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The Canadian Engineer

VOL. XI.—NO. 12. TORONTO AND MONTREAL, DECEMBER, 1904. PRICE 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

ISSUED MONTHLY IN THE INTERESTS OF THE CIVIL, MECHANICAL, ELECTRICAL, LOCOMOTIVE, STATIONARY, MARINE, MINING AND SANITARY ENGINEER, THE SURVEYOR, THE MANUFACTURER, THE CONTRACTOR AND THE MERCHANT IN THE METAL TRADES.

SUBSCRIPTION—Canada, Great Britain and the United States, $1.00 per year, foreign, 6s. Advertising rates on application.

OFFICES—18 Court St. Toronto ; and Fraser Building, Montreal.
Toronto Telephone, Main 4310. Montreal Telephone, Main 2589.
BIGGAR-SAMUEL, LIMITED, Publishers,

All business correspondence should be addressed to our Montreal office. Editorial matter, cuts, electros and drawings should be addressed to the Toronto Office, and should be sent whenever possible, by mail, not by express. The publishers do not undertake to pay duty on cuts from abroad. Changes of advertisements should be in our hands not later than the 15th of the preceding month or if proof is desired, 4 days earlier.

CONTENTS OF THIS NUMBER.

TO OUR READERS.

In closing the eleventh year of the Canadian Engineer, we desire to thank our readers and advertisers for the confidence they have shown in the paper, as manifested in their steadily increasing support.

We have now arrived at a point where the interests covered by the Canadian Engineer can be advantageously specialized, and in order to give better service and more matter to those of our readers who are solely interested in mechanical engineering, we have decided to start in January a new paper to be called

"THE CANADIAN MACHINE SHOP,"

which will be devoted exclusively to the interests of machinists, machinery users, foundrymen, and workers in the metal trades generally.

The new paper will be published in popular magazine style, at $1 per year, and will amply illustrate the latest developments in modern machinery and shop practice. Our readers will oblige by making this announcement known to their friends who may be interested and who will desire to have a Canadian paper devoted to their particular needs. We do not desire to displace the circulation in Canada of such of our esteemed contemporaries as the American Machinist, Machinery, the Model Engineer, and other excellent British and United States publications. We rather desire to see these ably conducted journals more extensively circulated, but feel sure that the addition of a thoroughly Canadian journal will be a useful adjunct in giving fresh information, and affording a valuable record of Canadian progress in the field. We shall be glad to receive the names of any subscribers for the "Canadian Machine Shop" from among the readers of the Canadian Engineer and shall take pleasure in sending a sample copy to them or any of their friends on request. We desire to enter upon our list as many as possible to start with the first number.

In conclusion we heartily wish our readers a merry Christmas and a happy and prosperous New Year.

THE BELL TELEPHONE COMPANY AND THE MUNICIPALITIES.

The decision of the Privy Council in the case of the Bell Telephone Company and the city of Toronto is a serious blow to the rights of municipalities. That any corporation should have the right under a Dominion Act to use the streets of Canadian cities and towns for the purpose of earning dividends for private stockholders, without adequate compensation for the privilege, is a position which should not be tolerated by the people. We are glad to note that Toronto has already taken action with the object of bringing the united pressure of the municipalities to bear upon the Government to amend the law in this respect. We are not, however, very sanguine as to the success of this policy. Experience in other matters, such as the exclusion of municipal and independent telephones from the railway stations at Fort William, Port Arthur, and other places, teaches that the monopoly generally emerges the victor in any agitation to curtail its rights. Only one means exists by which to secure to the people of Canada their rights in this, and other respects, and that is, break the monopoly by the establishment of municipal, or independent telephone systems under the control of the local authorities. In this connection we regret the lack of stability on the part of several municipal councils in their dealings with independent companies applying for competitive franchises. It is a matter of record that many aldermen who start out, at the beginning of an agitation for telephone competition, enthusiastic supporters of the movement invariably have a too willing ear for "Bell" arguments, and when a final vote is taken they are found on the side of the monopoly. In other cases all kinds of reasons are set forth to secure delay, or such onerous conditions are framed as effectually shut out any chance of competition. The result of all this is that the "Bell" in the end generally succeeds in retaining undisputed possession of the field. This ought not to be and aldermen with a sincere desire to protect the people's right to control their own property, and secure cheap and efficient service, should give no heed to any arguments which have for their object the postponement of the introduction of competition. In every case such arguments, no matter by whom advanced, if traced to their original source will be found to be creations of the "Bell" monopoly.

Municipalities who fail to encourage the growth of telephone competition, still further strengthen a monopoly which every year will acquire a tighter hold upon the people who will become more and more powerless to get back their rights which have been voted away by the men whom they elected to protect them.

We note with satisfaction that there is an inclination on the part of the Government to acquire the long distance telephone lines, and while we sincerely hope the time is not far distant when this proposition will be an accomplished fact, we are inclined to the belief that the day when the telephone trunk lines will finally pass out of the hands of the Bell Telephone Co., is a long way off. In the meantime there is a danger of municipalities being urged to delay action in dealing with local telephone matters, on the plea that they had better wait until the Government take action in regard to the long-distance system. On the other hand we are convinced that there is no possibility of Government ownership of the telephone trunk lines until the need for such action is made apparent by the establishment of independent local systems in various parts of the Dominion. It is therefore to be desired that the municipalities will unite in a vigorous effort to secure the building up of independent telephone systems, and will give all reasonable encouragement and assistance to bona-fide companies seeking franchises on fair terms, that is, where municipal ownership is not considered desirable.

The people should give no quarter to a company that openly defies the municipalities, under cover of a Dominion Act, and should further refuse to recognize the principle of granting exclusive franchises to a monopoly, in return for a payment, not for the privilege of using the streets, but to enable it to charge telephone users rentals very much in excess of those for which independent companies are willing to furnish a better service.

SMELTING BY ELECTRICITY.

Of the special reports issued by the Dominion Government during the year now closing, the most important is that of the commission sent to Europe to investigate the subject of smelting by electricity. A synopsis of parts of the report appears elsewhere; and we hope to refer to other aspects of the question later on.

We share the optimism of Dr. Haanel as to the utility of the electric furnace in metallurgy, because every week sees some advance made by inventors in overcoming the drawbacks that have been encountered in the various processes that are going through the evolutionary stage. There are situations in Canada that appear to be specially suited for putting the electric furnace into operation, and already some Canadians at Ottawa and Peterboro are ready to go on record as pioneers in this field. They will be leaders in a field that promises great things for a country like Canada with its colossal water-powers; they may even be financially successful at the start, which is not the good fortune of most pioneers.

If we take the present condition of the iron, steel, and other metal industries, we find that the countries which have been most successful have had good supplies of workable ore and cheap coal as well as cheap transportation between the localities producing the ore and those producing the coal. It is seldom that the ore and coal lie close together as they do in parts of Nova Scotia and British Columbia. Ontario and Quebec, for instance, have various ores of good quality and in good supply, but they have no coal as yet discovered in large veins. Hence these provinces have not developed in smelting as they might have done with cheap supplies of coal. But here nature and science have at last joined to make good the defect, and the success of electric smelting means a new industrial era for these and other provinces. The big water-powers are equivalent to so many coal mines and wherever these water-powers can be developed cheaply and are situated convenient to water transportation or cheap rail transportation, we may expect more or less of these industries to arise in the near future according to the enterprise of the people or their local advantages in other respects. These developments may take unexpected turns in various parts of Canada, especially when combined with the electro-chemical industries, which afford another vast field for the employment of our great water-powers. Looking thus at a large water-power as equivalent to a coal mine we may soon see cities arising in the midst of northern forests where water-falls have been vainly calling throughout the centuries to have their might displayed in harness.

It should be realized, however, that the electric furnace as now being developed cannot do every kind of smelting. It can already do some things better than any other kind of furnace. In the production of ferro-alloys, its success is already undeniable. In Italy, Switzerland and Alpine France, where fuel is dear but water-power abundant, its application has made great progress. In fact the electric furnace has already been the means of flooding the market with these commodities and other uses have to be sought. Diversifying the product of the electric furnace is now the problem there, but as pointed out by writers on the subject, this only follows the history of metallurgy by coal and coke, where the blast furnace is devoted to pig-iron, the puddling furnace to wrought-iron, the crucible furnace to special tool steel and the Bessemer furnace to its particular grades of steel. The refining of blast furnace pig-iron by the electric process has advantages over the present method. Starting with hot metal direct from the blast furnace the temperature is raised and maintained more easily because of the higher electrical resistance of hot iron. The production of steel by the electrical process seems more promising than the direct reduction of iron ores, one difficulty in the latter work being the designing of a furnace of sufficient capacity. Such difficulties may be overcome in time.

In a paper read before the recent Foundrymen's Convention at Philadelphia, P. McN. Bennie draws the following conclusions as to the application of the electric furnace to metallurgy and to foundry practice:—

" It will be seen that the electro-metallurgy of iron and steel has already left the domain of the laboratory and experimental plant, and taken on the serious aspect of an established industry. The electric furnace has its limitations, which it would be well to bear in mind. Even its most ardent advocates do not consider it a menace to the older methods, but rather as a new and useful adjunct to present metallurgical practice. It should be noted that while some processes are designed to perform the direct reduction of iron ores, the general tendency is to use the electrical energy for production of steel, and particularly as a refining agent in treatment of pig iron and scrap. For this field of usefulness, the electro-refinery seems destined to occupy a permanent place in the art.

When we shall witness the combination of the blast furnace for cast iron, the Bessemer converter for common steel, and the electrical refinery using energy generated from waste blast furnace gases, making higher grade steels, then industrial metallurgy will have attained the high-water mark in the utilization of the heat energy of coal. In attacking the older art from the crucible steel standpoint, electro-metallurgists are undoubtedly hitting at the weakest spot. In the application of the electric furnace to foundry practice, it would be possible to arrange an electrical refining furnace so that it could use the product of any one or all of the cupolas. With the furnace body in the form of a ladle, placed upon a carriage, suitably counterbalanced, and able to swing free in a circle, it may receive its charge and then be placed under the arrangement for carrying the electrodes. By lowering the electrodes, turning on the current, refining may be carried out as previously described in several processes. Without using excessive currents, liquid iron may be converted into steel of good quality. This may suggest to some of your enterprising foundry managers ways of employing their full capacity at all times; to improve the quality of their castings; to convert a portion of the product into steel. For a small cost, a foundry arranged for the manufacture of cast iron could undertake steel castings and augment considerably its sphere of commercial activity."

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HOW NOT TO GET CANADIAN TRADE.

The Monetary Times has published a pamphlet under the title of "Dishonest representations—a remonstrance against untruthful statements made in England in connection with Canadian trade." This pamphlet reproduces articles that have appeared from time to time during the past three years in the Monetary Times exposing the methods adopted by the travelling agent of two Montreal commercial journals in obtaining advertisements from British firms who are seeking trade in Canada. One of the schemes adopted by this canvasser was to claim that the paper he represented was subsidized by the Dominion Government. The attention of the Canadian Secretary of State was called to this matter, but it does not appear that any steps were taken until quite recently to put a stop to these misrepresentations, though the Under-Secretary of State denied that his department ever authorized its name to be used even as "a reference" in behalf of one of the papers referred to. A letter from the Under-Secretary to that publisher asking for the name of the official alleged to have given authority for the "reference" remained unanswered. The Canadian Engineer has been in receipt of letters from time to time from British firms who appear to reason, rather illogically, that because they have been disappointed in one advertising transaction there is no use in trying to do business in Canada through advertisements. A correspondent of "Commercial Intelligence" deals with this subject, and pokes fun at the readiness with which British firms have placed advertisements in certain journals "masquerading as trade papers" while their names are absent from the pages of the reputable papers in Canada devoted to their particular line of trade. Imagine, for instance, a coterie of leading British boot and shoe manufacturers spending hundreds of pounds in advertising British-made footwear in Canada, or furniture manufacturers pushing English-made goods of the common class, when Canadian furniture and boots and shoes are so much cheaper that thousands of dollars worth are shipped every year to the Old Country.

These mistakes of British merchants and manufacturers are not serious in themselves, but they are important as disclosing a condition of apathy in regard to trade opportunities in Canada, and of ignorance of the trade conditions now existing in this country. Why is it that, as a rule, we do not find United States firms making the same mistakes in placing their advertisements in Canadian papers? Yet United States firms advertise ten times as much in the trade papers of Canada as British firms, and the striking fact is that in many lines they are taking a proportionate amount of the orders placed by Canadian houses. Regret it as many of our people do, it must be confessed that our United States neighbors understand Canadian temperament better than our British cousins do, and keep themselves in better touch with us, and no clearer proof of this is needed than the methods adopted by the two peoples in cultivating Canadian trade.

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—Now that a large supply of electric power will soon be on the market at Niagara Falls, we shall expect to learn of electricity being turned to account to a surprising extent by the farmers of Ontario, especially in the Niagara peninsula to begin with. What has happened in some rural districts in the Western States may be taken as a forecast of developments in Canada. A notable instance briefly described elsewhere is the successful attempt made by the farmers of Kane County, Illinois, to supplant horse, hand and steam power by electricity in carrying out all the operations of the farm. The current is switched from the electric railways and is made to operate pumps, creameries, feed choppers, threshers, fanning-mills, saws, churns, water storage systems, and in fact perform almost all the work hitherto done by horses or steam engines. In a report to the Chicago Tribune these farmers state that the cost of electric power is from 40 to 60 per cent. less than manual or horse labor. The success of these experiments and the remarkable extension of the use of the telephone on the farm will mean a revolution not only in the methods of farming but in the social condition of the farmers. The farmer and his wife and children will no longer need to lead solitary lives. In a few minutes they can learn the price of produce in their market town, or the substance of the foreign news, or again have a social chat with their neighbors. With electric power to ease the strain of the heavier labor of the farm, rural life will have positive attractions to many people now toiling hard in ill-ventilated factories in cities. For a number of decades, "Back to the land" has been the vain appeal of philosophers who have realized the evils and drawbacks of city life; but electricity may soon accomplish a change which neither legislation, philosophy, nor the eloquence of patriots has effected in keeping the boy or girl on the farm or bringing him back after he has adventured into the city.

SMELTING BY ELECTRICITY.

The commissioners sent to Europe by the Dominion Government to investigate the status of the electrical reduction of ores and the making of steel, have sent in their report, which makes a volume of 221 pages, with several plans and diagrams. As mentioned in previous references to the subject, the commission was composed of Dr. Eugene Haanel, Superintendent of Mines, working under the Department of the Interior; C. E. Brown, assistant works engineer of the Canadian General Electric Co., Peterboro; M. Nystrom, draughtsman. In England these were joined by F. W. Harbord, who accompanied the commission as metallurgist.

In the electrical production of pig iron, the Héroult process at La Praz, France, and the Keller process at Livet, France, were investigated; and in the manufacture of steel by electricity they examined the Kjellin process at Gysinge, Sweden, the Héroult processes at Kortfors, Sweden, and at La Praz, and the Keller process at Livet. There is also a report on the Stassano process at Turin, Italy, though through an accident that furnace was not in operation when visited. Other new patents for electrical smelting processes are referred to in the report.

