in favor of horizontal framing. General H. F. Hodges states that the weights will be equal when the height is two-thirds of the length. The writer has made comparisons between the two types for various dimensions and is of the opinion that a vertically framed gate will weigh the same as a horizontally framed gate, in which arches are used, when the height is about 75 per cent. of the length and that when girders are used for the horizontal members the weights of the two types will be equal when the height is equal to the length.

Turning now to facility of construction—there can be no doubt that a vertically framed gate is much to be preferred. The conditions of loading and support are such that no extraordinary accuracy of workmanship is required. So far as water pressure is concerned, the gate is supported along the sill and at two points on the upper girder, while a horizontally framed gate is supported along three edges of the rectangular surface exposed to the water. It is clear that in order to obtain the support, in the latter case, extraordinary care in fabrication and erection is necessary. A vertically framed gate is well adapted to the use of adjustable diagonal bracing by means of which any sag or warp in the gate can be corrected. With large horizontally framed gates, it has not so far been practicable to use adjustable diagonals, and therefore the gate must be built so as to remain comparatively free from warp and sag, and this extra precision in workmanship and erection can not be obtained without extra cost.

Another cost-involving element in horizontally framed gates is the large amount of curved work usually found in this type. Even in those gates which have horizontal girders instead of arches, the ends are usually curved so as to reduce weight where the bending moment is small. The result is that the rivet holes in the sheathing plates are a little farther apart than those in the flange angles and the holes in the sheathing splices are still farther apart and will not agree with standard rivet spacing. This necessitates extra care in locating the rivet holes so that they will match up after assembling.

It is stated that for the Panama lock gates it was necessary to drill many holes from the solid after assembling the plates, in order to avoid excessive reaming which would have resulted in oval holes. The labor of bending the angles and plates and cutting the web plates on curves adds to the cost. None of this is necessary with vertical frames: first, because there is little curved work in the gate and, second, because, by being able to adjust the gate with diagonals, no extraordinary precision is required. The conclusion from the above is that where weight is the same the vertically framed gate is the cheaper on account of the facility of construction.

The type of gate selected affects the design of lock walls and sill. It is proper, therefore, to consider this effect in deciding upon type of gate for any given conditions. It relates principally to the amount of masonry and metal work required.

As to the volume of masonry in the walls, it has been stated, as a disadvantage of the vertically framed gates, that this type brings a heavy strain high up in the wall due to one-third of the total thrust being concentrated at the top girder. While it is true that there is a heavy load on the upper part of the wall, there is, nevertheless, no greater overturning moment than would be the case with a horizontally framed gate.

Let Fig. 4 represent the wall at the quoin; T, the thrust from a vertically framed gate, and T' the resultant of the thrust from a horizontally framed gate. If there is no water on the downstream side of the gate and if the water surface is level with the upper girder, it is evident that T will be one-third of T'. The lever arm of T above the sill is three times that of T'; therefore, their overturning moments about the plane of the sill will be equal and there will be no choice between the two types as far as stability of the wall is concerned. About the base of the wall, which is always some distance, a, below the sill, a different result is obtained. With a vertically framed gate, the overturning moment about the base of the wall, if the sill foundation is self-supporting, will be,

$$M = T\,(h + a) = Th + Ta.$$

For a horizontally framed gate,

$$M = T'\left(\frac{h}{3} + a\right) = Th + 3Ta.$$

The second expression is evidently greater than the first and therefore the advantage, if any, so far as the amount of masonry in the wall necessary to resist overturning is concerned, is with the vertically framed gate.

It has also been stated, with reference to the amount of masonry in the lock walls, that the top girder of a vertically framed gate is necessarily very deep on account of its heavy load and will require a deep recess in the wall, and therefore an added amount of masonry on the back of the wall in order not to decrease the top width and the available space for operating the gate. Even if a deeper recess were required, it is not clear why the masonry added to the back of the wall need be any greater in volume than that saved in the recess, but in reality the top girder of a vertically framed gate need not be any wider than the girders of a horizontal girder gate and usually encroaches on the wall much less than the arches of a horizontal arch gate. In the vertically framed upper gate recently designed for the new lock now being built at Louisville, Ky., the top girder is 6 feet wide. The length of the gate is about 62 feet. The depth of the girders should not in any case be less than about one-tenth of the span; therefore, in this case, the use of vertical framing does not encroach on the wall nor is there any reason why it should do so in any other case. Taking everything into consideration, it may be said that if there is any choice between the two types as to the volume of masonry in the walls, the choice is in favor of the vertical framing.

The volume of masonry required in the sill will probably be greater for a vertically framed gate, because for this type the stability of the gate is entirely dependent on the stability of the sill. The difference in the amount of sill masonry will, however, not be as great as might at first sight appear. Since a horizontally framed gate is so designed as to take horizontal thrust, due to water pressure, throughout its entire height, each horizontal member taking its own share of the thrust, it is clear that the gate would be stable even if the sill were removed. Therefore, if the gate were perfectly fitted, a large amount of masonry would not be required in the sill. In practice, however, it may happen that the gate will come in contact with the sill before the two leaves are mitered throughout their entire height, in which case there will be a heavy pressure on the sill and sufficient masonry must be provided to resist it. For either type the masonry in the sill must be sufficient and so disposed as to stop effectively the flow of water from the upper to the lower pools and this consideration may result in as much masonry for one type as for the other.

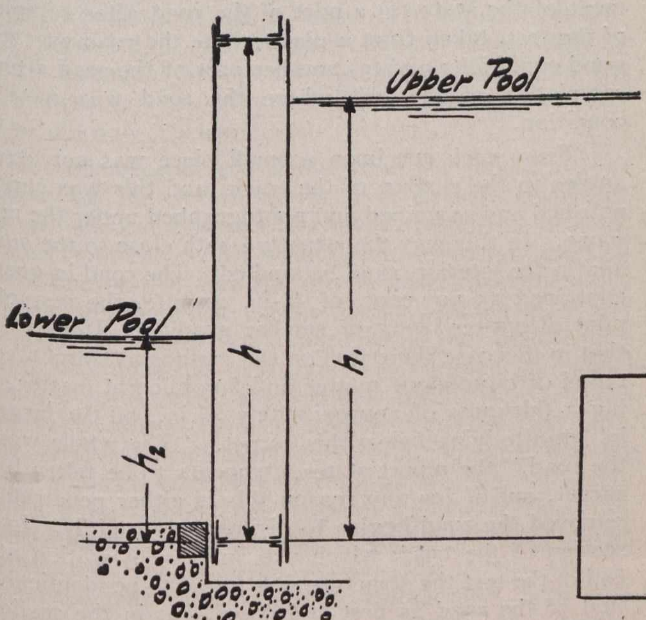


Fig. 3.

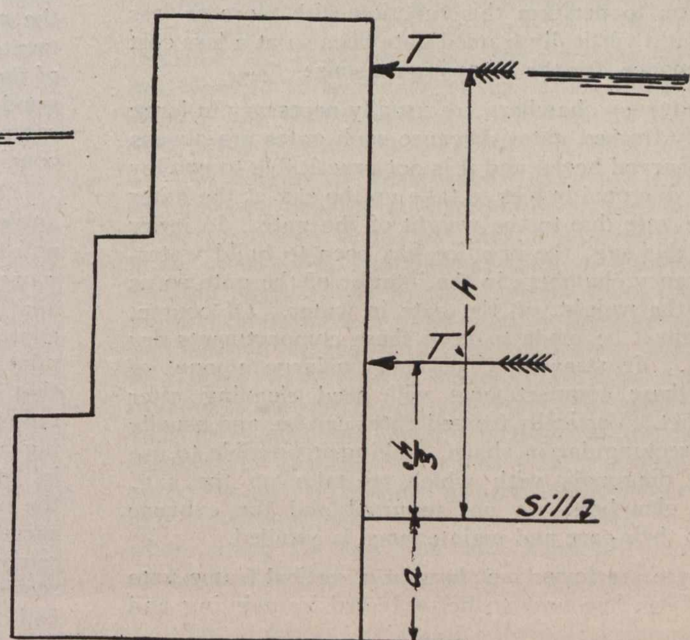


Fig. 4.

Metal work is required in the walls and sills for both types of gates. For large horizontally framed gates there is required a metal hollow quoin in the walls, the metal being equal in length to the height of the gate. In vertically framed gates the thrust is concentrated at the top and is only one-third as great; therefore, the metal hollow quoin is very much smaller. On the other hand, more steel is required in the sills for a vertically framed gate on account of the heavier load. These items should about balance each other.

Taking all the foregoing into consideration, the conclusions as to the relative cost of the two types are as follow:—

1. The advantage in weight depends on the ratio of height to length. For a ratio less than 1 : 1, vertical framing will weigh less than horizontal girders. For a ratio less than 75 : 100 vertical girders will weigh less than horizontal arches.

2. In facility of construction the advantage is with the vertical framing.

3. In cost of walls and sills, there is no very marked difference between the two types.

The next point to be considered with reference to choice of type is the relative efficiency of the types available.

The word efficiency here is intended to mean the ability of the structure to perform its functions with the best results at the least expense for operation and maintenance. The service desired of a lock gate is for the two leaves to swing on their hinges like a door and, when closed, to meet each other accurately throughout their height at the centre line of the lock at the same instant that the lower part of the gate comes in contact with the sill. Both horizontally and vertically framed gates can be depended on to perform this function with more or less success, but a vertically framed gate does so at a less cost for maintenance, for the following reasons:

1. Buoyancy chambers are usually necessary in large horizontally framed gates, because such gates are always built with curved backs and it is not practicable to employ adjustable diagonal braces to take up the sag at the miter end of the gate due to the weight of the gate. In order to reduce this sag, the practice has been to build water-tight buoyancy chambers in the interior of the gate so as to reduce the weight of the gate in water. Of course, provision must be made to keep these compartments dry and clean. In streams which carry a large amount of sediment these compartments will need cleaning after every freshet. Vertically framed gates can be, and usually are, built rectangular in shape, making it possible to use adjustable diagonals with which to take up the sag. Buoyancy chambers are not required and the expense incident to their care and maintenance is avoided.

2. There are fewer members in a vertical frame gate and, therefore, less area to be protected by painting and cleaning.

3. There are fewer large horizontal members to collect silt in a vertical frame gate and, therefore, less expense incurred in its removal.

4. The interior of a vertical frame gate is much more easily accessible on account of the absence of a large number of small cells into which a horizontal frame gate is divided by the many intersecting horizontal and vertical members.