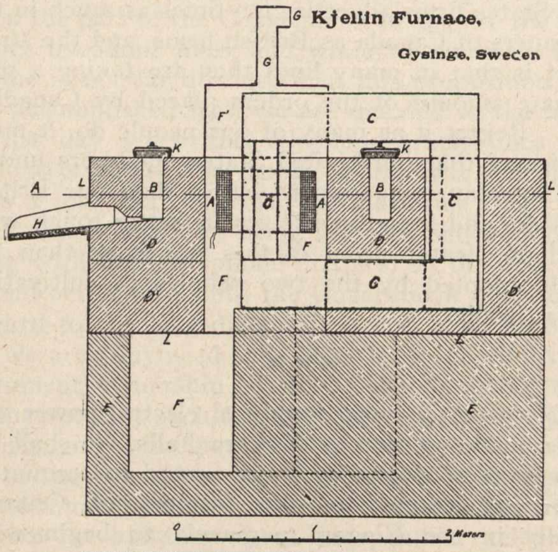


Fig. 1

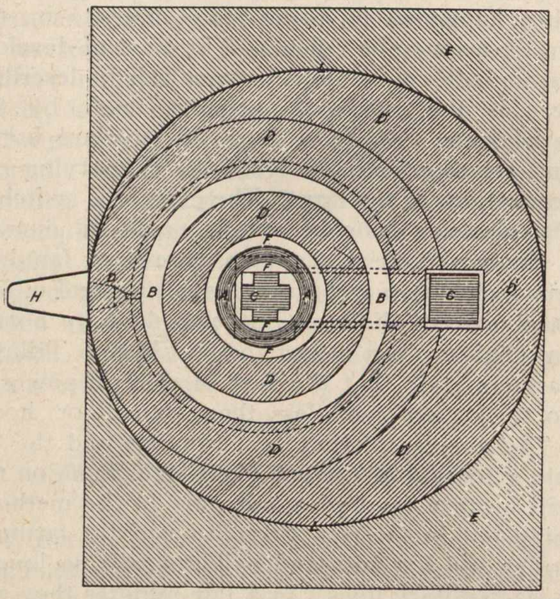
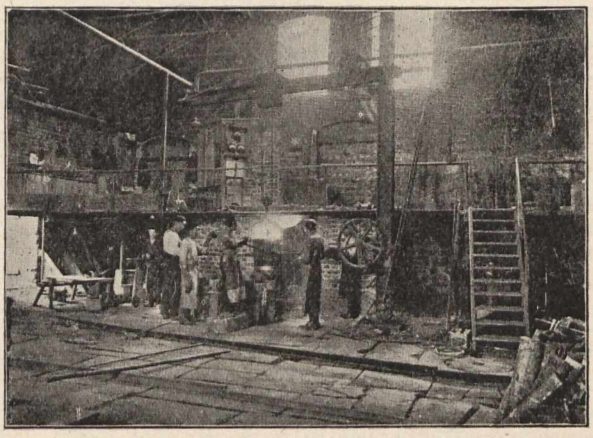


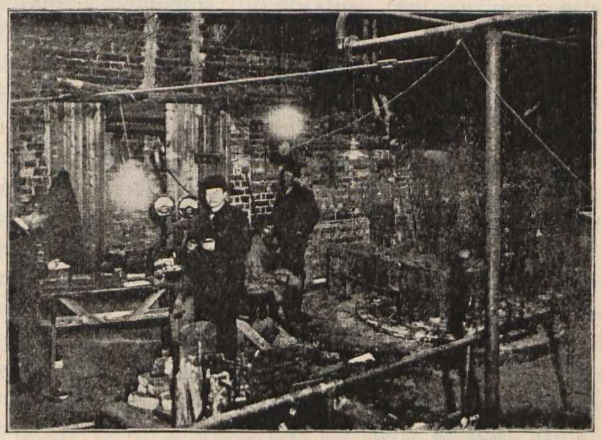
Fig. 2

Section A B

At the Gysinge works, steel of superior quality is made by the smelting together of charcoal-pig and scrap in electric furnaces of the induction type, i.e., furnaces without electrodes. The process does not permit the purification of the materials entering into the composition of the steel produced, the quality of the steel depending entirely upon the purity of the component materials employed. The process, therefore, corresponds to the crucible steel process, but has certain advantages over the latter, in that the melted material is at no time during the operation exposed to gases, which absorbed, deleteriously affect the quality of the product; moreover, the absence of electrodes, employed in all other classes of electric furnaces, avoids contamination of the molten material with the impurities which may be contained in the electrodes.

The furnace, of 225-h.p. capacity, is of the induction type, corresponding to a step-down transformer. Fig. 1 represents a vertical section through the tap-spout, and Fig. 2 a horizontal section through A B. The primary A A Fig. 1 consists of a coil of insulated copper wire wound about one leg of the magnetic current C C C C. The secondary is formed by the charge contained in the annular grove B B. To the primary an alternating current of 90 amperes and 3,000 volts is delivered. This current induces in the charge forming the single turn of the secondary, according to Mr. Kjellin, a current of 3,000 amperes at 7 volts. The conversion of electric energy due to the resistance of the charge takes place, therefore, in the substance of the charge. The furnace consists of a cylindrical iron casing, L L, partly closed at the base, resting upon the brick foundation E E. The casing is lined with firebrick D′ D′, and the portion D D (as shown in Figs. 1 and 2) is filled in with the exception of the annular grove B B, and the space F with magnesite or silica brick, according as a basic or acid lining is required for the grove, which forms the melting space or crucible. The space F F, surmounted by the iron cylinder F′, to which the pipe G is attached, serves the purpose of cooling the primary by the draft of air passing through it. In addition to the air draft, water circulation is employed to keep down the temperature in the space occupied by the primary. K K are covers for the annular crucible, and H the tapping spout. The upper part of the furnace is at the same level as the working floor and the charging is effected by simply removing the covers K K, and putting in the material. Since the heat is produced in the metal contained in the annular crucible, the slag which has formed is at a much lower temperature than in other steel furnaces, and as a consequence the workmen suffer little from the heat.


General View of Kjellin Furnace.


Top View of Kjellin Furnace.

The following figures, which could not be determined by the commission, relating to the efficiency of the furnace are given by Mr. Kjellin: From a series of trial runs, the production with this furnace averaged 4,100 kgs. in 24 hours, with a power of 165 kilowatts, or 225 electric horse-power. The loss of heat by radiation, transformation, etc., at a temperature of 1,400 deg. C., amounted to 80 kilowatts, this amount of energy being required to keep the temperature constant at 1,400 deg. C. The temperature of the fluid metal at tapping is from 1,600 deg. to 1,700 deg. C. The cost of a furnace of this type of 600-h.p. is, according to Mr. Kjellin, about $4,000.

Since the measurements of the absorption of electric energy constituted the most important factor in ascertaining the cost of producing steel by this method, and since there was no guarantee of the accuracy of the electric measuring instruments employed at the works, standard instruments were rented from David Bergman, consulting engineer in Stockholm, and placed in the circuit. Mr. Brown reports for an absorption of electric energy per ton of product of 0.116 and 0.145 electric horse-power years respectively. Mr. Harbord reports the estimated cost of steel by the Kjellin process to be $34 per ton of 2,000 lbs.

The capacity of the furnace is comparatively small, but for a larger plant Mr. Kjellin states that three furnaces of the pattern now used might be joined into a compound furnace, and supplied with a three-phase alternating current. This would treble the capacity and reduce the wages, since the number of workmen now employed in operating the one furnace could attend to all three.

Samples of the steel produced and of the materials employed were taken and shipped to England, to be tested as to quality and composition.

The following figures on which the cost of power per electric horse-power year, delivered at the furnace, is based, were furnished by Mr. Kjellin.

Cost of hydraulic canal	$22,000
Cost of power house	10,000
	$32,000

The quantity of water which can be delivered by the canal at low water is 22 cubic meters per second. The head is 3½ meters. Allowing an efficiency of 75 per cent. for the turbines, the available horse-power is 770.

225 horse-power are delivered to the furnace. Losses in generator, exciter and line, 40-h.p., a total of 265.

Part of the cost of power-house and canal to be charged to power for electric furnace is	$11,000
Cost of turbine	1,900
Installing turbine	500
Generator and exciter	5,850
Transmission line	1,000
Switchboard and instruments	600
	$20,850
10 per cent on first cost for interest, depreciation, repairs, taxes, insurance, etc.	$2,085
The part of operating expenses which is chargeable to electric furnace	500
	$2,585

Cost of 225-h.p. delivered to electric furnace is $2,585, or $11.50 per electric horse-power year.

Mr. Harbord, in his report on this furnace, says: "In my opinion, the furnace would require considerable modifications before it could be conveniently used for the manufacture of mild steel to compete with the Siemens furnace, as the difficulty of removing the whole of the slag, while retaining a small portion of the metal in the furnace, would, I fear, be considerable, and I anticipate that repairs could not be so readily effected if the walls were badly cut by the slag, as in the case of an ordinary Siemens furnace. Mr. Kjellin has, however, shown so much ingenuity in surmounting the difficulties in connection with the manufacture of high carbon steel, that, given the opportunity to experiment with a furnace on a reasonable scale, it is quite possible that he may be able to overcome these difficulties, and make the manufacture of mild steel a commercial success. The process, as at present worked, is admirably adapted for the highest class of steel from pure materials and the only objection to it, is that it is limited to these pure materials and can only be used where they are obtainable. I do not think in its present stage of development it is adapted to treat ordinary pig iron and miscellaneous scrap of more or less irregular composition, as the complete elimination of any impurities present could not always be relied upon. Under the special conditions existing at Gysinge and in some other places, it is capable of doing most excellent work and is a most efficient and economical metallurgical appliance. There seems no reason why the size of the furnace should not be very considerably increased, whatever difficulties there may be being electrical, rather than metallurgical, and with furnaces of 5 to 10 tons' capacity the labor costs would be very greatly reduced. Five men and one boy could do all the necessary work if they had a little assistance in charging, on a five-ton or even a ten-ton furnace without being in any way overworked, and this would at once reduce the cost of labor by nearly five to ten times, according to the size adopted, so that with a fair-sized furnace the cost of labor in Canada, notwithstanding the much higher rates paid, might be actually less than at Gysinge."

In another issue we hope to give some account of the other furnaces.

GENERAL CONCLUSIONS.

The following are the conclusions arrived at by Mr. Harbord, as a result of his investigation into the metallurgy of the electric production of steel, and the electric reduction of iron ore:

1. Steel equal in all respects to the best Sheffield crucible steel can be produced, either by the Kjellin, Héroult, or Keller processes, at a cost considerably less than the cost of producing a high-class crucible steel.

2. At present, structural steel to compete with Siemens or Bessemer steel cannot be economically produced in the electric furnaces, and such furnaces can be used commercially for the production of only very high-class steel for special purposes.

3. Speaking generally, the reactions in the electric smelting furnaces as regards the reduction and combination of iron with silicon, sulphur, phosphorus and manganese, are similar to those taking place in the blast furnace. By altering the burden and regulating the temperature, by varying the electric current, any grade of iron, grey or white, can be obtained, and the change from one grade to another is effected more rapidly than in the blast furnace.

4. Grey pig iron, suitable in all respects for acid steel manufacture, either by Bessemer or Siemens processes, can be produced in the electric furnace.

5. Grey pig iron, suitable for foundry purposes, can be readily produced.

6. Pig iron, low in silicon and sulphur, suitable either for the Basic Bessemer, or the Basic Siemens process, can be produced, provided that the ore mixture contains oxide of manganese, and that a basic slag is maintained by suitable additions of lime.

7. It has not been experimentally demonstrated, but from general considerations there is every reason to believe, that pig iron, low in silicon and sulphur, can be produced, even in the absence of manganese oxide in the iron mixture, provided a fluid and basic slag be maintained.

8. Pig iron can be produced on a commercial scale at a price to compete with the blast furnace only when electric energy is very cheap and fuel very dear. On the basis taken in this report, with electric energy at $10 per E.H.P. year, and coke at $7 per ton, the cost of production is approximately the same as the cost of producing pig iron in a modern blast furnace.

9. Under ordinary conditions, where blast furnaces are an established industry, electric smelting cannot compete; but in special cases, where ample water-power is available, and blast furnace coke is not readily obtainable, electric smelting may be commercially successful.

It is impossible to define the exact conditions under which electric smelting can be successfully carried on. Each case must be considered independently, after a most careful investigation into local conditions, and it is only when these are fully known that a definite opinion as to the commercial possibilities of any project can be given.

Nothing requires to be added to Mr. Harbord's conclusions regarding the electric production of steel; in reference to the production of pig, however, it must be pointed out that the results obtained at Livet were results of experiments in furnaces not specially designed for the production of pig iron ore. With the improved furnace, permitting, on account of the higher column of charge, a more effective use of the heat of the resulting gases, and of the reducing power of the CO evolved, a much better figure than the one obtained would result.

The modern blast furnace, and the different methods for the making of steel as at present employed, are the result of a hundred years of experience, and have reached their present perfection through many modifications, which, in many instances, were accepted and introduced into practice only after much hesitation and opposition. The process of the electric reduction of iron ore must yet be regarded as in the experimental stage; in fact, no plant exists at the present time where iron ore is commercially reduced to pig by the electric process. The more remarkable, therefore, it appears, and the more gratifying it is regarding the future of electric smelting, that experiments made off-hand, so to say, in furnaces not at all designed to be used for the production of pig should give a figure of cost which would enable the experimental plant employed to compete with a blast furnace in regions where electric energy can be had for $10 per E.H.P. year, and where coke is quoted at $7 per ton.

I am credibly informed that the water-power at Chats Falls can be developed at a cost to produce an E.H.P. year at the rate of $4.50. There are probably many water-powers favorably situated as regards good bodies of ore in the Provinces of Ontario and Quebec, which can be developed as cheaply. When such power is owned by the company intending to use it for electric smelting, and peat coke or briquetted charcoal, made from mill refuse (in the Ljungberg continuous kiln refuse wood is burnt into charcoal at 33 per cent. less cost than in heaps and with 22 per cent. higher yield), which would probably not cost more than $4 per ton, is employed for reduction, the cost of two of the heaviest items entering into the cost of producing pig by the electric process is reduced to one-half.

When it is considered that the electric process is applicable also to the smelting of ores, such as copper, etc., and that the furnaces are of simple construction, the temperature available 1,000 deg. C. above that of the blast furnace, and the regulation of the heat supply under perfect control, it is reasonable to expect that the near future will witness great strides in the application of electric energy to the extraction of metal from its ores, and that familiarity with handling large currents and experience gained in electric smelting will result in solving the difficulties encountered in the smelting of ores, which up to the present time have proven refractory to all economical processes known.

RAILWAY NOTES.

The Grand Valley Electric Railway ran their first car from Brantford to Galt on November 15th.

The Scarboro Electric Railway, Toronto, is being extended to Highland Creek, fourteen miles from the city.

The Government has secured from the Nova Scotia Steel Co. the right of way for the extension of the Intercolonial Railway to Sydney Mines.

The Grand Trunk is not at present considering the building of a third track from Toronto to Hamilton, as was reported some time ago.

The Canadian Pacific is negotiating for the Bruce Mines and Algoma Railway, owned by a Buffalo syndicate.

The Preston and Berlin Street Railway Co. has installed a storage battery of about 300-h.p. hour capacity. The battery was supplied by the Gould Storage Battery Co., Depew, N.Y.

Rhodes, Curry & Co., Limited, have received a contract from the Intercolonial Railway for the building of a roundhouse at Truro. The building will cost in the vicinity of $110,-000.

The C.P.R. recently made a contract to carry 10,000 tons of English spiegel from Liverpool to Sault Ste. Marie, the first contract of its kind made by a Canadian company. The spiegel has been purchased by the Algoma Steel Co.

The first twenty miles of the International Railway from Campbellton, N.B., have been completed. The line is to run west through the northern part of the province to the St. John river. Thomas Malcolm is the contractor in charge of construction.

The C.P.R. will build a line from Stratford to Conestoga, connecting the latter place with the Guelph and Goderich line. It is stated that the company will build a branch from Goderich to Stratford, paralleling the Grand Trunk. A line south from Goderich, making connection with Chicago, is also proposed.

The C.P.R. has about finished the new piece of track between Wild Rice and Emerson, Man., which will give it, in connection with the "Soo" line, a direct air line between Winnipeg and St. Paul, a distance of something like five hundred miles. This work was carried out by Mr. William Whyte, second vice-president.

It is expected that the portion of the Halifax and Southwestern Railway, between Halifax and Bridgewater, N.S., will be in running order this month. The rails are laid to Liverpool, but it is not likely the line will be operated till spring. The bridgework of this railway is divided between the Canada Foundry Co. and the Dominion Bridge Co.

A number of contractors are now figuring on the work of double tracking the C.P.R. main line between Winnipeg and Fort William. The date for the opening of the tenders has not yet been fixed, but it is the intention to try and begin work this fall. The plans and specifications for the rock and earth cuts and the fills have been in the hands of the company's engineers for some time past, and there will be no delays when once construction has started.

The new railway engineering department of McGill University, Montreal, is now being organized. It will have a council of administration composed of Charles M. Hays, president of the Grand Trunk Pacific Railway; Sir Thomas Shaughnessy, president of the Canadian Pacific Railway; E. B. Greenshields, R. B. Angus, and C. J. Flett. These gentlemen will determine upon the curriculum, but their chief regular functions will be of an advisory character.

An automatic brake, designed to prevent engineers running their trains past closed semaphores, has been invented by James Doyle, U.S. customs officer at Niagara Falls. The brake is operated by a trip, which, when the semaphore is closed, strikes a projection on the brake of the passing engine. A successful test was recently made in the Niagara, St. Catharines and Toronto Railway. It is said that the brake costs only about $30 per appliance.

A company, known as the Toronto and York Radial Railway Co., has been organized with chief officers as follows: President, William Mackenzie; general manager, W. M. Moore; assistant superintendent, John McCarty. The company is an amalgamation of the Metropolitan, the Mimico, and the Scarboro electric railways, and is independent of the Toronto Railway Co. The new company controls nearly fifty miles of railway. J. W. Moyes has been retained by the company as superintendent of the Metropolitan.

Railroad development in Prince Edward Island has taken quite a jump in the last few months. A new line of railway from Emerald on the P.E.I. Railway, through the New London district to the North shore, a distance of thirteen miles, has been surveyed. Two preliminaries were run. This road will likely be built next summer and will open up an old, thriving agricultural settlement, badly in need of railway accommodation. A survey of a railway from Souris, eastern terminal of P.E.I. Railway, to Elmira, near East Point, a distance of 13¼ miles, through a partly wooded country, was made in October by J. Ruel, chief; J. A. Macdonald, S. Can. Soc. C.E. and J. McLean. This road has been agitated by the people of that section for more than twenty years, and is to be built the coming year. The location survey of the Montague-Cardigan branch line was recently completed by A. T. Wilson, H. T. Emmerson, and J. A. Macdonald, engineers, and bids called for immediate construction. Mr. Willard Kitchen has secured the contract, and work will go on through the winter. The preliminary line for this road was run last winter by H. J. McKenzie, chief, with Messrs. Black and Owen, assistants. An amount of money had been placed in the estimates last session by the Dominion Parliament for the running of a preliminary line from, at, or near O'Leary, P.E.I. Railway, to the West Shore, but the line has not been yet run. The contract for Vernon River branch has been awarded to Willard Kitchen.

MUNICIPAL WORKS, ETC.

The waterworks being installed at Gananoque have been opened.

Brantford will vote in January on a by-law to raise $62,000 for an underground drainage system.

Stratford city council will probably submit a by-law to the voters in January for the raising of $50,000 to be used in extending the water mains and improving the fire protection.

The asphalt plant owned by the City of Winnipeg was burned November 6th. The loss will be over $20,000. All work on the asphalt street pavement will be stopped for the year.

Windsor has experienced a building boom this year. Nearly $500,000 has been spent in buildings in that city during the year, while about half that amount has been similarly spent in Walkerville.

St. Thomas has reached an agreement with the Gas Company without requiring the services of the arbitrators who were appointed. The price to be paid for the gas, electric light and power plant has been fixed at $196,000.

Dundas will repair the town dam, which has been damaged greatly by the spring freshets of the past two years. The cost is estimated at $1,500. R. L. Latham, of Hamilton, is preparing plans.

Recent visitors to New Liskeard report that that town is much improved in appearance. A better class of houses is going up, and everyone appears to be prosperous. The town recently purchased a fire engine and a supply of hose.

Toronto is now laying a six-foot water conduit across the bay, at a cost of $175,000. Plans are being prepared for an eight-foot tunnel under the bay, which is to be constructed after the completion of the conduit. The tunnel will cost, it is estimated, about $350,000.

Ottawa recently asked the Ottawa Electric Railway to set a price on the plant and franchise, and the figure quoted was $2,500,000, and the assumption of a bonded indebtedness of $500,000. The price is regarded as reasonable, but is thought by many to be beyond the city's finances.

The offer of Snow & Barbour, a Boston firm of engineers, to report on the best method of increasing the water supply of Halifax, was accepted by the city council, but was vetoed a week later by the Mayor, on the ground that sufficiently competent engineers could be found in Canada. A legal contest is said to be probable.

Westmount, Que., will on December 3rd, take a vote on a by-law empowering the town to acquire property for supplying electric light. It is thought that the town can supply light at about two-thirds of the price now charged by the company. The contract with the Montreal Light, Heat & Power Co. expires in December, 1906. The expense of installing the municipal plant will be met by a loan of $225,000.

MINING MATTERS.

A new gold vein has been discovered in Guysborough County, Cape Breton, three miles from the Richardson gold mine.

The German-American Co., recently organized, has secured 2,000 acres of mineral land near Lake Rideau, Ont., and is shipping phosphate to Germany.

A new plant, costing $50,000, is being installed in the Lower Cove (N.S.) coal mines. The number of hands employed will be increased from 150 to 300.

Molybdenum has been found near Black Donald, Renfrew County, Ont. Representatives of United States capitalists have purchased the property on which the discovery was made.

The Minto gold mine in the Michipicoten district, has been sold to Reading, Pa., capitalists for $108,500. The sale is regarded locally as an indication of the revival of interest in gold mining in that neighborhood.

Corundum found in Methuen Township, Peterboro County, has recently been assayed by Prof. Wilmot, of the Geological Survey, and declared to be the finest ever assayed by the Survey. It has a specific gravity of 3.99.

The iron range in Boston Township, some distance north of Haileybury, has been examined by Prof. W. G. Miller, Provincial Geologist, and is found to be similar in character to the other ranges in the northern part of the province.

A company working the copper deposit at St. Julien's, Nfld., have struck a superior quality of the metal at a depth of 30 feet. Four hundred tons of ore are already on the surface, and it is expected that 4,000 tons will be ready for shipment in the spring.

The deposits in the neighborhood of Cobalt, Ont., (a new station on the Temiskaming Railway, five miles from Haileybury), have panned out well the past summer, about $200,000 worth of cobalt, nickel, silver and arsenic having been shipped to New York for treatment. These deposits were discovered about a year ago.

The Sapphire corundum mine, in Peterborough County, which has been closed owing to the attempted frauds of Ernest Terah Hooley, who sank thousands of dollars of English capital in the mine, will be reopened and operated again. The company will be composed largely of local capitalists. L. A. Morrison, of Toronto, formerly of Peterborough, is at the head of the organization.

W. E. H. Carter, of the Bureau of Mines, made an extended trip to Northern Ontario last month. He reports activity in the mining industry. The Huronian Co., developing the water-power at Turbine, expect to deliver 11,000-h.p. to the Canadian Copper Co. next year. The Copper Company has a blast furnace in operation in connection with the converters. The Creighton mine has easily supplied sufficient ore to the works so that the other mines have closed down. High grade material has been produced from matte, having 80 to 82 per cent. combined nickel and copper, and at lower cost than in any previous period. The Massey Station copper mine has now got the Elmore oil plant satisfactorily concentrating ore. The Herminia copper mine adjoining the Massey is also being actively developed. A shaft has been sunk to a depth of 200 ft. to the vein. The Shakespeare gold mine is putting up a five-stamp mill, and ore will be treated shortly. Another adjoining mine in course of development is the Avon. On the Algoma Central, north of the Sault, the Williams iron mine has struck in lower levels, 200 feet deep, several bands of high grade hematite ore, totalling 23 feet of clean ore, and an additional ten feet or more of second grade. This is an entirely new iron area, and if the bodies prove to be continuous, may develop into an important field. North of Temagami there are two promising prospects, one for iron pyrites (sulphur ore), and another for arsenical pyrites. There are a number of other iron pyrites and arsenical properties in the district which are likely to be exploited next season.

MARINE NEWS.

The whaling steamer, Harbor Grace, with a crew of twelve men, from Norway for St. John's, Nfld., now nearly a month overdue, is given up for lost.

Davis & Sons, of Kingston, have received a contract to build an $8,000 steamboat for W. Thompson, Orillia. It will be eighty-two feet long and sixteen feet beam.

Next season the C.P.R. will purchase at least two new boats for the Atlantic service, and the Pacific fleet will be strengthened by the addition of two, if not three, new steamers.

The Hamilton Steamboat Co. has declared a dividend of ten per cent., and satisfaction with the season's business has been expressed. The Modjeska and Macassa will be improved and refitted during the winter.

The passenger steamer Ocean, which plied between Hamilton and Montreal, was burned to the water's edge at Port Dalhousie last month. She was 137 feet long, and was built in 1872 at a cost of $30,000. She was owned by the Wentworth Navigation Co., Toronto.

The Germanic, formerly of the White Star Line, and latterly on the American line between New York and Southampton, is now being renovated at Harland & Wolf's yards, Belfast. It is reported that she will come to Montreal next season as a Dominion liner, with the name Ottawa. She will have a speed of 17 knots, with a maximum of 20 knots.

The car ferry, Detroit, for use by the Michigan Central Railway, between Windsor and Detroit, was recently launched by the Great Lakes Engineering Co. She is a screw steamer, with two propellers at each end. She is 308 feet long, and can accommodate 28 standard-size cars. It is expected that she will be in commission before the river freezes over.

LIGHT, HEAT, POWER, ETC.

The wheelpit of the Electrical Development Co., at Niagara Falls, is completely excavated and work on the brick lining will soon commence. Work will be continued all winter.

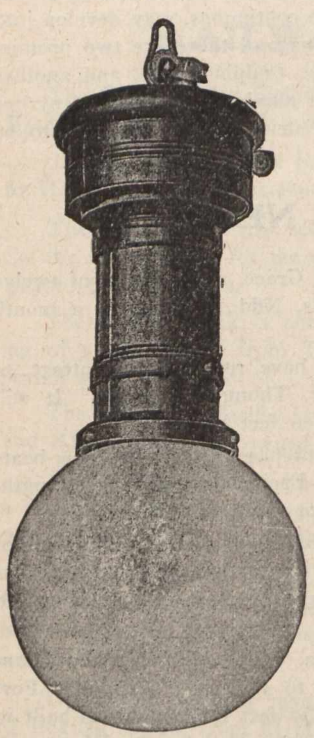
The Canadian Niagara Power Co. has let water into their forebay, and expect to have one of the 10,000-h.p. turbines working early this month.

The Hamilton Cataract Light, Power and Traction Co. last month put into commission two new generators in their power house at Decew Falls, thus adding 13,000-h.p. to Hamilton's supply.

The work of remodelling the electric light and power plant of the Alexandra Palace, University Ave., Toronto, has been placed in the hands of the Electrical Supervision Society. A new generator will be installed and other material changes made. Manufacturers of switch board supplies, lamps, etc., are requested to communicate with the engineer.

The water-power on the Wahnapitae river, which is being developed by Messrs. Cochrane & McBittie, will be available next spring. The dam has been completed, and the machinery is now being installed. Arrangements have been made to supply the town of Sudbury with electrical power for light and waterworks, and it is probable that power will also be supplied to the Mond Nickel Company, who are preparing to resume operations at Victoria Mines, west of Sudbury.

In Kane County, Ill., farmers are installing electric motors to do the work of the farms, such as sawing, pumping, threshing, separating, etc. Feed wires are run in from a contiguous trolley or third rail line, and a motor is installed in the barn. It is found that a 15-h.p. motor does the work of a man and a team of horses, and costs about 50 per cent. as much for maintenance. Land in that section is reported to be going up in value since the introduction of electric power.



Arrangements have been concluded whereby the marketing of the products of the Packard Electric Company, Limited, the Crocker-Wheeler Company, and Brown, Boveri & Cie, in Canada, will be looked after by the selling organization of the Packard Electric Co., Limited, of St. Catharines, Montreal and Winnipeg. The Crocker-Wheeler Company are manufacturers and electrical engineers with their works and main offices located at Ampere, N.J. Their line of manufacture includes electrical generators and motors for every industrial, lighting and power purpose. They are American licensees of Brown, Boveri & Cie, of Baden, Switzerland, celebrated designers and manufacturers of alternating current apparatus, whose efforts in this field have brought the alternating current machine to a point of standardization. The reputation for excellence earned by the Crocker-Wheeler apparatus during the past fifteen years, has spread beyond the United States, and it is to better serve their increasing trade in Canada that this arrangement has been made.

On Saturday evening, November 19th, the International Correspondence Schools gave their monthly lecture and entertainment in the Temple Building, Toronto, for the benefit of their students and friends. It has, therefore, been the policy of make these evenings "smokers," but for this occasion the smoke was omitted, and ladies were invited. The large hall was completely filled with ladies and gentlemen. The principal feature on the programme was an illustrated talk on "The Toronto-Niagara Power and Development," given by K. L. Aitken, chief engineer of the Electrical Supervision Society, Toronto.

Results of experiments conducted by William Grunow, Jr.; W. T. Oviatt and R. B. Davis of the Connecticut Railway and Lighting Company, at Bridgeport, last winter to determine the amount of current required to heat a third rail for the removal of sleet have been published and show that with the air at 15 deg. F., the temperature of the rail was raised 19 degrees in 15 minutes; and with the air 21 deg. F., the temperature of the rail was raised 19 degrees in 12 minutes. The energy consumption during these 15 minutes was equivalent to 90 kilowatts, if the heating had been applied to a one-mile length of the same section of rail. A 70-pound T-rail 30 feet long was used and was heated by means of a steel wire carried under the head of the rail and insulated from it by porcelain bushings. Wood protections were employed to shield the rail from wind and to maintain its temperature.

TELEPHONE AND TELEGRAPH.

Toronto is petitioning the Dominion Government to take over the long-distance telephone lines.

The Canadian Machine Telephone Co. will have their service in Peterboro in operation by January 1st.

Brantford City Council has passed a resolution asking the Government to acquire the long distance telephone lines.

Gregorio Pansa, of Naples, claims to have invented a wireless apparatus combining the telegraph, telephone, and telantograph.

The case of Price vs. City of Hamilton to quash the Bell Telephone Co.'s franchise in that city, is to be carried to the Court of Appeal.

The Marconi station at Cape Race, Nfld., has been completed, and works satisfactorily, its efficiency having been tested from a point 100 miles to seaward.

Wendel Shantz, a farmer living near Waterloo, Ont., is agitating the organization of a rural telephone company. It has been suggested that the proposed system might be operated by the county.

It is expected that at the coming session of Parliament, legislation will be introduced to bring wireless telegraphy under Government control. The Imperial Government is asking that this be done in all the self-governing dependencies.

Toronto asked the Stark Telephone Co., the Canadian Machine Telephone Co., and the Canadian Telephone and Telegraph Co. to tender on their own specifications for a telephone franchise. November 30th was the date for receiving tenders.

Brantford City Council has defeated the by-law ratifying a fifteen-year agreement with the Stark Telephone Co., of Toronto. This was due to a feeling on the part of some of the aldermen that the Canadian Machine Telephone Co. should have a chance to tender for a franchise after the completion of their installation in Peterboro.

PERSONAL.

Homer S. Johnson, vice-president and manager of the Penberthy Injector Co., Windsor, visited Toronto last month.

J. W. Platten, who is a native of Port Perry, Ont., has been elected second vice-president of the Lehigh Valley Railroad Co.

The superintendent of construction of the new ship being built at Bucksport, Me., for Lieut. Peary's Arctic explorations, is Herbert S. Newcombe, a native of Hopewell, N.B.

Joseph Sutherland, ex-councillor of Bilston, Staffordshire, England, who recently completed a trip through Canada, remarked: "The resources of Canada are such as to make her a Britain, France, Spain and Russia, all in one. She possesses the iron of Britain, the fruit and salubrious climate of France, the rich minerals of Spain and wheat fields that rival the best in Russia."

A. M. Wickens, chief engineer of the Canadian Casualty and Boiler Inspection Co., spent a few weeks in Manitoba in the interests of his company, returning to Toronto on the 10th ult.

G. T. Jennings has been appointed to a section of the French River Canal survey, which commences operations immediately. Mr. Jennings is the son of W. T. Jennings, C.E., of Toronto.

Frank Forsythe, of Hamilton, late of Berkeley Springs, W. Va., has been appointed factory superintendent for the Peterboro Shovel and Tool Co., recently incorporated. About 100 hands will be employed.

T. Christie, late of the Garlock Packing Co., of Hamilton, Ont., has recently been appointed Canadian representative for the Quaker City Rubber Co., of Philadelphia, Pa., with headquarters in the Carlaw Building, Toronto, Ont.

Engineer W. Blennarhassett, one of the senior engineers on the Fort William division, has received the appointment of travelling engineer on the C.P.R., in charge of all the locomotives on the division. This position was formerly held by the late R. J. Armstrong.

Sheldon T. Bent, who was secretary and treasurer of the Continental Light, Heat and Power Company, and Shawinigan Carbide Company, and who embezzled the sum of three thousand dollars from his employers, was sentenced on November 14th to nineteen months' imprisonment.

Alexander H. Notman, district passenger agent for the C.P.R., at Toronto, died in New Mexico on November 13th. He had a most successful railway career of twenty years, and was one of the most popular railway men in Canada. His place will be taken by C. B. Foster, of St. John, N.B.

J. D. Jones, general yard master for the G.T.R., at Montreal, has been appointed superintendent of St. Clair Tunnel and terminals, in the place of the late A. S. Begg, who met his death in the tunnel accident of two months ago. The position of acting superintendent of St. Clair Tunnel and terminals has been abolished.