The above indicates that the cost of maintenance of vertically framed gates will be less than for the other class.

We have still to consider comparative ease and reliability of operation. To dispose of this point, in the absence of examples of direct comparison, impossible because of the non-existence to date of very large vertically framed gates, I venture the assertion that the latter class will not suffer by comparison when such can be made. I base this assertion on knowledge of the successful working of this type of gate on the small locks of the Kentucky River, and on my inability to discover any reason which would prevent the successful application of the principle to larger lock gates.

All the foregoing seems to point to the desirability of using vertical framing for miter gates whenever the system will not increase the weight and, considering the greater simplicity of construction and the equal if not greater efficiency, the use of vertical framing appears to be justified even if it should result in a slightly heavier gate.

MICROSCOPIC WORK IN ROAD MATERIAL TESTING.

FROM the report for 1914-15 of the National Physical Laboratory in England, it is evident that the use of the microscope has figured a good deal in the attainment of results. In the treatment of specimens tested it is shown that a study of them has been carried out largely by preparing and examining micro-sections of the road at various stages, and the report mentions that one road in particular furnished results which are of interest as indicating the utility of the microscope in the study of road-construction problems. Three different sections of this road were examined, *viz.*: (1) A part of the road as laid down—*i.e.*, previous to the commencement of the test; (2) a part of the road after completion of the test, taken from a place where the road was still in good condition; and (3) another part of the road after the completion of the test where the road was in a bad condition.

From each specimen a small piece was cut at right angles to the surface of the track, and this was carefully polished and examined and photographed under the microscope. In this way the structure both close to the surface and in the interior could be studied. The road in question contained 55 per cent. of ⅜-in. granite, the rest of the mineral matter being of smaller grading. It was found that in this case there was on the surface a "carpet" composed of bituminous matter and fine mineral matter, having a thickness of approximately ⅜ in., all the large ⅜-in. granite lying below this carpet. "The whole work of the road," the report states, "appears to be taken by the carpet, and if for any reason this is either penetrated or removed the road begins to disintegrate rapidly. In that section of the track which was in good condition at the end of the test the structure was found to be identical with that of the road as first laid down, but in the section of the part which was in bad condition the ⅜-in. granite chips were visible in the surface."

Another road tested in the road machine broke up a few hours after the wet test, in which the entire surface is covered with water, had begun. A section of this road gave on analysis a very low percentage of bitumen, and when a similar road was laid again, using, however, a much higher percentage of bitumen, it withstood the water test for fourteen days. "This appears to show that with a certain grading there is a limiting percentage of bitumen which will make the road resistant to water action, although a much lower percentage will enable it to resist the same traffic in a dry state."

With a view to obtaining some information concerning the composition, grading, and micro-structure of various types of bituminous road, actual sections of roads in different parts of the country have been taken up, and are at present being examined. These include roads which have given very good results in practice, and also those which have failed soon after being laid down.

AERIAL WIRE ROPEWAYS.*

By J. Walwyn White.

ROPEWAYS generally (apart from telpherage installations) may be roughly divided into two main types—the single-rope and the double-rope systems. In a paper by Dr. Gisbert Kapp on the subject, he stated that "mechanical telpherage is only practicable on straight lines, or lines with few and very easy curves, subtending small angles." The reason for this was that the rope saddles then in use, owing to their "passive" form of adhesion to the rope, would not keep to the rope in going round the curve wheels which keep the rope in position when going around these angles, and it was necessary, when coming to a curve wheel, to run the carrier off the rope altogether, by means of a switch run rail, and so conduct the carrier beyond the obstruction until it could run on to the straight part of the rope again, on the fresh tangent.

In practice, however, it was found, with the rigid or passive form of saddle, that owing to the very narrow space naturally provided between the jaws of the fixed saddle, the saddle did not always engage properly on the rope, and "missed stays," so to speak, if there happened to be any extra swing on the carriers due to the wind, or gumping, or other cause. Consequently it was found desirable, if not indeed actually necessary, to keep an attendant always on the spot to put right any such strayed carrier, otherwise the fresh on-coming carriers would only block the line.

This releasing of the saddle from the rope was also necessary at the return terminal, a circular shunt rail being provided at this end to convey the carrier around, and free from the return sheave, and involving the services of one or two men for the purpose. Consequently, automatic return of the carrier at the return end of the line, such as is now customary with the double-rope system, or automatic negotiation of angles *en route*, was not possible with the saddles having fixed jaws. With the "positive" type of saddle, however, the jaws of the gripper have a definite hold on the rope, and do not let go even when going through curves *en route*, or when going around the return terminal. In this case the outer end of the fixed jaw is made V-shaped to fit into the groove of the return wheel. The inward tension of the rope pulls this jaw into engagement with the groove of the wheel, which thus supports the weight of the carrier, either loaded or empty, whilst the carrier is carried around the wheel by the action of the rope, without the necessity of a supporting rail at all at this point. A modification of a similar arrangement is also provided for automatically going around curves *en route*, thus overcoming one of the chief objections to the single-rope system of ropeways, especially where angles have to be negotiated.

Sectional Working.—These aerial ropeways can be used for lines of 20 miles, or even more, in length, but in that case it is necessary to divide the line into sections of about five miles each, as otherwise the rope would be so long and so heavy as to be beyond the range of practical working. Each section is provided with its own separate driving and tension terminals, and the carriers run from one section to the other, mainly automatically, the connecting rail being made with a suitable gradient.

It will be readily understood, especially on a long ropeway of this description, that it is advisable to use as small a rope as is practically possible, in order to reduce the mass of dead weight to be moved, apart from the weight of the actual loads and carriers, and supporting sheaves. The loads are, therefore, usually made in as small units as possible, as it is obvious that the size of rope used, and, therefore, its weight, depends primarily on the maximum unit weight to be carried, though, of course, the maximum length of span employed on the line, and, therefore, the aggregate number of loads on this span, is also a determining factor in fixing the strength of the rope that must be used throughout. It is interesting to note that spans up to and even exceeding 2,000 ft. can be readily employed on this system.

Where large carrying capacity is required it is necessary sometimes to duplicate the whole line; that is, to use two separate and distinct ropes, each with its own driving and tension arrangements, the double ropes or four ropes in all, being mounted on the same supporting standards. By this method up to 200 tons per hour can be carried, though where these heavy duties are required it is generally advisable to use the double-rope system, as much heavier and stiffer ropes can obviously be employed when they are merely fixed and not required to be moved along. It is, therefore, to the double-rope system that one must look for the real work that aerial ropeways are capable of doing.

No longer are designers of ropeways satisfied with installations dealing in small figures, with limited carrying capacities and small gradients, requiring skilled labor attendance, and the necessity of always going in straight lines. It is in this system that the greatest improvements have been effected, both in general design, and also in details, with the result that ropeways are now made of very great length, capable of dealing with unit loads of four or six tons each, and with a carrying capacity of 500 tons per hour if need be, and comfortably negotiating gradients of up to 1 in 2 against the load, automatically traversing around angles, both vertical and horizontal, *en route*, with automatic tipping anywhere along the line, and with automatic return of the carriers, and the employment where necessary of long spans of upwards of 6,000 ft. or more,

The carriers are automatically connected to the hauling rope on the loading rail, and automatically disconnected from this rope on their return, empty, to the loading end, so that for capacities of up to 25 tons per hour one man only is necessary for the entire working of the line. In this system, one rope is fixed, and the carriers travel along the rope itself (instead of with it, as in the first system), being drawn from end to end by a separate haulage or tow rope, which is naturally of much lighter construction. A separate fixed rope, generally of relatively light construction, is provided for the return, or empty side of the line, where loads are required to be carried in one direction only.

The ropes are supported between two terminals, at intervals of usually 100 to 150 yards, on steel or wooden standards, by means of saddles of varying design, some being fixed, whilst in some cases the saddles are free to rock on a pivot, the better to accommodate themselves to the gradient of the line. In one system, however, the carrying ropes instead of being continuous the whole length of the line are divided into separate lengths or

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* From a paper read before the Birmingham Association of Mechanical Engineers.

sections at every standard; that is, a separate length of rope is used for every span of the line, special means being provided for clamping up and tightening each rope, and also for making a smooth track for the carrier wheels from one rope to the other.

There are three particular advantages in this special sectional system of ropeway. In the first place, where absolute freedom from breakdown or stoppage is necessary, in the event of breakage of a carrying rope, instead of the whole length of rope coming to the ground, and with it, of course, all the carriers on it, only the short length of rope on the span at fault would be involved, the rest of the line remaining intact. Then, if a few spare lengths of rope be kept in stock it is only a matter of an hour or so to put in a new span of rope and start the line afresh. Then again, if any specially long spans are involved, and a correspondingly heavier rope be required for this span, only the length of the heavier rope need be used on this one span, the rest being of the normal type.

Improvements in Double-Rope System. — In the author's opinion, one of the greatest improvements that have been effected in the double-rope system is in the form of construction of the fixed rope, or rail rope, as it is sometimes called. This is the locked-coil type of rope. In each of the two types of locked-coil rope now made, the outer wires are so locked together in the stranding as to prevent a wire coming away loose from the rope, even if broken, and at the same time these interlocked wires form a smooth, hard, outer surface to the rope, effectually keeping out the weather from the inner wires, and, what is of greater importance, providing for the easy running of the carrier wheels, with very little vibration, and with a co-efficient of rolling friction very little more than with a similar sized running wheel on a main line steel rail. Then, owing to the absence of any hemp or other soft core in this type of rope, there is exceedingly little stretch in the rope itself when put to work. The reduction of vibration in this type of rope just referred to is of greater importance than appears at first sight.

Curiously enough, the principal cause of failure on these standing ropes is not due to wear on the top of the rope by the passing of the carrier wheels, as one would suppose, but is owing to the breakage of the wires at what is known as the point of arrested vibration. It is obvious that in the middle of a long span of rope there is considerable vibration due to the carriers, and also in some measure to the action of the wind. It is also equally clear that where the rope rests on the supporting saddles there can be no vibration, the rope being solid with the saddle. Consequently, there must be some point between the centre of the rope and the saddle where this vibration commences, and where the wires begin to move relatively to each other. This point is a few feet away from the supporting saddles, the actual distance depending on the construction of the rope itself, the length of the span, and the tightness to which the rope is drawn: and lastly, the amount or amplitude of vibration itself. It will, therefore, be seen that the less the vibration is, the less will be the disturbance at this point and the better for the rope.