J. H. Jewell recently entertained one hundred and fifty guests at dinner on the occasion of the opening of Jewellville post-office, named in his honor. The new village is in Renfrew County, Ont., near Palmer Rapids, and is the scene of the operations of the Corundum Refiners, Limited, of which Mr. Jewell is president.

At the annual banquet of the Canadian Association of Cincinnati last month, an address was delivered by H. G. Tyrrell, engineer, author and journalist, formerly of Toronto and Boston, now chief engineer of the Brackett Bridge Co., of Cincinnati. The subject of Mr. Tyrrell's address was Canada and her Educational System.

The Rumford Medal, presented every two years by the Royal Society to the scientist making the most useful discovery in the realms of heat and light, has this year been awarded to Ernest Rutherford, professor of physics at McGill University, in recognition of his researches in radio-activity. The fund which provides the medals was founded by Count Rumford, in 1796, and among the recipients have been Sir Humphrey Davy, Michael Faraday, James Clerk Maxwell, John Tyndall, and other physicists of world-wide reputation. Professor Rutherford is a native of New Zealand, where he took his M.A. and B.Sc. degrees. In 1894 he went to Cambridge as an 1851 Exhibition scholar, and from there came to McGill University. He was made a Fellow of the Royal Society in 1903. He has published over forty papers on radium, and is considered an authority on the subject, second only to M. and Mme. Curie, the discoverers of the element.

J. M. Bell, M.A., Ph.D., F.R.G.S., who for the past two years has been teaching in the mining and geological departments of Harvard University, has just been appointed geologist to the Government of New Zealand. Dr. Bell has had extensive experience in Canada as a field geologist, having led an expedition for the Canadian Geological Survey to the Mackenzie River and Great Bear Lake, for which work he received the fellowship of the Royal Geographical Society. For two years he was employed by the Algoma Commercial Company of Sault Ste. Marie, and during the past two summers has been engaged by the Ontario Bureau of Mines in the preparation of a monograph upon the Michipicoten iron range. Dr. Bell was born in St. Andrew's, Quebec, in 1877, and educated at Queen's University, and in England, receiving his degree of Doctor of Philosophy from Harvard University. He is a son of Andrew Bell, C.E., of Almonte, and a nephew of Dr. Robert Bell, director of the Canadian Geological Survey.

CALAMITY COLUMN.

Steamer Argo, of Lumsden's Line, was burned at Kippewa, Que. Loss, $15,000.

A special C.P.R. freight was ditched at Melbourne, Man. Eight cars badly smashed. Cause: broken coupling.

Ernest Mann's planing mill, Peterboro, was destroyed by fire. Loss, $10,000; insurance, $4,500. Will resume business.

An emery wheel burst at McClary's new foundry, London, by which George Braund, an employee, was probably fatally injured.

Wm. M. Drader's stave and heading factory, Chatham, was destroyed by fire. Loss, $20,000. One hundred employees are out of work.

T. E. O'Brien's flour and grist mills, at McIntosh Mills, near Brockville, were destroyed by fire last month. Loss, $20,000; insurance, $6,000. Cause unknown.

A collision occurred between a passenger train and an engine on the Grand Trunk at 2 a.m., November 15th, near Merritton. Engines badly damaged, also two cars. Ten persons injured.

The schooner Annie Falconer, owned and sailed by Capt. M. Ackerman, of Picton, Ont., went down in a gale last month, while on her way from Sodus Point, N.Y., with soft coal for Picton. James Sullivan, mate, died of exposure.

The schooner William Crosthwaite was burned to the water's edge while lying at anchor near Whitefish Point, Lake Superior. The crew barely escaped and the vessel is a total loss. Supposed cause: overheated stove in the galley.

A fire in Brockville destroyed a storehouse of the Central Canada Coal Co., also the wringer works and part of the tool works of the James Smart Mfg. Co. Seventy-five employees thrown out of work. Loss about $30,000, mostly covered by insurance. Company will rebuild.

Peter Wood, a builder's laborer, while wheeling a barrow across a beam in the new power-house at Toronto, fell to the basement and was killed. The coroner's jury will enquire whether the builders were guilty of a breach of the by-law for the protection of workmen on buildings.

An eastbound freight train broke in two in the Sarnia Tunnel on November 22nd, and but for the caution of the crew and favorable weather conditions, the disaster of October 9th might have been repeated. A cattle-drover, riding in the van, was overcome, and was revived with some difficulty.

Garnet, the engineer of the electric station, at West Prince Albert, N.W.T., was electrocuted on November 12th. After turning on the lights, he went behind the switchboard for some purpose unknown, and was found holding the connections. Efforts made to restore life were futile, and it is thought that death was instantaneous.

The C.P.R. car ferry Armstrong, plying between Prescott and Ogdensburg, sank on November 10th. She had on board two railway cars loaded with iron ore and 100 tons of steel rails. The lashings broke, so the cars ran out through the stern gangway, pulling the stern down till the water got into the hatches and filled the boat. The crew escaped in a life boat.

The Toronto Railway Co. has had an unusually large number of accidents recently, the most serious of which occurred on November 17th, when a car was run into by a Grand Trunk train at the Queen St. East crossing. Three lives were lost, and many persons were injured. The inquest is not yet finished, but the failure of the street-car brakes is thought to be responsible for the accident. J. E. Duval, inspector of accidents, has examined the crossing and says the Scotch dogs should be at least seventy-five feet from the steam railway tracks, instead of thirty feet, as at present.

William Strickland, a carpenter, was killed on Gerrard St., Toronto, on November 22nd by a fragment of a flywheel, which burst in Elias Rogers & Co.'s coal yard, 200 yards away. The stationary engine in the coal yard was hauling a loaded car up the incline, when the governor belt snapped. The portion of the wheel which killed Strickland was seen as a ball of fire flying through the air.

The Scientific American, in commenting on the recent epidemic of railroad disasters, says that the most fruitful cause of loss of life in head-on collisions is to be found in Pullman cars. Their heavy construction, while a protection to their inmates, is a menace to passengers in the lighter day coaches. In rear collisions, on the other hand, the inertia of the Pullmans serves to absorb considerable energy from the colliding train, and thus serves as a protection to cars ahead.

Buffalo has a grade crossing commission, composed of ten members, who are State appointed and unsalaried. Since 1888, when the commission was formed, $10,000,000 has been spent in improving the safety and convenience of level crossings. The commission decides what action is to be taken, and the railway is assessed 50 per cent. of the cost, the city and state each paying 25 per cent. The commission has power to close streets or acquire property, as may be necessary. In the appointment of commissioners, it has been the policy to choose citizens of large landed interests, to check the tendency to lavish expenditure. The Toronto Board of Trade has been investigating the working of the Buffalo Commission, and will advocate the forming of a similar commission in Toronto. By a peculiar coincidence, the representatives of the board were in Buffalo investigating the matter when the disastrous level crossing accident took place in Toronto last month.

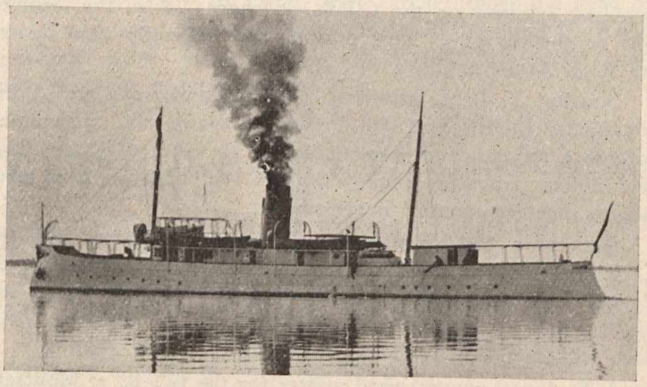
Since the accident in the Sarnia Tunnel in October, the tunnel has been examined by the Railway Commission's inspector of accidents, J. E. Duval. He was in company with Mr. Mountain, chief engineer of the Commission, and Mr. Hobson, chief engineer of the Grand Trunk Railway, who built the tunnel. Mr. Mountain afterward left to inspect the Baltimore and Ohio Railway's tunnel, at Baltimore, and the Hudson River Tunnel at New York before making a report to the Commission. Dr. F. T. F. Stephenson, of Detroit, an expert on gases, has examined the tunnel for the G.T.R. Co., and it is said he will recommend forced draft. Third Vice-President Morse recently visited New York to examine the equipment of the Subway Railway. Several electric companies are estimating on the cost of converting the traction in the Sarnia Tunnel and will submit propositions, after which it is expected that the management will decide between forced draft and electric traction.

The Railway Commission's Inspector of Wrecks has presented a report on the wrecks in the country since May 1st last. It may be summarized as follows: May 2nd, G.T.R. pitch-in, South River, Ont.; fireman killed; danger signal disregarded; engineer, fireman and forward brakeman thought to have been asleep.——June 17th, G.T.R. pitch-in, Paris, Ont.; three men killed; danger signal passed.——June 23rd, Intercolonial run-off, Riverdale, N.S.; spread track, due to lateral pressure of heavy engine rounding sharp curve at high speed.——August 1st, G.T.R. pitch-in, Gravenhurst, Ont.; engineer and conductor of work-train disregarded rule under which they were working.——August 31st, G.T.R., head-on, Richmond, Que.; nine killed; criminal failure of conductor and engineer of excursion train to comply with specific rule.——September 1st, C.P.R. head-on, Sintaluta, N.W.T.; five women killed; failure to close switch after a freight; conductor, engineer, and brakeman of freight responsible. The evidence shows that none of these accidents were caused by overwork of employees, and that the greatest loss of life is always in old, weak cars used as smokers and second-class coaches. The commissioners are considering requesting the Attorneys-General of the Provinces to prosecute in every instance where carelessness or disobedience is shown, mere dismissal being insufficient punishment. Since the compilation of the above report, the Commission has investigated the collision at Eastwood, Ont., September 28th, by which five men were killed, and has found that it was caused by a switch being left open by either the conductor or the brakeman, both of whom were killed, and both of whom had been on duty continuously for thirty-two hours. The inspector will make recommendations to the Board with a view of avoiding similar accidents.

CANADIAN CRUISER VIGILANT.

The Dominion fisheries protection cruiser, Vigilant, built by the Polson Iron Works, of Toronto, has been completed, and was recently given a trial trip. Although the speed contracted for was only 16 knots, the boat made 17.46 on her trial run. Captain Spain, of Ottawa, and Inspector Douglas Stevens were on board and were well pleased with the new boat's performance.

A photograph and drawings of the Vigilant are reproduced herewith. The principal dimensions are as follows: Length of water-line, 176 ft.; breadth moulded, 22 ft.; depth from top of keel to top of main deck, 14 ft. 3 in.; draft, 8 ft. The engines are twin screw, triple expansion; cylinders, 13½ and 22 and 36 by 21-in. stroke. There are two Clyde boilers, each 11 ft. 6 in. diameter by 12 ft. 8 in. long; working pressure, 200 lbs. steam. Armament: 4 rapid-fire guns. The boat has flush



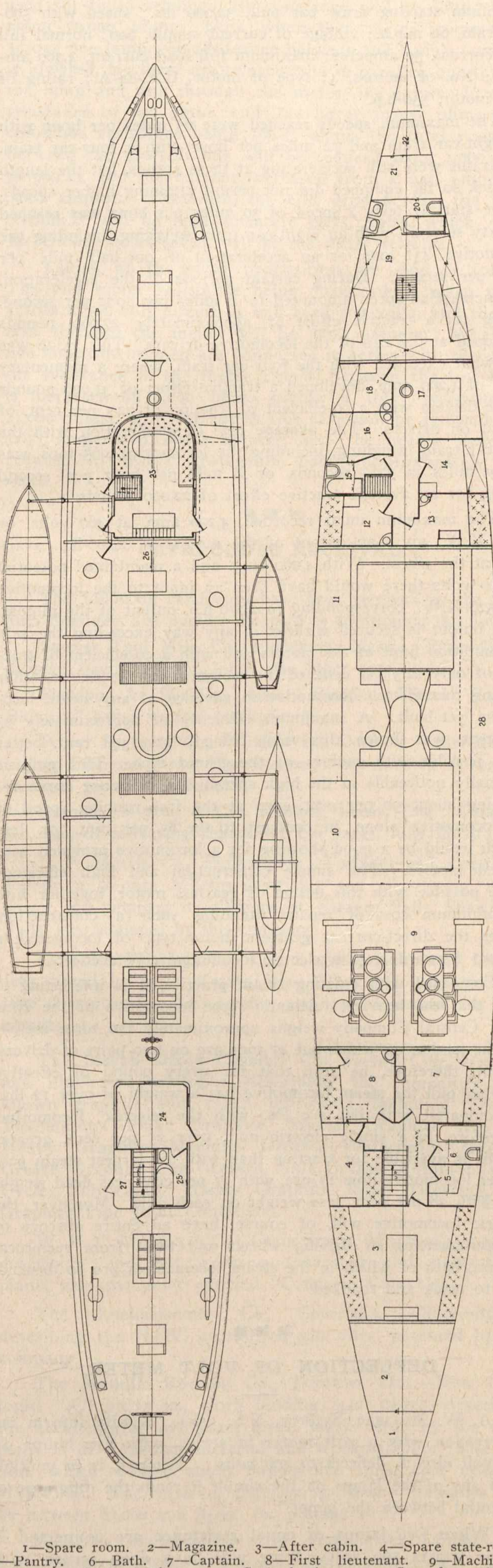
The Vigilant Leaving Toronto Bay.

main deck and bulwarks, having a ram bow and elliptical stern, of similar design to those of the cruisers of the British navy. She has a commodious deckhouse aft of the foremast, containing chart-room, galley and fan room, and also a deckhouse abaft the main mast. The bridge is arranged extending from the forward deckhouse to the ship's side. The vessel is schooner-rigged, with jib-headed foresail and mainsail. She has a complete installation of auxiliary gear, including steam steering gear, steam windlass for working the anchors, electric engines and dynamos, and powerful searchlight. She is to carry a 30-ft. speed motor launch, two 25-ft. gigs, and one 16-ft. dinghy. Cost, with complete outfit and armament, $150,000. Accommodations for the officers and crew are located below the main deck. The total complement, including officers and men, is about forty. Forced draft in the furnaces is obtained with Sirocco fans, a description of which appears elsewhere in this issue.

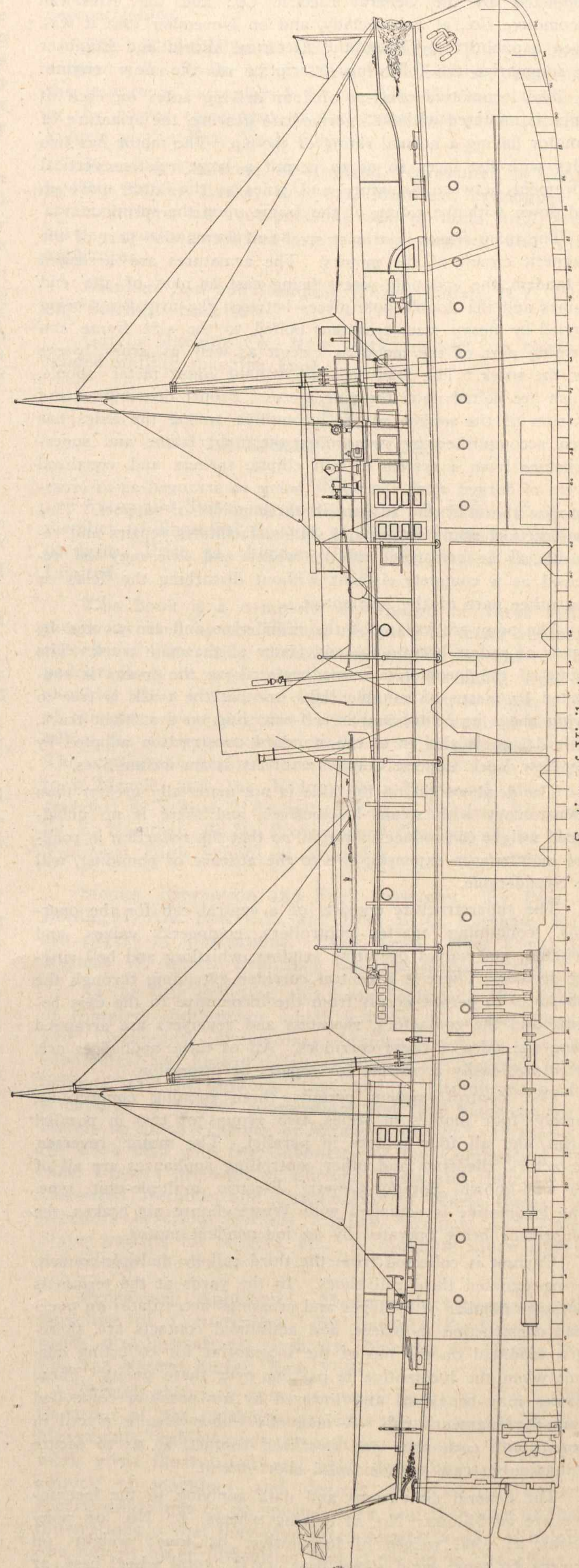
The Vigilant will displace the Petrel on Lakes Erie and Huron, while the Petrel will be sent to the Maritime Provinces to take the place of the cutter Kingfisher, which has been taken out of commission.

—The Toronto Automobile Club has arranged for a Royal Canadian Automobile and Sportsmen's Exhibition, to be held in Toronto from February 28th to March 4th next. The dates are so arranged that the show will be in the itinerary of the United States Licensed Manufacturers' Association, coming between Cleveland and Buffalo automobile shows. Application has been made for the use of the Armories for the occasion.

—The new lighting plant of the corporation of Pictou, N.S., was started October 25th. The plant consists of fire-proof building, two 150 h.p. boilers, horizontal tandem, compound condensing engine, direct connected to 60 cycle, three-phase, 2,200 volt Canadian General Electric Company revolving field generator and direct connected exciter for street and commercial lighting, the Canadian General Electric Company constant current system being employed for street lighting. The plant was designed and built by R. S. Kelsch, consulting engineer, Montreal.



Plan and Deck Plan of Vigilant.



Section of Vigilant.

1—Spare room. 2—Magazine. 3—After cabin. 4—Spare state-room. 5—Pantry. 6—Bath. 7—Captain. 8—First lieutenant. 9—Machinery space. 10—Coal bunker. 11—Coal bunker. 12—Second engineer. 13—Chief engineer. 14—First and second mate. 15—Bath-room. 16—Gunners. 17—Officers' mess. 18—Steward and cook. 19—Crew's quarters. 20—Bath-room. 21—Provisions. 22—Chain. 23—Reception rooms. 24—State-room. 25—Bath. 26—Galley. 27—Store-room. 28—Coal bunker.

ELECTRIC LOCOMOTIVE TESTS.

The New York Central Railmay is electrically equipping its New York terminal for a distance of about thirty miles from the Grand Central Station. The first one of thirty or more electric locomotives to be built for this work was recently completed by the General Electric Co., and the American Locomotive Co., at Schenectady, and on November 12th it was given a public test. From the Electrical World and Engineer we summarize the following description of the new engine:

The locomotive consists of four driving axles on each of which is mounted without intermediate gearing, the armature of a motor having a normal rating of 550-h.p. The motor has two poles with flat faces so as to permit a large relative vertical movement between armature and poles as the latter move up and down with the riding of the frame upon the springs.

The main frame is of cast steel and forms also part of the magnetic circuit of the motors. The armatures are arranged in tandem, the end pole pieces being cast as part of the end frames and the double pole pieces between the armatures being carried by heavy steel transoms bolted to the side frame and forming part of the magnetic circuit as well as cross braces for the truck. The field coils are wound upon metal spools, which are bolted upon the pole pieces. Proper distribution and division of the weight of the locomotive among the axles has been accomplished by suspending the main frame and superstructure from a system of half elliptic springs and equalized levers of forged steel, the whole being so arranged as to cross-equalize the load and to furnish three points of support. This construction, while strong and simple, facilitates repairs and renewals, as an armature with its wheels and axle may be removed as a complete element without disturbing the fields or any other part of the locomotive.

The pony trucks are of the radial type and are pivoted by means of radius bars to the end frame of the main truck. The frame of the locomotive immediately above the trucks is supported by means of suitable links, so that the truck is free to swing about its centre and is self-centering on a straight track. This design is similar to the standard construction adopted by the New York Central Company for its steam locomotives.

The dead weight on the axle is not materially greater than is customary with steam locomotives, and there is no unbalanced weight to produce vibration, so that the reduction in roadbed maintenance expenses, due to the absence of pounding, will be considerable.

The superstructure consists of a central cab for the operator, containing master controllers, engineers' valves and switches, and valves operating sanding, whistling and bell ringing devices. There is a central corridor extending through the cab so as to permit access from the locomotive to the cars behind, and the contactors, rheostats and reversers are arranged along the sides of these corridors. All of these appliances are, therefore, easily accessible for repairs or inspection.

The control system permits three running connections, namely, four motors in series, two groups of two in parallel series, and all four motors in parallel. The motor reverser, contactors, rheostats and other controlling appliances are all of the well-known Sprague-General Electric multiple-unit type. The locomotive is equipped with Westinghouse air brakes, the compressor being operated by an independent motor.

Current is collected from the third rail by multiple-contact, spring-actuated third rail shoes. In the yards at the terminals the large number of switches and crossings necessitates an overhead construction in places, and additional contacts are, therefore, mounted on the top of the locomotive for collecting current when the locomotive is passing over these points. These devices may be raised and lowered by air pressure controlled from the engineer's cab. A magnetic ribbon fuse is placed in circuit with each shoe and overhead contact, so as to secure protection in case of accidental short-circuit.

The general dimensions and data applying to the locomotive are as follows: No. of driving wheels, 8; No. of pony trucks, 2; total weight of locomotive, 95 tons; weight on drivers, 69 tons; rigid wheel base, 13 ft.; total wheel base, 27 ft.; length over buffer platforms, 37 ft.; extreme width, 10 ft.; height to top of cab, 14 ft. 4 in.; diameter of drivers, 44 in.; diameter of pony truck wheels, 36 in.; diameter of driving axles, 8.5 in.; normal rated horse-power of locomotive, 2,200; maximum horse-power, 3,000; normal draw bar pull, 20,400 lbs.; maximum starting draw bar pull, 32,000 lbs.; speed with 500-ton train, 60 m.p.h.; voltage of current supply, 600; normal full load current, 50 amperes; maximum full load current, 4,300 amperes; No. of motors, 4; type of motor, G.E.-84-A.; rating of each motor, 550-h.p.

The maximum speeds reached were 63 miles per hour with an eight-car train and 72 miles per hour with a four-car train. The trains were still accelerating at these speeds, but the length of track so far equipped did not permit attaining higher speeds. In the starting tests a speed of 30 miles per hour was reached in sixty seconds, with an eight-car train weighing, including the locomotive, 431 tons, or an acceleration of one-half mile per hour per second. During certain periods of the acceleration, the increase in speed amounted to .6 miles per hour per second, calling for a tractive effort of approximately 27,000 pounds developed at the rim of the locomotive drivers. This value was somewhat exceeded with the four-car train, where a momentary input of 4,200 amp. developed a tractive effort of 31,000 pounds at the drivers with a co-efficient of traction of 22.5 per cent. of weight on drivers. The average rate of acceleration with the four-car train, weighing, including the locomotive, 265 tons, was thirty miles in 37½ seconds, or .8 mile per hour per second calling for an average tractive effort of 22,000 pounds.

The maximum input recorded, 4,200 amp. at 460 volts, or 1,935 K.W., gives an output of the motors of 2,200-h.p. available at the wheel. With 4,200 amp. and a maintained potential of 600 volts there would have been an input to the locomotive of 2,520 K.W., corresponding to 2,870-h.p. output of the motors. This output is secured without in any way exceeding the safe commutation limit of the motors and with a co-efficient of traction of only 22.5 per cent. of the weight upon the drivers, thus placing this electric locomotive in advance of any steam locomotive yet built. A maximum efficiency of approximately 93 per cent. was shown, this value being fully 4 per cent. better than possible with motors of the geared type. This gain is especially noticeable at the high speeds, the efficiency curve remaining about 90 per cent. even at the free running speed of the locomotive alone, in contrast to the 85 per cent. or less which would be a good showing for a locomotive provided with geared motors. The simple construction and high efficiency made possible with this design of gearless motor, together with the minimum cost of repairs attending such a construction, makes the direct-current gearless motor type of locomotive a distinct forward step in electric locomotive construction.

Compared with existing steam practice, it is interesting to note that the heaviest "Atlantic" type locomotive of the New York Central Company weighs approximately 150 tons, including the tender, on which but 47 tons are on two pairs of drivers. It will, therefore, be seen that for every pound of effective drawbar pull the steam locomotive has a weight of over 12 lbs., as compared with but six lbs. with the electric locomotive. Therefore, in a single electric unit, over 25 per cent. greater weight is available for traction than with the largest steam passenger locomotive now in use, with 37 per cent. less dead weight and with 28 per cent. less weight on each axle. Moreover, the electric locomotive will, of course, have an entire absence of counterbalancing of driving wheels and twist from reciprocal motion, both of which in the steam locomotives are so destructive to track and roadbed.

DEFLECTION OF VOLT METER.

A. W. McIsaac, Sydney, N.S., asks: "Kindly inform me the reason why a volt meter in series, with five lamps on 500-volt circuit, deflects to 500 volts. When it is in multiple with any of the lamps on the circuit it reads the difference of potential between the lamps."

When five lamps of equal resistance are connected in series across 500 volts, there will be a drop across each lamp of 100 volts, and when a volt meter is connected across one of these lamps it will read just a fraction below 100 volts. The reason that it does not read exactly 100 is as follows: Assume that the lamp resistance is for each 200 ohms. Then five in series will give 1,000 ohms across a

500-volt circuit, which will result in a current of a half ampere. If a 500-volt portable Weston volt meter has been used for these readings, its resistance will be found to be about 70,000 ohms. Now, when this meter is connected across one lamp, the resistance between the lamp's terminals is lowered, for there are two circuits in parallel, one through the lamp and one through the meter, the former having a resistance of 200 ohms, and the latter 70,000 ohms. The combined resistance being 199.43 ohms, the total resistance between the 500-volt line will be reduced from 1,000 ohms to 999.43, and the current increased from a half ampere to .5002 ampere. Therefore, the CR. drop across the meter terminals will be approximately 99.75 volts, which, under the circumstances given, will be the meter reading.

Taking up the other proposition, we find as follows: The volt meter resistance being 70,000 ohms when placed across a 500-volt circuit, it will read 500 volts, and the current through the meter will be .0071 ampere. When the five lamps mentioned are connected in series with the meter, the resistance in the meter circuit, between the line wires, is increased by 1,000 ohms, giving a total resistance of 71,000 ohms. The current in this case will be reduced from .0071 ampere to .00704 ampere, and the needle deflection reduced in direct proportion, being approximately 495.7 volts.

CATALOGUES RECEIVED.

The following catalogues have been received by the Canadian Engineer, and may be obtained by mentioning this journal:

Sawyer Tool Mfg. Co., Fitchburg, Mass.; Price list of calipers having friction joint, also other specialties.

Sheldon & Sheldon, Galt; Booklet, "Steel Pressure Blowers," being section catalogue 18.

Power Specialty Co., Windsor and Detroit; Folder describing the Diamond Steam Flue Blower, a new method of handling the soot problem in boilers.

Graham, Morton & Co., Limited, Leeds, Eng.; Catalogue No. 940, of conveying apparatus; 150 pages, fully illustrated.

J. P. Morris Co., Philadelphia; Turbines and Centrifugal Pumps, a 50-page bulletin describing and illustrating water-power and pumping installations at Niagara Falls, Shawinigan Falls, etc., equipped by this company.

Canadian Westinghouse Co., Limited, Hamilton; Circular 1085, Small Induction Motors, Type CC, also folders describing type C motors for A.C. service, and type S motors for D.C. circuits.

The Joseph Dixon Crucible Co., Jersey City, N.Y. A new illustrated catalogue describing the company's well-known graphite and other lubricants, including Dixon's Ticonderoga Flake Graphite, Special Graphite No. 635, Heavy Graphite Machine Grease, Waterproof Graphite Grease, Graphite Cup Greases, Axle Grease, Automobile and Cycle Lubricants, Handy Graphite Rope Dressing, and Graphite Pipe Joint Compound.

W. H. C. Mussen & Co., Craig Street, Montreal.—Leaflets describing concrete working apparatus and contractors' plant; also pamphlet entitled "Concrete Catechism."

The Lunkenheimer Co., Cincinnati, Ohio,—Booklet describing the H.-W. cross-head pin oiler, patented by the company.

The Metallic Roofing Co., Toronto, Ont.—New Catalogue "A," 9 x 13 in., cloth binding, 440 pages, describing the architectural and sheet metal work made by the company, is of Canadian material and workmanship. The edition, which weighs about twenty-five tons, cost upwards of $10,000. The cost of distributing these catalogues will be between $3,000 and $4,000 for postage alone.

Meldrum Bros., Limited, of Manchester, London and Paris (address Atlantic Works, Manchester, Eng.).—Catalogues describing the "Koker" automatic stoker and patent forced draught for engines; also catalogue of the new Meldrum refuse destructor. Some Canadian testimonials appear, showing that the company is cultivating trade in this country.

The Canadian General Electric Co., Toronto.—New catalogue (8 x 10½), containing many illustrations of a large variety of annunciators, bells and house electrical supplies, embracing the latest designs and many novelties. From the same a folder, entitled "Track-cleaner Talks," describing various track-cleaning devices and brooms for which the company are agents; also, instructive booklet on incandescent lamps.

The Allis-Chalmers Co., Milwaukee, Wis.—A book, entitled "The Power of the New York Subway," describing the important part played by the Allis-Chalmers Company in the power equipment of the great enterprise popularly known as the New York Subway.

Fraser & Chalmers, of England, represented in Canada by W. Stanley Lecky, Box 622, Montreal, catalogues on steam boilers, air compressors, stamp mills and accessories, crushing machinery, winding engines and other appliances.

Diamond Saw and Stamping Works, Buffalo, N.Y., folder on "Sterling" hack saws.

Garvin Machine Co., New York, booklet on solid extended milling machine knee.

LITERARY NOTICES.

Automatic Surveying Instruments. By Thos. Ferguson, member of Shanghai Society of Engineers and Architects. 90 pages. Price, 4s. London: John Bale, Sons & Danielsson, Limited.

This book is a complete description of three instruments invented by the author, designed to make automatic records of itineraries, whether over land or water. The pedograph is an instrument which can be slung over the shoulder like a kodak, and which traces out, to scale, a plan of the route traversed, the only attention required being to adjust the instrument occasionally as to level and direction. The cyclograph performs the same function when attached to a bicycle, and the hodograph will record the route travelled by a boat. An introduction to the book is written by E. Hammer, Ph.D., Professor of Geodesy at the Royal Technical High School of Stuttgart.

Smoke Prevention and Fuel Economy. By Wm. H. Booth, M. Am. Soc. C.E., and John B. C. Kershaw, F.I,C, 190 pages; 75 illustrations. Price, $2.50. New York: The Norman W. Henley Publishing Co., 132 Nassau Street.

As the title indicates, this book deals with the problem of complete combustion, which it treats from the chemical and mechanical standpoints, besides pointing out the economical and humanitarian aspects of the question. "We believe," say the authors, "that coal of bituminous quality is capable of perfect combustion, and that black smoke is merely so much evidence of improper design." Chapters of the book deal with the Chemistry of the Combustion Process; Present Methods of Burning Fuels and their Defect; Improved Methods, and Examination of Waste Gases. An appendix describes various English, German, and United States patents for stokers, etc. A complete index adds to the value of the book.

Mechanical Appliances, Mechanical Movements and Novelties of Construction. By Gardner D. Hiscox. 400 pages; 970 illustrations; cloth, $3. Norman W. Henley Pub. Co., 132 Nassau Street, New York.

Though this is a complete work in itself, it is a continuation of the author's previous book on "Mechanical Movements," which went through ten editions. The present work gives illustrations and brief descriptions of 913 examples of machines and devices designed to overcome special difficulties or do special work, and the value of these illustrations is that they may often suggest a way of helping one out of other difficulties that come up in the effort to solve problems connected with new machines. There is a supplement of fifty-seven patents or devices by which various inventors have attempted to get perpetual motion. They form a buaget of curious information, but the author does not encourage the hopeless pursuit of perpetual motion. He simply shows the exceedingly ingenious means devised by misguided inventors in their endeavors to solve an unsolvable problem. The pages in which perpetual motion machines are described may induce those who still believe in this *ignis fatuus* to bend their energies in causes more worthy of their zeal. Moreover, some of the mechanical movements evolved by the perpetual motion inventor although they did not attain the end sought by him, may still be applied with profit to his instruction in true mechanical principles and to avoid the errors committed in the attempt to get something out of nothing.