It is also apparent that for this and other reasons a long and easy bearing for the rope is necessary at the saddles, with plenty of side support to reduce the flattening tendency on the rope when the load is passing over, and with gradual and easy tapering off of the bearing at each end of the saddle, so as to distribute the position of the point of arrested vibration under carrying conditions of load and tension of the rope.

The haulage rope is spliced endless on the spot. It is driven by gearing at one end, and the usual tension arrangement is provided at the other end, generally the return end, though if the carriers are to be automatically returned from the outwards to the return rope at this point, it is necessary to provide the tension gear at the driving or loading end, for obvious reasons. This driving gear generally consists of a grooved pulley of the same diameter as the gauge of the line, say, 8 or 9 ft. This pulley is keyed on to a vertical shaft, provided at its outer end either with fast-and-loose belt pulleys or with a friction clutch to connect up by suitable gearing with the steam engine or motor driving the line.

The grooved pulley may have one or more grooves around which the hauling rope makes as many half-turns as there are grooves, or if heavy duty is required a fleeting or surging pulley is employed, having a "C" shaped section on the tread around which the rope makes 2½ turns, or even more if necessary to give sufficient adhesion between the rope and the pulley.

There are good reasons for the adoption of either form of driving-wheel, and each form has its own adherents, but if the multiple-groove wheel be used, instead of employing the tension wheel to take the rope from one groove to another, as is generally done, it is better to use a fixed wheel for the purpose, and to run the outgoing loop of rope after leaving the tension wheel around a separate wheel, generally of the same diameter as the double-grooved driving wheel, but running loose on the same shaft. This arrangement saves the "slip" that must otherwise occur in the second groove of the driving-wheel whenever the tension wheel moves, under the varying conditions of load or temperature, and provides for much smoother running of the hauling rope.

Negotiating Angles.—Both vertical and horizontal angles can readily be automatically negotiated on the double-rope system, wherever required, provided a suitable form of gripper be adopted for the purpose. Where ropeways pass over traffic of any kind it is generally advisable to provide some form of protective bridge, in case some of the material carried should fall over the side of an overloaded carrier on to the traffic beneath.

There is yet another form of double ropeway which is now making some progress, though its name involves a contradiction in terms. In this case a single line of fixed carrying rope is used, along which a single carrier travels backwards and forwards, being actuated by an endless hauling rope, the travel of which is reversed as required, this reversal being done by hand or automatically. This type of ropeway forms an exceedingly simple and economic arrangement for automatically disposing of cinders, clinkers, pit dirt or other material, where the quantity is too small to permit the installation of a regular type of ropeway.

In the earlier forms, the carrier was simply stopped at the outer end of its travel, after tipping its contents, by an arrangement of the hauling rope, which moved over an electric switch, after the rope had run out a predetermined distance. The man in charge had to move the switch over again to bring the empty carrier back again. As tipping proceeded, arrangements were made to lengthen the run-out of the hauling rope before moving over the switch.

The next advance on this arrangement was to reverse the carrier automatically after tipping, so that the man in charge would not have to wait for the incoming carrier. For this purpose a mechanical device was considered preferable, consisting of a main driving pulley with a "C" shaped rim, around which the hauling rope makes 2½ turns. This pulley is driven by worm reduction gear actuated by two bevel wheels on an extension of the motor shaft. These bevel wheels run loose on the shaft, to which, however, either one or the other can be connected by cone clutches, and so reverse the motion of the drive to the worm gear. Either one or other ot these clutches as required is thrown into gear by means of a weighted lever, the action of the lever being controlled by a trigger in the cam wheel. This cam wheel is driven by chain from the main driving wheel, and is so arranged that as soon as the driving-wheel has made any required number of revolutions, the lever is thrown over, the one bevel wheel in gear is declutched, and the other bevel wheel clutches on to the motor driving shaft, thus reversing the motion of the hauling rope.

In another arrangement or the single-line ropeway, loaded conveyers are taken out directly on the rope, in a kind of combined cage and tippler, so arranged that on arrival at the point of tipping the tippler part of the cage is caused to revolve, capsizing the conveyer, as in the ordinary colliery tippler, and so automatically discharging its contents on to the tipping ground.

Another modification of this single-line double-rope system is well illustrated in the case of a ropeway employed at a steam power plant for conveying stock coal from railway cars on to the stocking ground, and back again from the stocking ground to the boiler bunkers when required for use. The dual capacity required rather different arrangements. In the first case the ropeway was required to be at its maximum height to provide ample space for automatic tipping, and in the second case the carrying rope had to be low down, so that the carrier could run below ground level for convenience in loading when taking up the stock coal. In the first arrangement, the coal to be stocked is emptied from the hopper-bottomed coal wagons, in which it arrives, into a conveniently-placed hopper, from which the coal runs by gravity along a chute into the carrier box in the ordinary manner. This carrier is large enough to hold one ton of coal, and, as space was limited, and it was desirable not to break the coal more than absolutely necessary, the box, instead of being made to tip right over in the usual manner, was made with bottom doors so arranged that they only opened sufficiently to let the coal out gently. As soon as the box is loaded the starting switch is moved over and the driving gear, which is similar to that described above, takes the load along past the first standard until it arrives at the tipping point on the stocking ground, where the coal is tipped automatically. As soon as the coal is tipped to a sufficient height (12 ft.), portable tramways are laid down and the coal is tipped directly into tipping tramway wagons and taken all over the tipping ground, which has an area of rectangular shape about 400 ft. long and 200 ft. wide.

When it is required to take the coal back again, the main rope of the ropeway is lowered by means of the special gear provided, until the carrier box is low enough to run in a trench dug along the line of route, so that the top of the carrier box is at about ground level. The coal is then brought along in the tramway wagons already described and tipped directly into the ropeway box, the capacity of both the ropeway box and the tram wagons being the same. The coal is then taken back by the ropeway to the original loading point. At this place the carrier is automatically released from the hauling rope, and is run by hand (at present) along a short length of run-rail to the boiler bunkers, into which the coal is tipped in the ordinary manner. At the same time, an empty carrier which is standing ready on a shunt rail, is run out on the ropeway ready for the next load, so that no loss of time is involved.

It it sometimes necessary to utilize to the utmost advantage such space as may be available for dumping, and naturally the best way is to carry the dump as high in the air as possible.

There are several methods of arranging this. In the case of the single-rope system, one way of getting over the difficulty is to employ a movable return terminal fitted on wheels, whilst the main rope of the ropeway is carried for some distance, sometimes several hundred yards beyond the point where tipping commenced, the return tension sheave, of course, being fitted at the far end of the rope, and approximately on the ground level. The tipping frame is situated at the commencement of the tipping ground, and the two ropes, that is, the outer and return ropes, are diverted upwards at this frame by means of sheaves, so as to be out of the way of the carriers, which at this point run off the rope in the manner already described on to the return rail, and are run round by hand from the outwards to the rope, the contents being tipped at the same time on to the ground just ahead of the tipping frame. Here the material is carefully packed at a higher elevation, and after sufficient tipping has taken place and is suitably trimmed, the frame itself is bodily moved forwards on to the higher ground, when tipping again takes place as before. At each successive move of the tipping frame the ground is carried higher, and with it, of course, the frame gradually rises, thus providing more and more tipping room as it travels along and upwards. This arrangement is quite good, but it requires the constant employment of at least two men to tip the carriers and run them round the return rail, and the actual continual movement of the frame itself is a matter of some difficulty.

In case of the double-rope system an ingenious but rather expensive arrangement has been introduced with a certain amount of success by one eminent firm of ropeway builders. In this case a rigid steel structure is provided with fixed run rails, along which the loaded carriers are conveyed. This framing is built of steel to the angle at which the tipping heap is to be made, sometimes as steep as 1 in 2, and as tipping proceeds, the steel frame itself is extended bodily out, section by section, until the required height has been attained. This arrangement works very well, but is somewhat expensive, both in the first expense and in the cost of maintenance. Probably one of the most effective methods after all is by the simple expedient of merely raising the height of the tipping standards themselves. In one case, a ropeway was originally installed some 1,010 ft. long to carry pit dirt from a colliery over a river, and there tip it automatically on the tipping ground beyond. The length of the ground is about 560 ft., and the standards and return terminal were made 50 ft. high, giving a tipping space for 60,000 tons of pit dirt, which was estimated would last the colliery some considerable time. After the work was completed, the colliery company were fortunate enough to strike a new seam, increasing their output of coal and dirt enormously, with the result that the capacity of the ropeway, which was originally designed for carrying 6 tons of dirt per hour, had to be increased by adding on further and larger carriers up to about 20 tons per hour.

Naturally the tipping space provided was then rapidly filled up, and it became necessary to provide further tipping room. The problem was solved by simply adding on 25 ft. to the height of the tipping standards and the return terminal, so making these 75 ft. high from the original ground level, and at the same time the gauge of the ropeway was widened out from the original 7 ft. up to 12 ft. This had the result of not only gradually increasing the height of the tipping space, but also increasing the width of the heap at the top, the original capacity of 60,000 tons being increased up to 130,000 tons of dirt by these means.

Dummy Standards.—Yet another method of increasing the tipping height is by having a dummy standard, or probably a better term would be a portable standard, say, 21 ft. high, which is placed in the centre of the span to support the carrying ropes and take up the sag on them, which naturally increases the tipping height in the centre by this 21 ft. The standard itself is lightly built, and is merely bolted on to two long crossing timbers, without requiring any other foundations. It is easily moved from time to time as required. Care is taken in tipping not to put any debris on the standard itself, and after the extra tipping height thus provided is filled up, the debris at one point near the centre is levelled and the standard raised on to a new position, 21 ft. higher, of course providing for this height of tipping room in the centre of the span. This raising of the dummy standard goes on as tipping proceeds, until finally the ultimate tipping height is reached.

In one instance where this system is followed the length of the tipping ground is 1,120 ft., whilst the tipping standards and return terminal are 65 ft. and 75 ft. high, respectively. With the ordinary arrangement of tipping, this would give a capacity of 141,000 cubic yards. However, with the aid of four of these portable standards, erected in the way described, this capacity would be ultimately increased by 2,769,000 cubic yards, giving a total tipping capacity of 2,910,000 cubic yards, with a height at the centre of 300 ft., and covering the ground at the bottom for a width of 900 ft.

The return standard of a ropeway in Scotland is 150 ft. high. The tipping span in this case is only 400 ft. long, as it was desired to make the best possible use of the limited area at disposal. With the ordinary rate of tipping this one span of 400 ft. would provide a tipping room of 650,000 cubic yards. However, with the aid of two of these portable dummy standards the ultimate tipping content will be increased to 1,740,000 cubic yards, with a height in the centre of 250 ft., and practically filling an area of 750 ft. diameter.

Take the case of a ropeway 1,000 yards long, with tipping standards and return terminal 100 ft. high; this would give a capacity of about 1,250,000 cubic yards, whilst with the use of dummy standards the total tipping room would be about 47,200,000 cubic yards. It will thus be seen what enormously extra tipping space is provided by the simple expedient of using these portable dummy standards.

An interesting installation of ropeways occurs at a quarry on an exposed coast with a flat shore. To save the steamers having to come alongside the pier and take the ground at low water during loading, it was decided to build a bunker capable of holding 1,000 tons of stone out in deep water. Steamers can come alongside this bunker at almost any state of the tide and load a cargo of several hundred tons of stone in about half an hour, the floor of the bunker being laid at the natural angle of repose of the stone to facilitate the sliding of the stone by gravity down chutes directly into the hatchways of the vessel. A ropeway was provided 1,935 ft. long to load the stone automatically into the bunker at the rate of 30 tons per hour. No attendance whatever is required on the bunker during this loading, except that about twice a day a man goes down to alter the position of the tipping bar. This ropeway in its course makes an angle of 148 deg., and the final span from the shore to the bunker is 530 ft. long.

The author has had a lot of interesting figures given to him by various users of ropeways, in each case under the seal of secrecy, but he may say that the expense varies from about 1d. per ton up to 3d. per ton of material carried per mile. The latter figure is probably the maximum. It may probably be taken that 2d. per ton per mile is about a fair average cost of working, including depreciation, interest on capital and actual working expenses, under reasonably fair working conditions.

In one case the actual cost of working a line of ropeway for conveying washed slack from a coal washer to the storage bunker worked out at 0.526d. per ton, whilst the cost of upkeep of the plant is 0.09d. per ton, on a working capacity of 300 tons per day.

In another case, on a ropeway 1.3 miles long, the total charges came to 2.76d. per ton for the whole length, or just over 2d. per ton per mile.

In the case of a ropeway somewhat less than a mile in length, with one automatic angle standard *en route*, the detailed charges are as follows, per ton:—

	d.
Man looking after engine, oiling buckets, ropes, rollers, etc., and shifting the automatic tipper when required	0.266
Filling buckets at the loading end from the tramway trolleys and clutching on to the rope...	0.234
Boy pulling round empty carriers at loading terminal	0.140
Cost of running engine, petrol, oil, belt, and sundries	0.261
Wear and tear of wire ropes	0.192
Wear and tear of wheels, grippers, etc.	0.064
Labor expended for repairs of the whole ropeway	0.801
	1.967

MANUFACTURE OF COAL BRIQUETTES.

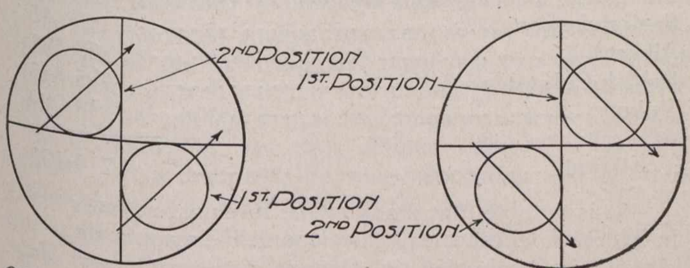
Up to the present European crisis the coal-briquetting industry of the world has been practically limited to Germany, France and Belgium. The magnitude of this industry is shown by a total output of nearly 40 million tons in 1912, and its vitality by a threefold increase in 11 years. The importance of the industry for Germany is exhibited in the fact that that country produced 61 per cent. of the total world-output last year, France sharing it to the extent of 8.74 per cent. and Belgium 6.73 per cent. It is instructive to note that the production of this form of fuel increased in Germany from 9.251 million tons in 1901 to 24.392 million in 1912, in France from 1.883 to 3.496 million tons, and in Belgium from 1.588 to 2.691 million tons in the same period. These figures evidence great vitality in this young industry. It is remarkable that it has not yet taken a deep root in Great Britain, the United States or in Canada. The German product consists largely of brown coal.

OBSERVATION OF THE SUN FOR AZIMUTH.

By J. A. Macdonald, Ottawa, Ont.

STAR observations require a clear sky. They may be prevented by smoke, haze or light clouds, although the sun may be quite visible. It may, therefore, happen that the observation of the sun will be the only method available for the determination of azimuth. The method may not be quite as accurate as with Polaris, and involves considerable calculation. The writer has made use of solar observations almost invariably in railway and land survey and other work, and finds it quite satisfactory. The method here described will be found to eliminate inaccuracies as much as possible.

The observation is made first with the vertical circle in one position, to the right of the observer, for instance, and next with the circle to the left, after reversing the telescope and turning the upper plate 180°. In the first position of the instrument, the image of the sun is brought into the angle formed by two of the threads in the telescope, so as to be tangent to both at the same time. The same process is repeated with the instrument in the second position, but with the sun's image in the opposite angle. (Figs. 1 and 2.) In order to bring both threads tangent



Observation of the Sun (left) in the Forenoon; (right) in the Afternoon, with an Erecting Eyepiece.

to the sun's limb at the same time, the sun's image must be so placed as to move towards one thread while going away from the other. The former thread is kept tangent to the limb by the proper slow-motion screw until both threads are tangent together. In the opposite angle of the threads the same process is repeated with the other slow-motion screw. Fig. 1 shows how the sun's image appears in the forenoon with an erecting eyepiece. In the upper left angle of the threads, the sun's image moves away from the horizontal thread and towards the vertical thread; the latter is kept tangent by the slow-motion screw of the upper plate. In the lower right angle of the threads, the sun's image moves away from the vertical thread and towards the horizontal thread, the latter being kept tangent by the slow-motion screw of the vertical circle. Fig. 2 shows how the discs would be placed in the afternoon.

The observation is easy enough if made methodically, otherwise there is a risk of not placing the images in opposite angles, which would entirely vitiate the result. The following rules, if followed, will prevent mistakes:

(1) Always commence with the sun on the right of the vertical thread and impinging upon it. Above the horizontal thread in the forenoon, and below in the afternoon.

(2) Always commence by following the sun with the slow-motion screw of the vertical circle.

(3) Place the sun on the left of the vertical thread and impinging upon the horizontal thread; below in the forenoon and above in the afternoon.

(4) Follow the sun with the slow-motion screw of the upper plate.

The reading of the horizontal circle on the reference object, generally a line picket, must be taken in both positions of the instrument, and the approximate time of observation noted. The best time for observation is when the sun is near the prime vertical; that is, say, nearly due east and west.

The following formula may be used for calculation:

$$\cos\frac{Az}{2} = \sqrt{\cos S \cos (S-P) \sec. L \sec. h}$$

$$\text{where } S = \frac{h + L + P}{2}$$

h being the true altitude of the sun, L the latitude, P the sun's polar distance on $Az.$, the azimuth. Reckoning the bearing from 0° to 360° and from the north point through east, south and west. $Az.$ is the bearing in the forenoon and 360° minus the bearing in the afternoon.

Below is an example of an observation taken in the forenoon, (H.C.R. denoting horizontal circle reading):

Date—June 15, 7.20 a.m.

Place—Longitude 6 h. 57 m.; latitude. 51° 26′ 45″.

Face.	Sun's altitude.	H.C.R. in sun.	H.C.R. on line.
Right ...	30° 09′	175° 43′ 00″	176° 39′ 00″
Left ...	30° 15′	176° 51′ 00″	176° 40′ 00″
Mean ..	30° 12′	176° 17′ 00″	176° 39′ 30″

Greenwich time.

Local time = June 14	19 h.	20 m.
Longitude - -	+ 6	57
Greenwich time -	2 h.	17 m.

Correction for Altitude.

Obs. altitude	= 30° 12′ 00″
Refraction	= —1′ 40″
Difference	= 30° 10′ 20″
Paralax	= + 8″
h - - -	= 30° 10′ 28″

Sun's Polar Distance

Decl. at 0 h.	= 23° 20′ 16″ N.
Var. for 2 h. 17 m.	= +14
Decl. at 2 h. 17 m.	= 23° 20′ 30″
P - -	= 66° 39′ 30″

h = 30° 10′ 28″
L = 51° 26′ 45″
P = 66° 39′ 30″

$2S$ = 148° 16′ 43″
S = 74° 08′ 21″
$S - P$ = 70° 28′ 51″

sec h = 0.06324
sec L = 0.20533
cos $(S-P)$ = 9.99629

$$\cos^2\frac{Az}{2} = 19.70150$$

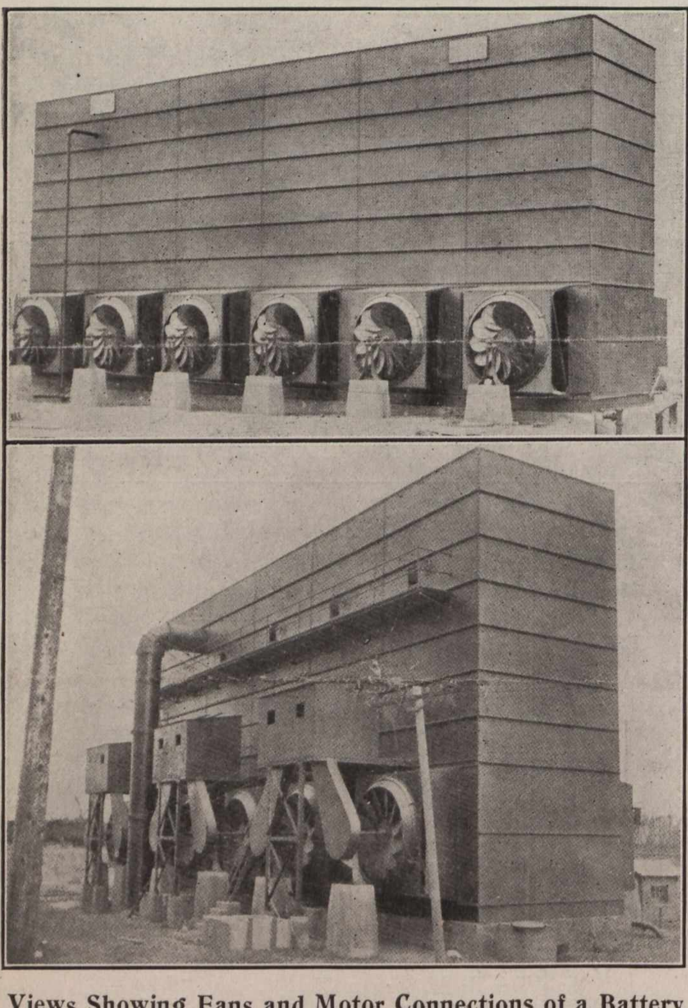
$$\cos\frac{Az}{2} = 9.85075$$

$$\frac{Az}{2} = 44° \; 50' \; 00''$$

Az. or bearing	=	89°	40′	00″
H.C.R. on sun	=	176°	17′	00″
Correction	=	86°	37′	00″
H.C.R. on line	=	176°	39′	30″
Bearing of line	=	90°	02′	30″

LARGE BATTERY OF COOLING TOWERS.