The fifth annual convention of the American Railway Engineering and Maintenance of Way Association was held in Chicago in March last, and the complete proceedings, comprising over 800 pages, besides inserted diagrams and tables, is now published. Reports are given from special committees on buildings, ties, fences, ballasting, masonry, terminals, and several other subjects coming within the scope of the association. A notable feature of many of the committee reports is the definition of terms, which is carried out in a thorough manner. For instance, the correct use of the terms "station" and "depot" is stated, the latter being a storehouse or depository for goods, while the former is the building to which both names have been indiscriminately applied. In all departments the report contains an abundance of information, and it should prove a useful work of reference. The association now has 453 members, representing 184,550 miles of railway in the United States, Canada, Mexico, Japan and elsewhere.

"Mining in British Columbia" is the title of Bulletin 19, issued by the Bureau of Provincial Information of that Province. It is a book of 170 pages, going very fully into the present state of the mining industry in the Province, with brief historical sketches. The compilers freely admit that the tale is not one of unbroken success, for many failures are recorded. The chief drawback experienced in the past, as well as at present, has been the lack of capital. One fact, however, inspires and justifies a great confidence in the future of the Mineral Province, and that is that in the past ten years the annual output has increased more than fourfold. Fifteen thousand copies of the bulletin were printed ten thousand of which were sent to St. Louis for distribution.

The Engineering Directory of October, 1904, is a book of 80 pages, containing classified and alphabetical lists of advertisers in "Engineering." The book is put in neat form for ready reference, and is sent gratis on application to the offices of "Engineering," 35 Bedford Street, Strand, London, W.C.

The Abner Doble Company, of San Francisco, with the permission of the Civil Engineering Department of the Massachusetts Institute of Technology, has published a thesis by H. C. Crowell and G. C. D. Lenth, entitled, "An Investigation of the Doble Needle Regulating Nozzle." It makes a pamphlet of thirty pages, containing about twenty figures and five plates.

The British Fire Prevention Committee have devoted the first number of their quarterly journal to the Baltimore conflagration of February last. The magazine contains a map of the fire area, a series of about seventy photographs of buildings affected, the official Government report of the fire by Capt. Sewell, the report of the Boston Mutual Experiment Station, and the conclusions of the special committee of the National Fire Protection Association of the United States. The whole is arranged by Edwin O. Sachs, F.R.S.Ed., who also contributes a summary of the technical features of the fire and of the lessons to be drawn. Among other preventive measures which the Baltimore fire has shown to be necessary Mr. Sachs finds these: The restriction of cubic contents of individual risks; the guarding of external openings with shutters or otherwise; the protection of all iron-work by concrete or terra-cotta; the prohibition of the use of stone for supports; the provision of means of rapidly cutting off gas, water and electrical supplies of blocks of buildings, and special water supply for fire purposes. The book should be of great value in the cause of fire prevention. It is published by the committee at 1 Waterloo Place, London, S.W. Price, 5s.

The publishers of the Canadian Magazine are to be congratulated on the production of a very attractive Christmas number, which will make a suitable gift to send to friends abroad. It is pleasing to learn from the publishers that this magazine is displacing to a greater extent than heretofore the foreign publications so largely used here for Christmas souvenirs. In this number Mr. Waters, a returned self-supporting missionary, gives a picture of social life and customs in Tongaland. Sir Gilbert Parker tells of his experiences during his first days in the House of Commons. William Wilfrid Campbell contributes a two-page poem, and there are half a dozen short stories.

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It is reported that the Delaware, Lackawanna and Western Railway will convert their motive power from steam to electricity, beginning the installation very soon.

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—Willis Chipman, C.E., Toronto, has been instructed by the council of Portage la Prairie, Man., to prepare plans for a new water-works system for the town. Test wells are now being sunk for water supply, but the piping will not be laid till spring.

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—The Ontario Government will appropriate $180,000 to the building and equipment of a department of physics, which will mean a large extension to the equipment of the present School of Practical Science. The Government will also give $10,000 to aid the University of Ottawa in equipping an engineering department.

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At the Liberal convention in Toronto last month, one of the resolutions passed endorsed the principle of municipal ownership of public utilities, such as water, gas, electric light, telephones, street railways, etc., and expressed the opinion that hereafter no franchise should be given to a private corporation for a period exceeding 30 years.

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The Hamilton, Ancaster and Brantford Railway, which had right of way through all but one of the municipalities, and which had let contracts for construction, has been blocked by Barton Township Council, who make almost impossible conditions for the right of way over a quarter-mile of road, which they control. Hon. Charles D. Haines, of New York, the chief promoter of the road, says he will abandon the scheme.

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—At the first meeting of the Electrical Section of the Canadian Society of Civil Engineers, held 3rd November, a paper on "The Design, Construction and Testing of Core Type Transformers," was read by A. E. Foreman, student member of the society. A meeting of the Mechanical Section was held on Thursday, 24th November, when a paper on "The Measurement of Water by a Venturi Meter, Viewed from a New Standpoint" by R. Steckel, member of the society, was read.

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—Eugène P. Poisson, civil engineer, representing the Fèves Lille Company, of Paris, France, and Eug. Parrot, engineer of the Société de Construction des Batignolles, of Paris, favored the Canadian Engineer with a call a few days ago. Messrs. Poisson and Parrot are visiting Canada in the interests of a number of companies and syndicates in France, who have in contemplation the investment of capital in Canada or the establishment of agencies for promoting French trade with Canada. They have travelled from the Pacific Coast east, and are at the Windsor Hotel, Montreal during December. They express themselves as much interested in the developments now going on in Canada, and no doubt the result of their visit will be the opening up of some new trade or industrial connections between France and Canada.

—The Toronto branch of the Canadian Manufacturers' Association has now 425 names on its membership roll, and the council of the branch has decided to inaugurate five sections, which will include the various classes of manufactures, and which will each have their own governing body. The sections will be described as the dry goods, leather and paper, wood manufactures, metals and jewellery, and groceries, drugs and chemicals, departments. An Executive Committee will be elected by each.

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—Sir Guilford Molesworth, the new president of the Institution of Civil Engineers, spent more than thirty years in India and Ceylon, and made those realms the subject of his inaugural address. Public works policy there has swung between private and state enterprise, the author showing a decided preference for state ownership. In Ceylon, with which Sir Guilford was long associated, the profits of the railways have already more than covered the capital outlay. The future of India must depend mainly on works carried out by civil engineers.

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John Bertram, president of the Bertram Engine Works, Limited, Toronto, president of the Collins Inlet Lumber Co., and chairman of the Dominion Government's recently created Commission on Transportation, died a few days ago in Toronto from appendicitis. Mr. Bertram was also a member of the Ontario Forestry Commission, and was a high authority on lumbering and forestry questions. In 1900 he succeeded his brother, the late George H. Bertram, as president of the engine company bearing his name. Mr. Bertram was a man of plain life and strong common sense, and took a keen interest in public questions. He is survived by seven children, of whom Robert Bertram is vice-president of the engine company.

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The Allan Liner Parisian, which for years has been the queen of the Allan fleet, is being retired from the Liverpool-Montreal route. Next season the Victorian, the Virginian (turbine steamers), the Tunisian and the Bavarian will constitute the fleet on this route. The Parisian will probably run from New York to Glasgow, though this is not determined. She was built in Glasgow in 1881, by Charles Napier & Sons, and was one of the first of the trans-Atlantic liners to be constructed of steel. In her twenty-three years of service she has never met with an accident of any consequence and never has lost a life. Originally the engines were of the old-fashioned type, but a few years ago she was over-hauled, and triple expansion engines were installed.

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—Sir Wm. Garstin, G.C.M.G., has just issued a report on various schemes for controlling the Upper Nile. Sir William has been studying the river for five years, and he has proved that the White Nile contributes almost nothing to the volume of water flowing to the delta, almost eighty per cent. being lost in its passage through swamps between Lado and Fashoda. Sir William's proposal is to cut a new channel 200 miles long, to the eastward of the present channel. Alternately, he would train the present channel by damming the tributaries and planting trees at intervals for hundreds of miles. Several subsidiary works would be necessary, in the way of regulating the flow from the feed lakes, etc. The total expenditure would amount to over £20,000,000, and the work would take ten or fifteen years to complete. The result would be to add fifty per cent. to the volume of the White Nile at Khartoum.

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—The Canadian Westinghouse Company has sold to the Hamilton Cataract, Power, Light and Traction Company, for use in its Victoria sub-station, at Hamilton, two motor-generator sets, each consisting of a synchronous motor and a direct current generator. The motor-generator sets will be of the two-bearing type, the generators delivering direct current at 550 volts to the railway system, and each being rated at 750 K.W. The synchronous motors will take two-phase current at 8,000 alternations and 2,400 volts and will be rated at 1,380-h.p. The excess of capacity in the motors is provided so that they may be used for raising the power factor of the transmission system. Power is taken through lowering transformers from the high tension transmission line from the De Cew Falls station of the company. These motor-generator sets will be built at the works of the Westinghouse Electric and Manufacturing Company, at East Pittsburgh, Pa.

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—The Portland Cement Company, Limited, of Manitoba has been incorporated with a capital stock of one million dollars. Operations are to be carried on in the municipality of Springfield and the head offices will be in Winnipeg. The company is composed of D. A. Keizer, C.E.; Thomas C. Dougherty, financial agent; R. R. Sutherland, barrister; Arch. Wright, gentleman; C. J. Jamieson, M.D., of Winnipeg, and D. W. Shunk, of Ste. Anne.

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—The Arcola branch of the C.P.R. was opened for traffic last month. This section is 113 miles long, running from Schmeitzer Junction to Arcola, and opens up rich new land. It also gives a second connection between Winnipeg and Regina. The connection made a month ago at Emerson gives the C.P.R. four lines connecting Winnipeg with St. Paul and Minneapolis. Among the other works carried out by the company during the past season is a change of location of sixty miles, between Swift Current and Moose Jaw, made to get an easier grade, while a reduction of grade has been obtained at Broadview and between Winnipeg and Fort William. A new branch has been built east from Lacombe on the Calgary and Edmonton line, one from Wetaskiwin east to intersect the Long Lake and Saskatchewan. The Kirkella branch is also being extended. Double tracking between Winnipeg and Fort William will probably be carried on through the winter.

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Frank H. Mason, United States Consul at Berlin, reports on a German patent for a process of electric heating, which can be applied to house warming as well as the smelting of metals. A compound called "Kryptol," composed of a mixture of graphite carborundum and clay, is placed on an earthenware plate having carbon electrodes on its opposite sides. The mixture is in granules offering resistance to the electric current according to the fineness of the grains, but the grains are not destroyed by the heat. When the "Kryptol" covers the plate entirely the circuit is complete, and heat generated in the mass. The heat can be controlled at will, as it is generated only where the layer is thinnest and is limited to the thin spot. Having the grains fine or coarse also varies the heat. It is said that while the thin spot may be made incandescent, the parts where the layer is thick will be so cool as to be easily stirred by the naked hand. It is said to be applicable to heating rooms, street cars, etc., though how the mixture would keep a determined level in a jarring, oscillating car is not apparent by the description.

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—The report of the directors of the British Columbia Electric Railway for the past year states that the business of the company has continued to grow in all departments. A number of further contracts for sale of power have been made during the year. This branch of the business will be much extended when the Vancouver power installation is complete. Less than one-third of the tunnel between Trout and Coquitlam Lakes remains to be driven; the concrete dam at Trout Lake, the power-house, and the sub-stations have all been completed, and three pipe-lines are in place. Since December 19th, 1903, the City of Vancouver street lighting has been carried out by means of power delivered from Trout Lake, and a contract has been entered into to supply the City of New Westminster with power for street lighting over a term of years. The engineers estimate that the work will be completed about May, 1905. The negotiations for the purchase of the Vancouver Gas Company have been successfully carried through. The cessation of competition between these undertakings has resulted in benefit both to the British Columbia Electric Railway Company and to the public in Vancouver. The price of electricity has been lowered since the purchase.

Indian Head, N.W.T., is considering the installation of a street lighting plant, and a waterworks system under municipal ownership.

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—W. Kirkwood, formerly of Toronto and Belleville, has opened an iron rolling mill in Winnipeg, for the manufacture of all kinds of steel and iron supplies for railway and other enterprises.

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—The annual meeting of the American Society of Mechanical Engineers will be held in New York from the 6th to 9th inst. in the society's rooms at 12 West 31st St.

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—The Grand Trunk Railway Co. has been awarded two gold medals at the World's Fair for its exhibits in the fish and game building. The company received similar honors at Paris, in 1900, and at Osaka, Japan, in 1903.

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—While hunting for relics of the stone age, in Northern Manitoba recently, Prof. P.G. T. Kendall, of Tulane University, New Orleans, found a rich ledge of copper with extensive surface croppings. He proposes to test it more thoroughly in the spring.

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—A valuable deposit of cement marl has recently been discovered near Winnipeg. It varies from 7 to 25 feet in depth and the area is said to be 750 acres, or sufficient to produce a million and a half barrels of cement. T. O'Doherty, Main St., Winnipeg, reports that Prof. Kendrick has made an analysis of the marl and pronounces it to be like English marl in character.

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—The Dominion Government has been asked to assist a company to be known as the Canadian Tin Plate and Pressed Steel Co., who will establish a factory at Morrisburg, if permission is granted for the use of the Williamsburg Canal for water-power. They will employ 150 hands at first, which number is to be increased ultimately to 1,000. Over one hundred skilled workmen will be brought from Wales.

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—A new law, providing compulsory compensation for factory employees and miners in the case of all accidents, has been put into force in Russia. In the event of death an annuity is payable not only to widows and legitimate children, but to illegitimate children and to the mothers of such children, and also to adopted children, the annuity to equal the wages of 260 days per annum, whereas the average of working days in Russia only number 220.

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—The 18th annual banquet of Toronto, No. 1, Canadian Association of Stationary Engineers, was held at the Walker House, Toronto, on November 16th, President W. L. Outhwaite in the chair. After an excellent menu, toasts were proposed in honor of the King; Canada our Home; Toronto our City; the Legislature of Ontario, by Thomas Crawford, M.P.P.; Manufacturers, by John J. Main and E. E. Keele; Education; Executive Council; Sister Societies; the Mechanical Press; Our Guests. A programme of songs and recitations was rendered between the toasts. About 175 members and friends enjoyed the evening.

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—The Free Press, Winnipeg, reports that the Manitoba Gypsum Company has succeeded the old Manitoba Union Mining Company, which has been in operation for the past three years at Gypsumville, Lake Manitoba. Lying adjacent to the property of the Manitoba Union Mining Company is a gypsum deposit 1,200 acres in extent which belongs to Wm. Martin of the Northern Elevator Company, and Hon. Hugh Sutherland. The combination of the two properties gives the new company gypsum lands of over 2,000 acres in extent, and the control of the only large gypsum deposit yet discovered in the Canadian West. The new company, in addition to the lands, have acquired the fine gypsum mill, erected two years ago at Gypsumville, and which has a capacity of 10,000 tons per annum. This mill will immediately be enlarged to a 20,000-ton mill. Gypsumville is about twelve miles from the quarries at present opened and already the new company have a gang of men out cutting ties for a narrow gauge tramway to connect the quarries and mills. In addition to the steamer Petrel, purchased from the Union Company, another steamer is being acquired. These steamers will bring the finished products down to Westbourne or Delta for transhipment by rail east and west. The officers of the new company are: B. C. Mason, Kansas City, president; William Martin, Winnipeg, vice-president and general manager; Hon. Hugh Sutherland, Winnipeg, secretary-treasurer; James Fisher, W. J. Holahar, Mason City, Iowa; T. A. Potter, of the same place; D. E. Roberts, of the Plymouth Plaster Company, Fort Dodge, Iowa, directors. The Plymouth Plaster Company, with which Mr. Roberts is connected, is one of the largest concerns of its kind in the United States. The company will find occupation for 100 to 125 men.

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—The exciter plant of the Canadian Niagara Power Co., at Niagara Falls, Ont., is now in operation, and the first and second units of 10,000-h.p. each are to be ready to generate electric power by the 1st of January. Until calls are made for power on the Canadian side the current from these two generators will be transmitted to Buffalo to supplement the power sent from the United States side of the Falls.

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—During the past two years the Vulcan Iron Works, of Winnipeg, have been greatly extended. The company moved into one new shop last spring, and another new one has recently been finished and occupied. One of these shops is 264 by 100 feet, the other 200 by 100 feet, the original shops being only 100 by 70 feet. The company will build its own power house and have its machines operated by electricity. The new shops include boiler shops, foundry, and general machine shops, and are being fitted up with the most modern tools. John McKechnie is president of the company.