The accompanying views illustrate a large battery of forced draft cooling towers, built by the Wheeler Condenser and Engineering Co., of Carteret, N.J., for the Texas Power and Light Co. The towers, which have a capacity of 600,000 gallons per hour, are of the steel shell type, arranged in a battery 100 ft. long, 40 ft. wide and 40 ft. high. There are six pairs of 10-ft. fans operating



Views Showing Fans and Motor Connections of a Battery of Six Forced Draft Towers.

at 250 r.p.m., belt-driven by motors located above each pair of fans in small motor houses. The fan housings are extended and are provided with doors which may be opened to permit unobstructed entrance of air for operation by natural draft during the winter season. A platform reached by a ladder from the ground serves the three motor houses, and an upper gallery is built on the level of the water distributors and the water-regulating valves which control the water discharge to each compartment. Any section may be cut off for inspection or cleaning without interfering with the operation of any of the others. The water piping is designed for an additional installation of six towers of equal capacity.

CANADA'S POWER RESOURCES.

THE latest statistical statement respecting Canadian water powers by the Dominion Water Power Branch is of great interest. Within the provinces of the Dominion and excluding the Northwest Territories, practically all of the Yukon and the northern and eastern portions of Quebec, it is estimated that 17,764,000 horse-power are available, this amount being inclusive, in the case of Niagara Falls, Fort Frances and the St. Mary's River at Sault Ste. Marie, of only the development permitted by international treaties, and further, does not contemplate the full possibilities of storage for the improvement of capacities. The developed powers, which are inclusive of all water powers, whether for electrical production, pulp grinders, for milling or for the great many other uses, aggregate 1,712,193 horse-power as developed by turbines, and this amount is distributed over the provinces as shown in the following table:—

Province.	Horse-power developed.
Nova Scotia	21,412
New Brunswick	13,390
Prince Edward Island	500
Quebec	520,000
Ontario	789,466
Manitoba	56,730
Saskatchewan	45
Alberta	33,305
British Columbia	265,345
Yukon	12,000
Total	1,712,193

It is notable that many of the foremost advancements in hydraulic engineering have found their application and also their inspiration in Canada. Several very large power plants have been constructed and the many hydraulic plants approaching two million horse-power in aggregate capacity, have permanently established markets, while over eight times this amount is within reasonable zones of commercially economic development. The large cities of Canada are fortunate in being liberally endowed with adjacent water power sources.

EXPANSION JOINTS IN ROADS.

With respect to the use of expansion joints in concrete roads, Mr. H. J. Kuelling, highway commissioner of Milwaukee County, Wisconsin, states that in road construction under his supervision about three-fifths of the work is not provided with protection plates. The intention is to do away with them entirely, as most of the joints are tarred before winter, whether protected by plates or not, in order to waterproof them. So the main advantage of the plates, that of protection, is lost. The joints, whether protected or not, are filled with felt, impregnated with asphalt or tar, coming flush with the concrete in the case of protected joints and about one-half inch above in the case of unprotected joints. The object of leaving the felt extend above the concrete is to seal the joint by filling the crease, which is made by rounding the edge of the concrete next to the joint to a ¼-in. radius. The concrete on each side of the felt is brought to grade by means of a double wooden float, thus insuring both sides being of the same elevation. All joints are being placed 50 feet apart and are ¼ inch thick.

Editorial

ACTIVATED SLUDGE PROCESS.

The papers read by Messrs. Ardern and Lockett on May 30th and December 15th, 1914, and by Mr. S. E. Melling on December 15th, 1914, before the Society of Chemical Industry, on the experiments conducted by them at the Manchester and Salford sewage disposal works, have directed great attention to the possibility of treating sewage by aeration and producing results superior to those ordinarily obtained by the usual bacteriological treatment.

Experiments are now being carried on in Milwaukee, Wis., Chicago and Urbana, Ill., Washington, D.C., Brooklyn, N.Y., Baltimore, Md., Brockton, Mass., Houston, Tex., Cleveland, O., Regina, Sask., and Toronto, Ont. As might be expected, all of the preliminary experiments are on a small scale and it is advisable they should be so, for in a new process it is essential that everything should be noted and investigated, as the characteristic changes in color flocculency and volume of sludge will doubtless have their influence on subsequent developments.

The activated sludge treatment is the intensified application of the oxidizing and nitrifying processes which take place in well aerated and carefully managed percofilters. The colloidal matter contained in, and the flocculent matter carried by, the tank effluent adheres to the filter media. It is oxidized, becomes inoccuous and later on loosens and is washed away by the filtrate.

The method that is now being tried is to pump air into raw sewage until nitrification takes place, remove the clarified liquid and add more raw sewage. The air not only causes oxidation and nitrification, but also keeps the whole content of the tank in a state of ebullition, and solid matter absorbs or takes to itself the impurities contained in the water.

The latest information is that given by Mr. Chalkley Hatton, on Milwaukee experiments, published in the Engineering News for July 15, 1915. According to the figures published, and they are more or less confirmed by those obtained at Urbana and other places, the bulk of the free ammonia is oxidized to nitrate and 99 per cent. of the bacteria in the raw sewage are taken up by the activated sludge, so that the effluent is practically sterile. Mr. M. N. Baker, the Editor of the above journal, describes in the issue of July 22 the various activated sludge experiments he visited. It is evident that the process is being tried by different engineers and chemists in a variety of ways, and in due time we shall be informed of what has been achieved.

There are many problems, however, which are deserving of consideration by Canadian authorities. If there is a potential advantage to the public in the adoption of new and improved methods of surmounting our civic troubles, it is highly desirable that they should be carefully investigated. Sewage treatment is one of the civic problems which will be ever present with us. The city of Toronto and other cities as well, have big problems to solve. The provincial governments have also their responsibilities to discharge in this regard, for the final word rests with them as to the approval or rejection of schemes devised to treat sewage. The science and art of sewage treatment is changing from period to period, or more correctly expressed, the knowledge on the subject is constantly increasing and this inevitably means improved designs. Broad irrigation has given way to bacteriological filters; the design of tanks has changed many times during the last twenty years; standards as to the quality of the effluents have been revised; and the requirements with respect to chemical analyses have been re-drafted. Having regard to these conditions, it is to be hoped that the Canadian sanitary authorities will be so enterprising as to take a place in the front ranks in these important investigations, for in the immediate future they will be called upon to adjudicate on the merits of schemes submitted to them for their adoption or approval.

A MUNICIPAL PROSPECTOR AND HIS FIND.

A few weeks ago the engineer of an industrially thriving Canadian town laid on the council table a sketch of a water connection of considerable size leading from the town mains into a manufacturing plant extremely well known throughout Canada. The management of the plant changed several years ago and the new officials knew nothing whatever of this water service, as there happened to be another connection upon which the supply had always been checked by meter. The discovery created surprise first in the company management and later in the town council. Apparently no one knew that such a connection existed, and it was very evident that this particular plant had received the greater part of its supply for a good many years without charge. Town engineers with investigative dispositions must certainly be an awful nuisance.

In excavation for foundations for new buildings, in the installation of water distribution systems, and in many works of a similar nature the engineer or contractor often encounters pipes and mains concerning which the city or town officials have little or no knowledge. An instance is in mind where a fair sized job was delayed a matter of weeks during a single season as a result of encountering unrecorded water, gas and sewer pipes and waiting for the proper officials to take them in hand.

The Canadian Engineer has referred several times to the present inactive stage of municipal development as being opportune for underground surveys which provide civic officials with an accurate knowledge of what their utility systems really comprise, and which prevent loss of valuable time when stray lines are encountered in the course of a hurried construction job. A careful record of pipes and conduits saves the municipality a good deal of expense in this respect, and it is certainly appreciated by the contractor. Further, it assists the engineering departments in a more judicious consideration of extensions of the various systems involved.

One favorable feature of such a survey is that it costs practically nothing in the way of equipment, while it familiarizes the engineering department of the city or town with essential details, a clear knowledge of which would ridicule the instance referred to above. It is safe to say, in this particular case, that neither the engineer, the manufacturing company nor the present town officials had any knowledge or intimation of the fact that the greater part of the plant's water supply came to it in a mysterious way. It reflects, however, upon the past, and shows the importance of preventing similar occurrences in the future.

May we repeat again that now, while engineering work is slack, is the most favorable time that the present generation may ever see for undertaking an accurate and detailed underground survey. If it is not done during these slack times, there is every likelihood that its remaining undone will be the cause of a good deal of unnecessary expenditure, as the size of our towns and cities increases.

INVESTIGATION OF SEA-WATER CONCRETE.

There have been in the past certain cases of failure of concretes exposed to sea water, which have become very widely known. It is probable that to no one phase of the concrete industry has so much thought and labor been devoted as to the study of the behavior of concretes in sea water and the production of a cement capable of withstanding their action. There is considerable disagreement among authorities as to the causes of such disintegration, but there seems to be concurrence in the opinion that the formation of calcium sulpho-aluminate by interaction between the sulphates of sea water and the aluminates of the cement, is in large measure responsible. This salt (calcium sulpho-aluminate) increases largely in bulk by crystallization and disrupts the concrete by the physical actions attendant thereon.

As a result of considerable research conducted in the Sibley College laboratories of Cornell University, Mr. Nathan C. Johnson has outlined a number of features of the detrimental action of sea-water on concrete in a paper read last June before the American Society of Mechanical Engineers. In it he points out that a microscopic study of the problem reveals much of importance. He indicates the likelihood of this calcium sulpho-aluminate, when formed, producing a gradual straining of the material confining the crystals until rupture occurs. He claims that in the matrix of concretes which show outward signs of disintegration are found, by microscopic study, ample interior evidence of such strains. He relates this crystalline description with similar disintegration in natural stones, containing soluble matter or lying in a locality where seepage water is charged with dissolved salts of various kinds.

There is certainly much to be learned regarding the action of sea water on concrete. By no means all engineers are in favor of the microstructure method advanced by the above writer. Many concrete enthusiasts are inclined to criticize such an investigation, and dislike the publicity that has been given to the importance of the affair. But concrete failures have occurred in sea water that are so indicative of disintegration due to the action of ingredients of the water, that there should be no question of the advisability of most careful investigation, which is readily seen to be of a constructive rather than a destructive nature.

Canada is generally recognized as one of the foremost power-producing countries of the world. Her numerous rivers have immense potentialities, and within the area of population reasonable to be anticipated in the near future is estimated to have water power possibilities aggregating 17,764,000 horse-power, while some 1,712,193 horse-power of this amount has already been developed. Comparison with other countries establishes the Canadian standing among the industrial nations; power development on such a scale is significant of corresponding industrial activity.

RAILWAY PROGRESS IN BRITISH COLUMBIA.

The Kettle Valley Railway, completed some months ago, is now running trains on regular schedule over its entire line. The Canadian Northern Pacific Railway, from the Westminster Bridge to the Yellow Head Pass, a distance of 500 miles, will be ready for operation about September next. According to Mr. F. C. Gamble, chief engineer of the British Columbia Department of Railways, the line has been completed from the bridge to mile 190. Between mile 190 and Kamloops, mile 245, twenty miles have been completed, and twenty miles of ballast have been distributed. This latter portion will be finished by the end of August. North of Kamloops, 125 miles, or mile 370 from bridge at Westminster, have been completed, with the exception of about fifteen miles north of Kamloops, which require a second lift. The ballasting was finished to Blue River, mile 384, last week. Between Blue River, mile 384, and tunnel 41, mile 413, there are twenty miles under way, but this will be completed soon.

The through cut to take the place of the collapsed tunnel at mile 413 will be completed, it is stated, in a few days, when the track will be relaid and connected up. From mile 413 to Yellow Head Pass, the line is completed.

The company is proceeding with the roundhouses, turntables, etc., at the terminal and division points. At different places where stations are to be erected, men are at work.

When the track is connected up between Yellow Head Pass and the bridge at Westminster, three temporary bridges crossing the Thompson River north of Kamloops, above mile 326, will be renewed with steel structures.

The Pacific Great Eastern Railway between the dock at Squamish and Lillooet is in running order and a mixed passenger and daily freight train is running between these two points. Over these sections men are still at work, putting on additional ballast. Beyond Lillooet the track is laid up to Bridge No. 94, which is completed, ten miles north of Lillooet. Bridges Nos. 96, 97, 99 and 100 are in course of construction. It is anticipated that Clinton will be reached with the track by the middle of September.

PROGRESS ON THE HUDSON BAY RAILWAY.

The Department of Railways and Canals, Ottawa, is hastening the completion of the Hudson Bay Railway and its terminal facilities at Port Nelson. It is expected that the line will be completed for operation in about 18 months, according to a statement made the other day by Mr. W. E. Hawco, the superintendent of construction of the terminal works at Port Nelson. The alignment of the entire road has been completed, grading has been finished over two-thirds of it and steel laid over about half of it. It is expected that grading will be completed before the end of this year, and that the steel will be in place before midsummer of 1916. At Port Nelson harbor improvements are under way, docks are being constructed and a large dry dock is almost finished. As soon as the wharves and quays are completed, a grain elevator will be built equal in capacity to any on the Great Lakes. This elevator is expected to be finished in time to store 1916 grain.

Three dredges, including the suction dredge "Port Nelson," specially built for the work by the Polson Iron Works, Limited, Toronto, are engaged in deepening the approach to the harbor. About 850 men are employed on the Port Nelson operations.

A RECORDER FOR MEASURING THE FLOW OVER WEIRS.

BECAUSE of their simplicity and the ease with which they may be standardized, weirs are preferred by many for measuring liquids. Among them is the V-notch weir, the properties of which were first investigated over half a century ago by James Thomson, brother of Lord Kelvin, and further developed by the late James Barr, of the city engineering department, city of Toronto.

With any type of weir or orifice, the rate of flow is dependent upon the head, and once the law of the weir or orifice is known, may be calculated directly therefrom. For most purposes of measurement, however, mere knowledge of the rate of flow at a given instant is not sufficient, but continuous or total results are wanted. This has led to the development of various types of flow recorders. Fig. 1 is designed to illustrate the principle and essential elements of one of the most recent types of such recorders. First there is a float which moves vertically in response to changes in head. With weirs or orifices where there is a free surface of the liquid on the up-stream side, this float rests directly on the surface, whereas with Pitot tubes and Venturi tubes, it ordinarily rests upon the surface of mercury in one of the legs of a U-tube, the two ends of which are subject to the differential pressure due to the Venturi or Pitot tube.

If the motion of the float is employed directly to actuate the recording device, so that the action of the recording pen is directly as the motion of the float, or in proportion to it, a record of rate of flow can be obtained, but the divisions on the chart are not in general equal for equal increments in rate of flow. It is, therefore, necessary to incorporate some kind of translating or modifying mechanism between the motion of the float and the motion of the recording pen. This translating mechanism is ordinarily a cam.

Besides taking account of the law of flow over the weir, the translating mechanism must also provide the proper ratio between float movement and pen movement. The maximum float movement may be, for instance, 4 or 10 ins., whereas the maximum pen movement, that is the maximum height of the chart, may be 2½ ins. The flow of water over a V-notch varies as the 5/2 power of the head, and if the cam for use with a V-notch were of the same length as the maximum movement of the float, it would be very steep at the end corresponding to the high heads, which would give rise to binding between the surface of the cam and the cam follower. In the design of recorders for use with V-notch and rectangular weirs, it is customary, therefore, to make the total length of the cam much greater than the movement of the float, using a multiplying gearing between the float stem and the cam.

In the Cochrane flow recorder herein described, the cam is laid out as a spiral on a flat circular plate, and the multiplying mechanism consists of a small drum mounted upon the spindle of the cam, and having wrapped about it a thin metal cable which is attached to the float spindle, a counterweight on another cable serving to keep the first cable taut. The spiral groove is cut into the surface of the disk, and is so arranged that the part of the cam corresponding to the low heads is near the centre of the disk, and the part corresponding to high heads is near the periphery of the disk, whereby the angle between a tangent to the cam at any point and a tangent at the same point to a circle concentric with the disk is kept small, due to the fact that what would otherwise be the steeper part of the cam is at the greater radius. To accommodate the recorder for use with weirs of different heights it is only necessary to substitute cable drums of the proper respective diameters. One cam serves for all weirs, having the same law connecting head and flow, and hence it has been commercially feasible to devote considerable expense to the mechanical means of reproducing this cam to insure accuracy.

The elimination of friction and back-lash are prime requisites in the design of such apparatus. Back-lash has in the present case been eliminated by the use of a cable drum instead of the gear and pinion drive formerly employed, while friction has been reduced as much as possible by mounting the spindle of the cam upon anti-friction rollers. Accuracy is also promoted by the use of a large, powerful float, and where an enclosed weir chamber is employed, and the float stem must pass through a packing gland, the latter should be of the self-aligning type. By using a slender stem, the harmful effects of errors in alignment are reduced, and the cross-sectional area upon which any pressure which may exist within the float chamber may act in tending to force the stem out of the chamber is minimized.

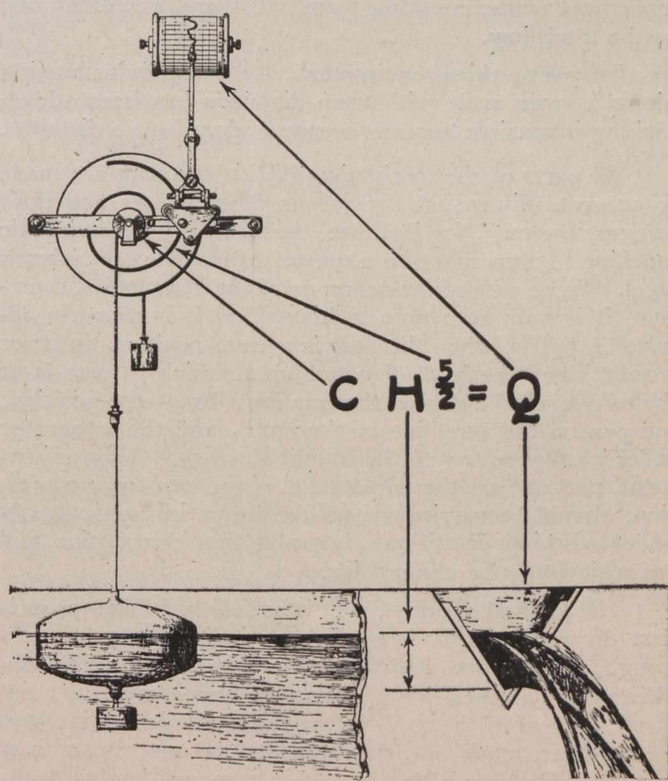


Fig. 1.—Diagram Showing the Principle of the Cochrane Recorder.

The pen carriage is provided with large rollers or wheels, which rest upon horizontal ways, so that the cam follower which is attached to the pen carriage moves diametrically to the cam disk. The pen is suspended from the pen carriage in such manner that it rests lightly against the chart drum by gravity, and can readily be removed for cleaning of the pen or while the chart is being renewed. The direction of motion of the chart drum is such that the progress of the pen is from left to right when the chart is held with the bottom toward the observer.

The chart being driven uniformly by a clock, the pen not only records the rate of flow at each instant, but the area under the pen trace is proportional to the total flow for any elapsed period. In other words, the user of this recorder is supplied not only with a history of the rate of flow, as, for instance, the rate at which his boilers have been fed throughout the day, but may also obtain by the use of an ordinary engine planimeter the total amount of water which has been fed to the boilers, and by comparing this quantity with the amount of coal used, may determine the total and average evaporation for the day.

Many users, however, desire to obtain the total flow directly, without the use of a planimeter, and for this purpose an integrating attachment has been added. This consists of a counting-train likewise suspended from the pen carriage, and driven by a small roller, which rests upon an aluminum clock-driven disk. When the float and cam are at the position corresponding to the zero head, this roller is at the centre of the disk, and hence receives no motion from the rotation of the latter. As the pen carriage is moved away from the zero position, the small roller is carried away the same distance from the centre of the aluminum disk, and hence is propelled at a rate corresponding to the rate of flow over the weir. The total movement of the counting train will therefore correspond to the total flow.