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—A conference was recently held at Glace Bay, N.S., between the officers of the Dominion Coal Co. and delegates from the P.W.A. A fear had prevailed that a cut would be made in wages during the winter, which would be certain to be followed by a strike in the spring. The arrangements arrived at, however, are such as will give the coal trade in Cape Breton a degree of stability such that the company can reach out after contracts unhampered by fear of labor troubles to handicap them in the falling of the same. The present rate of wages is to prevail for three years. The over-crowding of mines is a matter of great moment to the men. This phase of the subject will also receive consideration.

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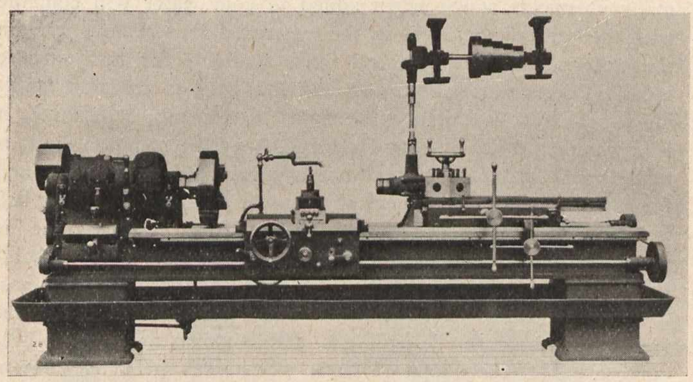
—In 1898 the Newfoundland Government made a contract with the Reid Newfoundland Railway Co. by which the company was given the right to operate, for fifty years, the railways and the telegraph lines connected with them, as well as certain other telegraph lines in the island that belonged to the Government. At that time the Anglo-American Cable Company enjoyed a qualified monopoly of telegraphic service in the island, which, however, was to terminate in April last. In view of the Anglo-American monopoly the Government gave to the Reid Company a subsidy of $10,000 a year to operate the telegraphs until the date of the expiry of the Anglo-American monopoly, as mell as all profits during that period and until the end of the fifty-year period in 1948. The Government, however, have been anxious to take back the telegraphic service. To determine the compensation, if any, to be paid the Reid Company for the surrender of rights, arbitrators have been appointed, Hon. Edward Blake, named by the Government, Donald McMaster, K.C., by the company, and P. S. Archibald (formerly chief engineer for the Intercolonial Railway), by the courts of Newfoundland. This arbitration board sat at St. John's from October 27th to November 19th, and all evidence was put in. The board will meet again in Toronto on January 9th next.

ROUGHING AND BORING LATHE.

The accompanying illustration presents a very interesting machine just brought through by The American Tool Works Co., of Cincinnati—a 22-inch "American" lathe with patent all geared head, pan, oil pump, turret, and special boring device. The entire screw cutting mechanism has been omitted on this machine, inasmuch as the lathe is primarily intended for roughing and boring, and the feeding mechanism, while of the same principle as that regularly incorporated on the "American" lathes, is of a special nature. There are seven carriage feeds, ranging from .2 to .015, being scientifically graded for the greatest efficiency in that character of roughing and boring planned for this lathe by the customer. The patent geared head is an extremely simple, powerful, and efficient construction. Only six gears are required to obtain four speeds through levers shown on the front. This simplicity of construction enables the gears to be made of very wide face, and large diameters, this giving the entire mechanism sufficient strength to transmit the maximum power delivered to the machine by six-inch double belt. The four speeds obtainable through the head, in connection with a triple friction countershaft supply twelve distinct speeds to the spindle, ranging from 5 to 322 R.P.M. The carriage is fitted with plain block rest, which is provided with an interesting calipering attachment. This consists of a set of four adjusting screws, attached to the plain block rest after the manner of eyebolts, each one falling, when desired, over into corresponding slots in the yoke piece over the front carriage dovetail. By adjusting knurled locknuts on any of the four screws and dropping same into the slot, the travel of the cutting tool toward the centre, and hence the diameter to be turned is limited at pleasure. This attachment is very valuable in duplicate work, as adjustments can be made for duplicate turning of pieces with four shoulders. The hexagon automatic turret is of liberal size, with rapid and easy adjustments. Is provided with power feed, driven by sprocket chain from the feed rod, thus giving fourteen feeds to the turret, ranging from .16 to .007. The worm is dropped out of mesh with the wheel by an improved tripping device, adjustable at will from the front of the machine. The turret slide has extra long bearing on the bed; the top slide has 24-inch movement, controlled by pilot wheel, and is supported on the front end by an improved supporting shoe, which slides on the ways, and is firmly bolted to the end of the turret slide directly under the cutting tool. It ensures accurate alignment in boring, and has gibbed bearing both at the top and bottom of ways, thus preventing all spring in any direction. The drilling attachment is affixed to one of the faces of the turret, and is extremely valuable in boring operations. It consists of a symmetrical housing carrying mitre gears, which actuate a spindle with ball bearing thrust, which carries the boring bar. The spindle is made to revolve from a separate overhead countershaft, as shown in the illustration, by means of universal joints connected by a telescopic rod, which thus compensates for any movement of the turret slide. The boring spindle revolves in the opposite direction to the main spindle on the head, an obvious advantage. The boring spindle has five rates of speed through the cone pulley on the countershaft giving proper gradation to obtain the best results in the boring for which the lathe is intended. Whenever it is desired to use another face of the turret, it may be revolved without disturbing the drilling attachment, due to the telescopic rod. The boring tool is provided with oil supply, same being drawn by auxiliary pump up through the turret stem and boring bar. The carriage has similar oil supply to the turning tool. The pan beneath the bed catches all waste oil, which is returned to the machine repeatedly. The lathe is very heavy and substantial throughout, to adapt it to the unusually heavy strains which a lathe of this character must undergo. Further information will be furnished by the makers.



ELECTRIC TRACTION FROM GAS POWER.

A new departure from established methods in electric traction has recently been undertaken at Warren, Pa. The Warren & Jamestown Street Railway Company is equipping an alternating current, single-phase electric railway system to operate between Warren, Pa., and Jamestown, N.Y., for which power will be supplied by gas engines operating upon natural gas. The equipment is now being constructed by the Westinghouse Companies at East Pittsburg, Pa. The power station will be located at Stoneham, Pa., two miles from Warren. The initial equipment will consist of two Westinghouse gas engines each of 500 brake horse-power capacity. They will be of the horizontal, single-crank, double-acting type, direct connected to two 260-K.W. Westinghouse generators furnishing current at voltage sufficient for direct use upon high tension transmission line. The power equipment also comprises a 55-h.p. Westinghouse gas engine for operating air compressor and exciter unit. Natural gas will be used, furnished by the local distributing company. In this district the gas has a calorific value of about 1,000 b.t.u. per cub. ft. Transformer sub-stations, five in number, will be located along the right of way. These will receive the high tension current from the transmission line and reduce the voltage to such an extent as to render it more suitable for use in single-phase motors. The present motive power equipment will comprise four quadruple sets of Westinghouse single-phase motors, each 50-h.p. capacity. An interesting feature of the system is the arrangement for operating alternating current motors upon the direct current trolley lines within the city limits of the termini. The Warren & Jamestown Street Railway is not a newly-organized system, as it has operated part of the present lines for a period of eleven years. Three years ago the company began experimenting with the use of gas power, with sufficient success to influence them in the new exclusive adoption of gas engines for their entire power generation. The operation of the new system will be watched with much interest by the engineering public, and its success will mark an important advancement in modern electric railroading.

PURIFYING WATER FOR ENGINES.

An instructive report on water purification for engine use has been made by a committee of the Association of Railway Superintendents of Bridges and Buildings (U.S.). The committee embodies in its report a memorandum by G. M. Davidson, chemist and engineer, of the Chicago and Northwestern Railway, who observes that the character of water for boiler use may be influenced by the following: 1. By the kind of rock and soil through which it passes. 2. By the depth to which it penetrates the rock and soil. 3. By the time that it remains in the earth. All natural water contains more or less solid matter in solution, or mixed with it mechanically and held in suspension. The ideal water for use in locomotive boilers is one that does not deposit scale, does not corrode, and does not cause the boilers to foam. Unfortunately, such a water does not exist in nature.

Of boiler compounds, he says: The number of boiler compounds on the market are so numerous that I will only refer to a few of them in a general way. Some are entirely mechanical in their action, such as wires, plates, twigs, and brushes, which are supposed to catch and entangle the scale-forming matter and prevent it depositing and forming hard scale. Others are supposed to have a chemical action, and indeed are well known chemicals that do have such action, but the high prices of such chemicals limit their use. Others, like potatoes, peas, wheat, moss, crude oil, kerosene, etc., are of some little benefit because they form centres about which the lime and magnesia gather and thus prevent the formation of hard scale. It was once customary for owners of boilers to use various boiler compounds, boiler purgers, boiler scale dissolvers, and similar nostrums, which were offered from time to time and which were represented to cure the evils due to the use of poor water. After experimenting and trying a great many of these boiler compounds, it was concluded that while many of them seemed to give fairly good results, yet a large portion were humbugs. Many of them contained well known chemicals which, when properly used, would give fair results. Some of them contained material that yielded doubtful results. Some of them were found to contain chemicals which were known to be very harmful to boilers. Some ten years ago it was found that if properly used, soda ash in locomotive boilers would yield fairly good results. You will note that I say "if properly used," because it was found that if used improperly, soda ash would do more harm than good to a locomotive boiler. When soda ash was first used, the locomotive engineers were divided into two classes in regard to their opinions as to the benefit derived from its use. Some of them declared it did good work in locomotive boilers, while others declared just the reverse. Upon investigation it was found that the proper use of the blow-off cock had much to do with the results obtained. If the engineer used the blow-off cock frequently and thus removed the "sludge" and concentrated water from his boiler, the results were generally fairly satisfactory. A boiler, however, was not designed for the purpose of treating water with chemicals and the use of a locomotive boiler as a vessel in which to carry on a chemical operation was found to be poor practice. As the use of boiler compounds required their introduction into the boiler, they did not meet with very much favor.

The hardness of boiler water depends upon the quantity of lime and magnesia compounds that it has in solution. There are two kinds of hardness, commonly distinguished as "temporary hardness" and "permanent hardness." "Temporary hardness" is due to carbonate of lime and carbonate of magnesia held in solution by carbonic acid gas. Such water may be softened by boiling and thus driving off the carbonic acid gas, or by adding to the water some chemical that will unite with or absorb the carbonic acid gas. "Permanent hardness" is due to the sulphates of lime and magnesia, and sometimes some other compounds which are dissolved in the water. These remain in

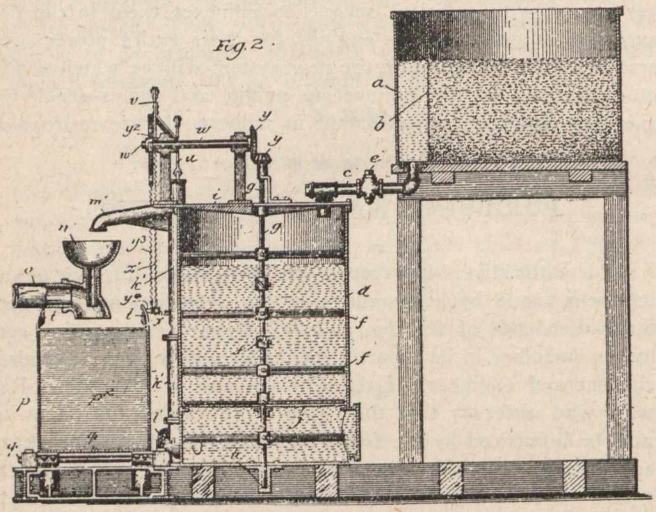


Fig. 2.

solution after water is boiled because they do not depend on carbonic acid gas to hold them in solution. The principles of the art of water softening have been known for over one hundred years, but it was not until the year 1841 when Dr. Clark, of Scotland, took out his famous patent for softening water on a large scale, that an attempt was made to soften water for boiler use. The Clark process is the basis for all other water softening processes that have been commercially successful.

The chemical treatment of water before it is used in boilers has been carried on in Europe for a number of years, but only recently has the subject been given much thought in this country, even for stationary boilers, and the purification of water for locomotive boilers has only been taken up by the railway companies during the past few months.

All water used for boiler purposes, unless it is rain collected from the roof of a building and not allowed to come in contact with the earth, contains more or less scale-forming material in solution. This scale-forming material is composed of compounds of lime, magnesia, iron, alumina, silica, etc. Of these the carbonate and sulphate of lime and the carbonate and sulphate of magnesia form 98 per cent. of the scale, and it is these four compounds that generally cause trouble in boilers. It is to the removal of these compounds that I will particularly call your attention.

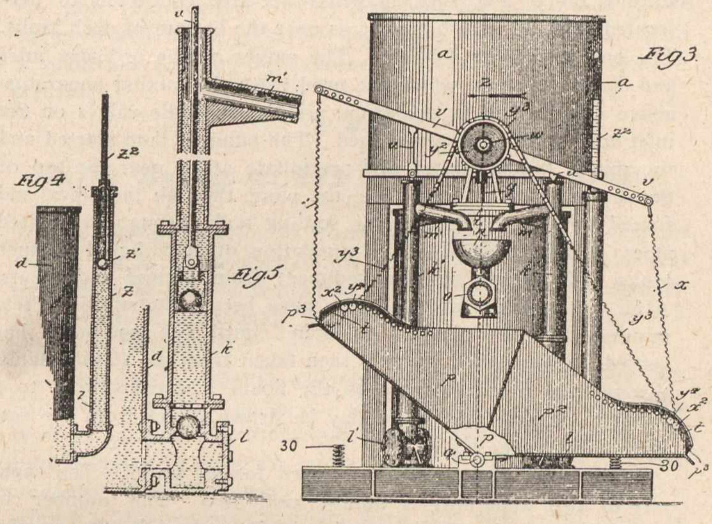
Carbonate of Lime is the chemical name for common limestone, marble, and chalk. It is the commonest form in which lime is found in water. It is but slightly soluble in chemically pure water, but is readily soluble in water which contains carbonic acid gas. Rain water, in falling to the earth, absorbs carbonic acid gas from the atmosphere. When water charged with carbonic acid gas passes through the soil, it dissolves more or less of the lime that is in the soil. In localities where such water comes in contact with limestone the amount of lime dissolved by water passing through it is very large. When such water is boiled the carbonic acid gas is driven off by the heat, and the lime which was held in solution by it is deposited on the inside of the boiler. Carbonate of lime alone does not form very hard scale, but it is rather bulky because when crystallizing carbonate of lime combines with many times its weight of water. The white, chalky matter that is washed out from boilers and which can often be seen about roundhouses, is impure carbonate of lime. Since carbonate of lime is held in solution in water by the presence of carbonic acid gas, any means that will remove the carbonic acid gas from the water will at the same time throw out of solution the carbonate of lime. There are many chemicals which when added to cold water will combine with the carbonic acid gas in the water and thus remove it from the water. The one chemical most available for this purpose because of its great abundance and low cost, is common building lime. This is called quick lime. Chemically considered, it is a compound of lime and oxygen. When common lime is mixed with water it unites with a portion of the water and forms a new product, commonly known as slaked lime, which is chemically called hydrate of lime. When slaked lime is added to the water containing carbonate of lime held in solution by carbonic acid gas, it unites with this carbonic acid gas, forming carbonate of lime, which being insoluble in the water freed from its carbonic acid gas, settles down as a white precipitate. The carbonate of lime, which was held in solution by the carbonic acid gas, is thrown out of solution as soon as the gas is removed by the slaked lime, and also settles in the form of a white precipitate. Therefore, to remove carbonate of lime from a water before it enters a boiler, it is only necessary to add to the water the proper amount of slaked lime required to combine with the carbonic acid gas that holds the carbonate of lime in solution, and allow the resulting precipitate to settle. The clear water above the sediment that settles out, can then be used in a boiler without causing scale to be formed from any carbonate of lime that may have been in the water before it was treated.