To meet a third requirement, a visible pointer moving along a large scale with open divisions has been added, making it possible to read the rate of flow from a distance.

All parts of the mechanism of this recorder are made to accurate dimensions by means of templates and limit gauges, the cam, for instance, being cut by an automatic machine to correspond to a master cam made of hardened steel. To be sure of the accuracy of the instrument, therefore, it is only necessary to know that it is properly adjusted; that is, when the float is at zero position; in other words, when the level of water upon which it rests is at the zero level of the weir, the cam must be at zero position, the pen on the zero line of the chart, and the integrator roller at the centre of the aluminum disk. This adjustment, particularly the adjustment of the pen to zero position, should be carried out while the entire apparatus is under working conditions, in order that contraction and expansion may be allowed for.

The method of adjustment is as follows: The water is first drawn down to zero level, as indicated by a hook-gauge, usually attached to the outside of the weir tank. When this has been done, a micrometer screw at the point of attachment of the cable to the float stem is manipulated until a zero mark on the cam stands opposite a fixed pointer. The cam is then locked in zero position by means of a pin, after which the pen is brought to the zero line of the chart by a micrometer adjustment on the pen suspension, and a similar adjustment is used for setting the integrator roller to the centre of the aluminum disk.

While originally designed for use with V-notch weirs, this Cochrane flow recorder may be used with rectangular weirs or submerged orifices. It is regularly supplied in connection with the Cochrane V-notch meters and metering heaters manufactured by the Harrison Safety Boiler Works, Philadelphia, Pa., who have supplied the information from which this article has been prepared.

The British Columbia government will co-operate with the Vancouver and Victoria branches of the Canadian Society of Civil Engineers in arranging the programme of entertainment for the occasion of the forthcoming visit in September of large numbers of eastern members of the Society.

DEVELOPMENT OF CANADIAN PEAT BOGS.

ATTENTION is being drawn to the possibility of expansion of Canadian commerce and industry as a result of the war. This may take the form of domestic production of articles for a supply of which we have been dependent upon foreign sources, or of increased exports to other countries of products hitherto supplied by Germany and Austria.

Among other things this emphasizes the importance which development of the latent resources of Canadian peat bogs might readily assume if full advantage of the new conditions arising from the war were taken.

Sulphate of ammonia, the chief by-product of European peat plants, is a valuable fertilizer worth about $60 per ton. The world's production last year is estimated at 1,365,000 tons, worth about $80,000,000. The chief importing countries are as follows, the figures representing excess of consumption over production.

	Tons.	Value.
United States and Canada	58,000	$ 3,500,000
Japan	115,000	7,000,000
Java	57,000	3,500,000
France	15,000	900,000
Spain and Portugal	42,000	2,500,000
Italy	15,000	900,000
	302,000	$18,300,000

Of these amounts the portion supplied by Germany and Austria was:—

	Tons.	Value.
Germany	90,000	$ 5,400,000
Austria	30,000	1,800,000
	120,000	$ 7,200,000

These figures show the existence of extensive markets which might be supplied, in part at least, by Canada, and of an opportunity to capture some share of the trade of Germany and Austria in this product.

The extent and rapid growth of the domestic market for artificial fertilizers is shown by the following statement of Canadian imports for 1902 and 1903 and the past six years.

Year.	Value.	Year.	Value.
1902	$ 84,996	1903	$112,256
1908	403,171	1911	586,453
1909	529,660	1912	620,147
1910	548,493	1913	737,656

Many Canadian peat bogs are rich in nitrogen, and therefore suitable for this industry, and enquiries have already been made by British capitalists with a view to establishing chemical works in Canada, provided that a sufficient supply of peat can be guaranteed.

Apart from the potential value of our peat bogs as a subsidiary source of fuel supply and for production of sulphate of ammonia, there are numerous other products such as moss litter, peat dust, alcohol, acetic acid, acetone, tar, tar oils, creosote, etc., which might form the basis of paying industries giving employment to many people, where now we have only waste lands.

In the peat bogs of Northern Holland alone it is stated that about $3,000,000 worth of peat fuel is made yearly, and over 200,000 tons of peat moss litter. About 10,000 families are employed in the peat fields, and many prosperous towns owe their existence and prosperity to the industry. In addition to shipments made by rail, it is estimated that peat furnishes annually about 48,000 cargoes to the Dutch canal boats.—Journal of the Canadian Peat Society.

ROAD PROGRESS IN QUEBEC.

Hon. J. A. Tessier, Minister of Roads, and Mr. B. Michaud, Deputy Minister, inspected last week the four roads which the provincial government is constructing, *viz.*, the King Edward road, Montreal-Quebec road, Levis-Jackman road, and the Sherbrooke-Derby road.

Sixteen miles of the King Edward road is now complete; the material for ten miles is ready, and work is being pushed rapidly. On this road the provincial government will experiment for one mile with fluxphalte.

Work on the Montreal-Quebec line is also progressing well, especially in the eastern section. It is expected that all the sub-sections in the east will be finished this coming fall. On the western section one of the sub-contractors has nearly completed his contract, save for one part, where work cannot go as fast as desired, because of the nature of the soil. In the central section, that is, on both sides of Three Rivers, the contractors are speedily completing the work.

At present over fifty miles of the Levis-Jackman road is gravelled and fifteen miles ready for gravelling. Work here has been going on smoothly, and by this fall it is expected that the boundary line will be reached, at least as far as the gravelling is concerned.

Both gravelling and bituminous work on the Sherbrooke-Derby line is going on well, and all grading work from Sherbrooke to the border at Derby line is complete.

"EMDEN" STIMULATES RAILWAY.

The "Emden's" exploits are now a thing of the past, but the inconvenience they caused brought into renewed prominence the project for constructing a railway between India and Burma, Rangoon having been practically cut off from the Bengal coast during the raids of the German cruiser. Now the government has taken the matter up, and a survey is being made. The most probable route would be along the coast, the start being made from Chittagong, the terminus of the Assam-Bengal railway, and then running southwards through the rice fields to the Indo-Burmese frontier, thence for 160 miles to the harbor of Kaukkphu. This line would cost about £7,000,000. Another proposed route is via Manipur, which would cost about £5,000,000; and a third is via the Hukong Valley, this being the cheapest, the cost being estimated at only £3,500,000, but the line would run through a very thinly-populated country, whereas the Chittagong-Kaukkphu route would pass through a district already possessing a big trade.

London County Councils Tramways, the municipal street railways of Greater London, is a system that comprises 149.75 miles, of which all but 5.75 miles are electric. Passengers carried in the year ended March 31st, 1915, numbered 550,497,093 as compared with 522,952,640 in the preceding year. Car-miles operated in the year were 58,978,792, and the cost per car-mile of the electric railways, excluding war allowances, was 13 cents, while including war allowances, this cost was 13.6 cents a car-mile. The receipts on the electric lines were 19.4 cents a car-mile as compared with 18 cents a car-mile for the preceding year. On the horse car lines receipts were 19 cents a car-mile as compared with 16 cents for the preceding year.

COAST TO COAST

St. Catharines, Ont.—About 800 Italian laborers employed by contractors on the Welland Ship Canal are leaving to join the colors overseas.

Vancouver, B.C.—A 17-mile railway is to be built from Quatsino Sound into some mining property to be developed forthwith. Mr. J. F. Twohy, of Twohy Bros. & Co.. was over the ground a few weeks ago.

Ottawa, Ont.—The $45,000,000 loan which the government floated in New York recently is to provide for capital expenditures during the current year upon government undertakings now in the process of construction.

Macleod, Alta.—Heavy and prolonged rains have interfered considerably with the grading of the Macleod branch of the C.N.R. by the Northern Construction Co. Over 20 miles have been graded, however, about 400 men being employed.

Fredericton, N.B.—In connection with the completion of the Valley Railway between St. John and Grand Falls, a new bridge is to be constructed over the St. John River at Gorham Bluff. Boring on the proposed site will commence in a few days.

Winnipeg, Man.—The first freight train over the new route of the National Transcontinental Railway between Toronto and Winnipeg, via Cochrane, arrived in Winnipeg ten hours ahead of scheduled time. It comprised 40 cars, in all, about 1,400 tons.

Collingwood, Ont.—To facilitate yard operation the local branch of the Imperial Oil Company has decided to change from steam to electric motive power. It has contracted for 350 h.p. from the Water and Light Commission and has already placed orders for 1-50, 1-15, 1-40, 1-20 and 2-125 h.p. motors.

Prince Rupert, B.C.—The floating dry dock, together with its plant, foundry and machine shops, is expected to be ready for operation next week. It has cost about $1,500,000, and consists of three units, the two end sections being each of 5,000 tons capacity, and the middle section 10,000 tons. The work of construction has been under way since 1912.

Vancouver, B.C.—The British Columbia Telephone Co. is doing some extensive underground work along Kingsway to provide additional telephone facilities for the south and east sections of Fairview. Considerable improvements are also being carried out in Victoria, especially in the Cloverdale and Milner sections. Altogether, an expenditure of considerably over $100,000 is being made.

Midland, Ont.—The Port Severn locks at the Georgian Bay end of the Trent Valley Canal were opened for the first time on July 26th. When completed the canal will be 222 miles long. From Georgian Bay to Lake Simcoe the rise is 318 ft., with a drop to Lake Ontario of 470 ft. Several contracts are still under way, but the greater part of the work is reaching completion. There are still several contracts to be let.

Vancouver, B.C.—A new dredging contract has been let to Mr. H. S. Clements which will involve the dredging of about 3,000 ft. of the Courtenay River. Two rock bars are to be blasted out in the interests of navigation and deep-water retaining-walls to be constructed on either side. Another interesting piece of work involves the construction of the second unit of the Fraser

River main channel jetty at Steveston. This was let some little time ago to Messrs. March, Hutton, Powers Co., Limited, the price being about $400,000. It is a Dominion Government contract.

Brantford, Ont.—Since the negotiations between the city and the Canadian Pacific Railway whereby the Paris-to-Galt section of the Grand Valley Railway becomes the property of the C.P.R., in consideration of the payment to the city of $30,000 and the promise to electrify the Lake Erie and Northern Railway, plans are being laid for future extension. The roadbed of the line between Brantford and Paris is to be straightened and repaired, and plans are under way for the construction of a new station and waiting-room. Plans are also being considered for an extension of the municipal railway system to Terrace Hill and to West Brantford.

PERSONAL

W. G. HARDY, of St. Lambert, Que., left recently for the front with the Sanitary Section of the Canadian Army Medical Corps.

SYDNEY V. ARDAGH, until recently on railway work in Northern British Columbia, has enlisted for active service with the Canadian Engineers.

GEORGE BICKLE, of Hamilton, has been appointed assistant engineer in charge of the Beach Pumping Station, Hamilton, succeeding Mr. George Henderson, resigned.

H. J. McAUSLAN, B.A.Sc., O.L.S., of Anderson & McAuslan, civil engineers and surveyors, has been appointed town engineer of North Bay, succeeding Mr. John Shaw, resigned.

B. B. McLAY, assistant city engineer of Vancouver, in charge of construction work, has resigned and is returning to his home in Scotland to enter the service of the British Government.

OBITUARY.

The death is announced of Mr. Edward B. Allen, assistant master mechanic at the Granby smelter at Anyox, B.C. The deceased, who was a native of St. John, N.B., and 37 years of age, was accidentally struck by a water jacket and killed almost instantly.

The death occurred last week of Mr. J. H. Roberts, material inspector at Walkerville for the motive car and power department of the Grand Trunk Railway. Mr. Roberts was formerly master mechanic of the shops at Stratford, Ont.

CANADIAN ELECTRIC RAILWAY ASSOCIATION.

The new officers, elected at a recent convention in Quebec, of the Canadian Electric Railway Association, are as follows: President, J. D. Fraser, secretary-treasurer of the Ottawa Electric Railway Company; vice-president, E. P. Coleman, general manager of the Dominion Power & Transmission Co.; secretary-treasurer, Acton Burrows; executive, the president, vice-president, secretary-treasurer, and the following: A. Eastman, general manager Windsor, Essex and Lake Shore Rapid Railway; H. M. Hopper, general manager St. John Railway Company; Wilson Phillips, superintendent Winnipeg Electric Railway; C. L. Wilson, assistant manager Toronto & York Radial Railway; A. Gaboury, superintendent Montreal Tramways; H. G. Matthews, general manager Quebec Railway, Light, Heat & Power Company; C. B. King, manager London Street Railway.

COMING MEETINGS.

PACIFIC HIGHWAY ASSOCIATION.—Fifth annual meeting to be held in San Francisco, Cal., August 11th and 12th, 1915. Secretary, Henry L. Bowlby, 510 Chamber of Commerce Building, Portland, Ore.

PROVINCIAL ASSOCIATION OF FIRE CHIEFS.—Annual Convention to be held in Ottawa, Ont., August 24th to 27th, 1915. Secretary, Chief James Armstrong, Kingston, Ont.

NEW ENGLAND WATERWORKS ASSOCIATION.—Annual Convention to be held in New York City September 7th to 9th, 1915. Secretary, Willard Kent, 715 Tremont Temple, Boston, Mass.

AMERICAN ROAD BUILDERS' ASSOCIATION and AMERICAN HIGHWAY ASSOCIATION.—Pan American Road Congress to be held in Oakland, Cal., September 13th to 17th, 1915. Secretary, American Road Builders' Association, E. L. Powers, 150 Nassau Street, New York, N.Y. Executive Secretary, American Highway Association, I. S. Pennybacker, Colorado Building, Washington, D.C.

AMERICAN ELECTROCHEMICAL SOCIETY.—Twenty-eighth annual general meeting to be held in San Francisco, Cal., September 16th to 18th, 1915. J. M. Muir, 239 West 39th Street, New York City, Chairman of Transportation Committee.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Convention to be held in San Francisco, Cal., September 16th to 18th, 1915. Secretary, Calvin W. Rice 29 West 39th Street, New York City.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—Convention to be held in San Francisco, Cal., September 16th to 18th, 1915. Secretary, F. L. Hutchinson, 29 West 39th Street, New York City.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Annual convention to be held in San Francisco, Cal., September 16th to 18th, 1915. Secretary, Charles Warren Hunt, 220 West 57th Street, New York.

INTERNATIONAL ENGINEERING CONGRESS.—To be held in San Francisco, Cal., September 20th to 25th, 1915. Secretary, W. A. Catell, Foxcroft Building, San Francisco, Cal.

AMERICAN ELECTRIC RAILWAY ASSOCIATION.—Annual convention to be held in San Francisco, Cal., October 4th to 8th, 1915. Secretary, E. B. Burritt, 29 West 39th Street, New York.

NATIONAL PAVING BRICK MANUFACTURERS' ASSOCIATION.—Annual convention to be held in Dayton, O., October 11th and 12th, 1915. Secretary, Will P. Blair, B. of L. E. Building, Cleveland, O.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Annual convention to be held in Dayton, O., October 12th to 14th, 1915.. Secretary, Charles Carroll Brown, 702 Wulsin Building, Indianapolis, Ind.

COAST TO COAST.

(Continued from page 244.)

Saanich, B.C.—Excavation work has commenced for the Saanich waterworks system.

Winnipeg, Man.—The Shoal Lake dyke has been fully completed, the entire cost of which was approximately $120,700. Tomlinson and Flemming were the contractors.

Empress, Sask.—Work has commenced on the erection of a 30,000-bushel elevator for the Lake of the Woods Milling Co. G. F. Grundy is in charge of the work for the company.

London, Ont.—Work on the West London breakwater is now in full swing. In order to facilitate the work of construction, the Springbank dam has been opened to lower the river.

Banff, Alta.—The boring at the site of the proposed new bridge over the Bow River at Banff has now been completed by Engineer Macleod, of the Department of Public Works for Alberta.

New Westminster, B.C.—The Dominion Construction Company, contractors for the piling and decking of the new city market, have completed their work, and the government dredge No. 303 is proceeding with the fill for the extension.

Victoria, B.C.—In a few weeks at the outside, the work on the new Hudson's Bay block, corner of Douglas and Herald Streets, will have been completed, with the exception of the interior finishing. The contract held by the B.C. Construction Co. was commenced early last year.

Gray Creek, B.C.—Road work is progressing favorably on the portion of the imperial highway between Gray Creek and Crawford Bay. When this portion of the imperial highway is completed there will be a good road from Char Bay to Kootenay Bay.

Moose Jaw, Sask.—The 18-inch sanitary intercepting sewer, which has been in the course of construction from the 26th of January last, was completed on the 28th of June. It was constructed entirely by day labor, at a total cost of $31,723. The total length of this sewer is 6,086 ft.

Bayfield, Ont.—Mr. J. J. Merner, M.P., South Huron, has been notified from Ottawa that work will begin within a few days on the dredging of the harbor here. The work is needed to complete the improvements which have been made to the harbor, an extension having been added to the pier and the old pier strengthened and largely rebuilt.

Saanich, B.C.—Splendid progress is being made in the road work. Mr. Johnson, engineer for the municipality, has fixed the end of August as the date for the completion of the pavement between the junction of the East Saanich Road and North Quadra Street and the Royal Oak. This will give a splendid route for traffic from Victoria through South Saanich to the different resorts both of that district and of North Saanich.

Quebec, Que.—The Dorchester Electric Co., which was some time ago disposed of by auction for the sum of $100,000, has now registered under the name of the Public Service Corporation, and all the affairs, etc., will be run as of old. The building of the transmission line from Quebec City to Shawinigan has already commenced. As is well known, the sale recently effected brings about the absorption of the Dorchester Electric Co. by the Shawinigan interests.

Hamilton, Ont.—With the commencement of the laying of concrete on the Toronto-Hamilton highway between the Valley Inn and the Brant House, that section of the road will be completed and ready for traffic soon. The engineers in charge stated that they expected the section would be completed by September 1. This will be the first part of the road to be finished, although other sections will be ready for traffic shortly afterward. The stretch near the Brant House is the first where the cement is being poured.

Winnipeg, Man.—Through railway connections are now being maintained over the Grand Trunk Pacific transcontinental line between Prince Rupert and Toronto, giving direct service from the Pacific to the Atlantic. The new G.T.P. service became effective last week with the opening of the new section of railroad between Winnipeg and Cochrane, which section was built by the Dominion Government, and known as the National Transcontinental, connecting North Bay over the Temiskaming and Northern Ontario Railway.

Ottawa, Ont.—The International Joint Commission announces a series of hearings early in September in connection with the investigations they have been carrying on for a couple of years past relating to the levels of the Lake of the Woods and its tributary waters. The meeting will open at the town of Warroad, Minnesota, on September 7. The commission will then take testimony at International Falls, on the Minnesota side of Rainy River; and finally at Kenora, Ont., at the outlet of the Lake of the Woods.

Port Colborne, Ont.—A 300-foot test section of the proposed pipe line to supply water to the municipalities along the new Welland Canal is being built here, on property owned by the government. The work is in charge of Mr. Pringle, C.E., of the St. Catharines office, assisted by Engineer Johnson and staff. The 300 feet under construction is a 48-inch stave pipe, wire-wound, and covered with 6-inch iron reinforced concrete, and will be placed two feet under ground. When finished, the pipe will be thoroughly tested, and if found satisfactory will probably be used throughout the line.

Edmonton, Alta.—Grading on the A. & G. W. is expected to be completed to within a few miles of McMurray in two weeks. Except at the crossing of the Burnt River, where there are some heavy cuttings, the grading on the fifty miles of the Dunvegan Railway main line from the Smoky Valley and Spirit River City is completed. Good progress is being made in the heavy work at the crossing of the Smoky. All the work on the extension of Canada Central from Reno to Peace River crossing, 21 miles, is covered by contractors and is to be completed by October. Contractors are also at work on the Grand Prairie branch from Spirit River, and grading will be completed before winter.

Chatham, Ont.—The Chatham, Wallaceburg and Lake Erie Railway, at present owned by the Canadian Northern Railway Company, may form the first link in the chain of hydro radials that will be built in this part of the province. Negotiations are now being carried on between the Ontario Hydro Commission and the C.N.R., with the object in view of purchasing the line, which runs from Erie Beach, on the south, to Wallaceburg on the north. It is said that if the road is purchased it will be extended to Sarnia, through Petrolia and other places that will shortly take hydro power. It was also intimated by Sir Adam Beck that in case the road is purchased extensions would also be made from Erie Beach to Rondeau in addition to the one to Sarnia, thus connecting two lakes, Erie and Huron.