Sulphate of lime, which is commonly known as gypsum or plaster of paris, is found in a great many waters, and is responsible for the hard scale which is often found on flues and crown sheets of boilers. Scale formed from sulphate of lime alone is often as hard as porcelain. It is not thrown out of solution until the water is heated considerably above the boiling point, namely, 302 degrees Fah., which corresponds to about 55 pounds' boiler pressure. The sulphate of lime is precipitated in the form of heavy crystals, which unite with such other deposits as are in the boiler, and form a hard cement-like coating on the flues and sheets. It is a very poor conductor of heat, so that when flues are coated with it it is necessary to burn a greater amount of coal in order to produce steam. Sulphate of lime being soluble in water that is free from carbonic acid gas, it cannot be removed from water by means of slaked lime. It can, however, be removed by means of carbonate of soda, commonly known as soda ash. The chemistry of this process is as follows: When a water containing sulphate of lime dissolved in it is mixed with a water solution of carbonate of soda, a chemical reaction takes place. This chemical reaction may be expressed as follows: Sulphate of lime and carbonate of soda when dissolved in water and mixed, react and form carbonate of lime and sulphate of soda. The sulphuric acid, which was combined with the lime as sulphate, leaves the lime and combines with the soda, forming sulphate of soda, while the carbonic acid gas, which was combined with the soda, leaves the soda and combines with the lime, forming carbonate of lime.

Carbonate of lime, being insoluble in water free from carbonic acid gas, settles down as a white precipitate, while sulphate of soda, being soluble, remains in solution. Therefore, to remove sulphate of lime from water before it enters a boiler, it is only necessary to add to the water the proper amount of soda ash required to combine with the sulphate of lime, allow the resulting white precipitate to settle, and then draw off the clear water.

Carbonate of magnesia is the commonest form of magnesia. It acts like carbonate of lime, being held in solution by carbonic acid gas dissolved in the water, and thrown out of solution when this gas is driven out of the water. By simply mixing slaked lime with water containing carbonate of magnesia in solution, the carbonate of magnesia is thrown out of solution in a manner somewhat similar to carbonate of lime, already described, so that the treated water when used in a boiler does not deposit scale from any carbonate of magnesia that was in the untreated water. We are all familiar with the magnesia boiler lagging, which is applied to the outside of the boiler to prevent the radiation of the heat, on account of magnesia being a poor conductor of heat. When the magnesia, however, is deposited on the flues or firebox inside of the boiler, it is surely on the wrong side of the shell.

Sulphate of magnesia, commonly known as epsom salts, does not of itself form boiler scale, but when it is in a boiler with a soft carbonate of lime scale, a chemical reaction takes place which results in the formation of hydrate of magnesia and sulphate of lime. These two compounds form a very dense



scale as hard as stoneware. Sulphate of magnesia can be removed from water before it enters a boiler by treatment with caustic soda, or what amounts to the same thing, and is cheaper, with slaked lime and soda ash.

The above mentioned two compounds of lime and two compounds of magnesia are the cause of almost all of the trouble with boiler waters that deposit scale, and are also the cause of much extra coal being used to generate steam. Rankine, in his book on mechanics, states that the resistance to the passage of heat offered by wrought iron being taken as 1, that of copper is 0.4; of slate, 9.5; of brick, 16; carbonate of lime, 17; and of sulphate of lime, 48.

Sometimes a water that is obtained near mineral veins contains free sulphuric acid, and, of course, such water is very corrosive. The addition of lime to such water neutralizes the acid. Water from mountain streams and from streams near waterfalls is also corrosive. This is due to the absorption by the water of oxygen and carbonic acid from the air. Likewise water that has had air pumped into it is corrosive for the same reason. Some waters from streams contain sand or mud in suspension. These can be removed by filtering, or precipitated by the use of alum or sulphate of alumina. If such water is hard it can be softened at the same time that suspended matter is removed.

Briefly stated, the scale in locomotive boilers is due to one or more of the following causes: 1st. Deposition of lime and magnesia carbonates, due to the boiling off of the carbonic acid gas from the water in which they were dissolved. 2nd. Deposition of sulphate of lime, due to high temperature in the boiler. 3rd. Deposition of magnesia compounds, due to their decomposition in the boiler. 4th. Deposition of sand, clay, and other matter that was suspended in the water. 5th. Deposition of alkali salts, due to concentration.

We have seen that in order to remove from hard water the scale-forming compounds of lime and magnesia, it is only necessary to mix with the hard water the proper amount of slaked lime and soda ash. The mechanical operations required may be classified as follows: 1st. Weighing, mixing, and dissolving the lime and soda ash in water so that the resulting mixture will have a uniform and constant strength. 2nd. Mixing a certain predetermined quantity of this chemical solution with a certain predetermined quantity of the hard water, and agitating the resulting mixture so thoroughly that the lime and magnesia compounds that were dissolved in the hard water are quickly thrown out of solution in the form of a white precipitate. 3rd. Separating and collecting this precipitate from the clear softened water.

These mechanical operations should be conducted at a minimum cost, and therefore, the mechanical apparatus should be simple and as nearly automatic as possible; easily adjusted to suit the different waters; not liable to get out of order; be operated without any extra power other than an ordinary pump, such as is used at water stations; so simple that an ordinary pumper can attend to it without neglecting his regular work, and so cheap that the cost of installation does not prohibit its use.

The author then describes an apparatus constructed for the company's use. Fig. 2 is a section, and Fig. 3 is an end elevation of same. Fig. 4 is an elevation partly in section, showing the float and gauge for measuring the depth of chemical solution in the chemical tank. Fig. 5 is an enlarged vertical section of one of the pumps, showing the arrangement of ball valves and connection of the pump to the chemical tank. Fig. 6 is sectional elevation of the settling tanks and pump house, showing the location of the entire apparatus for storing, feeding, mixing and settling water.

The operation of the apparatus is as follows: The proper quantity of chemicals, usually lime and soda ash, having been determined, they are weighed out and dumped into the mixing vat *a* (see Fig. 2), where they are mixed and dissolved in a proper quantity of water to make the solution the strength desired. By opening the valve *e* this solution is allowed to run into the chemical tank *d*. To thoroughly mix and keep the solution stirred up in the chemical tank *d*, stirring blades are fixed on the vertical shaft *g*, which rotates in the centre of this tank. In order to measure and deliver predetermined quantities of the chemical solution, the chemical tank *d* is provided with two pumps *k* and k^1 (see Fig. 3) connected at the lower portions to the chemical tank *d*, through the T's *l* and l^1. The upper portions of these pumps have discharge pipes *m* and m^1, which discharge into a funnel *n*, attached to an elbow terminating on the hard water supply pipe, so that just before the hard water passes out of this pipe the chemical solution is mixed with it.

To obtain the best results it is essential that the quantity of the standard chemical solution and hard water be mixed in proper proportions, and also that this be done regularly whenever the apparatus is being used, also that it be done economically. To do this a tilting vessel *p* (see Fig. 3) is used. It is supported on a shaft *q*, which is located directly under the elbow from which the mixed hard water and chemical solution is discharged. This tilting and measuring vessel is divided into two compartments of equal capacity, p^1 and p^2. When it is in the position shown in Fig. 3, the mixture of hard water and chemicals falls from the discharge elbow *o* into the compartment p^1. When this compartment is nearly filled it counterbalances the weight of the other compartment p^2, so that the vessel tilts until it strikes the springs 30, emptying the contents of the compartment p^1 and at the same time bringing the other compartment p^2 under the discharge elbow *o*. When this in turn is filled it reverses the movement of the tilting vessel *p*, emptying the contents of the compartment p^2, and bringing the compartment p^1 again under the elbow *o*. For convenience these compartments p^1 and p^2 are made such size that 100 gallons of water are required to fill them to the point where they commence to tilt and empty their contents. Having determined the amount of a standard solution of chemicals required to precipitate the scale-forming compounds from say 100 gallons of any hard water, it is necessary to mix it with the 100 gallons of hard water in one of the compartments p^1 or p^2. This is done by regulating the length of the stroke of the pumps k and k^1, which pump the standard chemical solution from the tank d into the funnel n. These pumps k and k^1 are operated by the tilting vessel p in the following manner: The plungers u are connected to a walking beam v, which is rotably mounted on the shaft w. The ends of this walking beam are connected by means of the chains x, and x^1 with studs x^2 on each end of the tilting vessel. An examination of the drawings, particularly Fig. 3, will show that if the parts are in the position shown in Fig. 3, when the tilting vessel p is tilted downwardly to the left, the plunger of the pump k is raised so that a quantity of the standard chemical solution is delivered into the funnel n and flows with the hard water into the compartment p^2. When 100 gallons are in it the tilting vessel p operates in the opposite direction, causing the other pump k^1 to operate, and delivers a quantity of the standard chemical solution into the funnel n, from whence it flows with the hard water into the compartment p^1. It will be understood that the hard water is running constantly through the elbow o, and that the two pumps k and k^1 are intermittent in their action. The quantity of the standard chemical solution delivered at each stroke of these pumps is regulated by the length of the strokes. This can be adjusted by the length of the chains x and x^1, so that a predetermined quantity of chemical solution will be delivered at each stroke. From the above description, it will readily be seen that a fixed quantity of chemical solution is discharged into the elbow o, and flows with the hard water into each compartment of the tilting vessel p, in proportion to the amount of hard water that is required to cause this vessel to tilt. It is desirable to automatically and economically operate the vertical shaft g in the chemical tank d (see Fig. 2) so that the horizontal blades attached to it will keep the chemical mixture thoroughly agitated. To do this it is geared to the horizontal shaft w by the pinions y and y^1. The other end of the horizontal shaft w is provided with a sprocket wheel y^2 (see Fig. 3) around which a link belt chain passes, the ends of this chain being attached to the ends of the tilting vessel by the studs y^4. It will readily be seen by this arrangement that whenever the tilting vessel p moves, the stirring blades attached to the vertical shaft g in the chemical tanks also move, thus agitating the chemical mixture in the tank d. For convenience in measuring the height in the tank of this chemical mixture, a pipe z (see Fig. 4) is attached to the side of tank d near its bottom. In this pipe is a float z^1 attached to a graduated scale z^2 from which can be read the quantity of liquid in the tank d.

The above described apparatus automatically mixes the proper quantity of the chemical solution with each 100 gallons of hard water, delivered by the steam pump and utilizes the weight of the water to furnish power to operate it. The result of this mixture is that the scale-forming matter that was in solution in the hard water is thrown out of solution, but remains in suspension in the treated water. This is separated from the treated water in the following manner: By referring to Fig. 6, it will be seen that the apparatus is located in the second story of the pump house, and that the pump house is located between two tanks placed on the ground. Fig. 7 shows a plan of the second story of the pump house. It will be seen from this that the tilting vessel above described empties its contents into a wooden box which is provided with troughs r and r^1, leading to the two settling tanks. These troughs are provided with shut-off gates so that the water can be run into whichever tank is desired. Fig. 6 shows a sectional elevation of these tanks. It will be seen that the troughs r and r^1 empty their contents into vertical pipes that extend to the bottom of the tanks and terminate in elbows. The object of this arrangement is to stir up as much as possible the old precipitate that remains in the tanks from former treatments, in order to hasten the settling of the new precipitate. It is a well known fact that if the old precipitate is stirred up well. the new light particles become attached to the old heavier particles and settle quickly.

After these tanks are filled or partially filled with the treated water holding the new precipitate in suspension, it is desirable that the sediment from former mixtures be thoroughly agitated and mixed in the settling tanks in order to hasten the settling of the new precipitate. To accomplish this result the same steam pump is used that was used for pumping a supply of water into the main. This pump has its inlet connected to branch pipes, leading into each of the settling tanks. These branch pipes have their outer ends 15 and 16 jointed to the main portions thereof, so as to be swiveled thereon. Floats 17 (see Fig. 6) are secured to each of these inlet ends of the branch pipes 15 and 16 to maintain their inlet-openings at or near the level of the liquid. The discharge pipe 11 of such pump is also

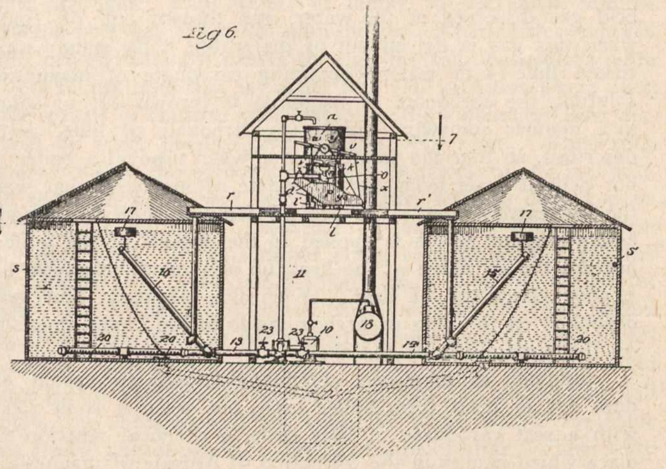


Fig. 6.

connected with branches 19, which extend into each of the settling tanks, and such branches are also connected to perforated pipes 20, which rest at or near the bottom of such tanks. The operation is as follows: The valves on the ordinary inlet and discharge pipes, which are used when the mixing apparatus above described is in operation, are closed, while valves on the inlet and outlet pipes are opened. The pump is then started and the mixed treated water and precipitate at or near the top of the settling tank is drawn into the pump through the pipes, and forced into the bottom of the settling tank through perforated pipes, thereby maintaining a circulation of such liquid in such tanks, and stirring up the sediment from former treatments. After the contents of the tanks have been agitated for a few minutes they are allowed to stand until the sediment has settled. The purified water is then taken from the settling tanks through the pipes, attached to the floats, and transferred to a suitable storage tank, or it may be drawn direct from the settling tanks to the boiler.

The same size apparatus is used for all plants. The capacity of this apparatus is almost unlimited. The number of oscillations of the tilting vessel p is determined by the amount of water that can be pumped into it, so that if settling capacity is provided, the capacity of the apparatus depends entirely upon the capacity of the steam pump. In regard to settling capacity: It has been found by using tanks 30 feet in diameter and 16 feet high, that each tank can be filled with treated water, the precipitate allowed to settle, and the clear softened water transferred to the railway supply tanks in 12 hours. These tanks have a capacity of 77,000 gallons, but as a certain quantity of water is left in these with the sludge, their net capacity is about 60,000 gallons of softened water each 12 hours, or 120,000 gallons per tank per 24 hours.

Once a month it is necessary to remove the sludge that has collected in the bottom of the settling tanks. When the softening plants are located near a drain the removal of the sludge is a very simple proposition. It is then only necessary to open the valves in the bottoms of the settling tanks and allow the sludge to run into the drain.

Up to the present time the only use found for this sludge is for making whitewash. On account of its firmness and freedom from grit, it is especially adapted for use in a whitewash spraying machine.

With this apparatus the cost of treating waters will vary from a minimum of about 1 per cent. 1,000 gallons for a fair boiler water, to a maximum of say 10 cents per 1,000 gallons for a water that is so bad that an attempt to use it untreated in boilers would result in so much trouble and expense as to practically debar its use.

The salient points brought out in this paper are as follows:

1st. Scale, deposited from water, on the inside of boilers, is the cause of much trouble and expense.

2nd. Water as it falls on the earth does not contain any scale-forming matter.

3rd. The amount and character of the scale-forming matter in water varies greatly and depends upon the character of the soil and rock through which it passes.

4th. Scale-forming matter can be removed from water before it is used in boilers by simple chemical processes and inexpensive mechanical apparatus.

5th. Ninety-eight per cent. of scale in boilers is derived from carbonates and sulphates of lime and magnesia.

6th. Carbonates of lime and magnesia are thrown out of solution by boiling. They, alone, form soft scale.

7th. Sulphate of lime requires a boiler pressure of about 55 pounds to throw it out of solution. It forms hard, compact scale.

8th. Sulphate of magnesia is decomposed in a boiler, forming hydrate of magnesia and sulphate of lime. These make a very hard, brittle scale.

9th. Carbonates of lime and magnesia can be thrown out of solution in cold water by adding to the water any chemical that will absorb the carbonic acid gas that holds them in solution. Slaked lime is the cheapest.

10th. Sulphates of lime and magnesia can be thrown out of solution in cold water by decomposing them with various chemicals. Carbonate of soda is the cheapest.

11th. The use of boiler compounds in boilers is not advisable. The proper time to remove scale-forming matter from water is before it enters the boiler.

12th. Hard water that is very poor for boiler use can be softened and made good for boiler use at a cost that is only a small per cent. of the expense of using the hard water untreated.

NEW WATER WORKS OF ST. JOHN'S, NFLD.

An interesting piece of work has been going on during the present season at the City of St. John's, Nfld. During the year 1903, the city council requested John Galt, consulting engineer of Toronto, to investigate into and report on the present system of water supply.

After careful surveys and consideration of the subject, Mr. Galt reported that the 24-in. gravitation supply main from Windsor lake, which was coupled to the two 16-in. mains, was quite unsuited to meet the wants of the city owing to defective gradients along the route, which was naturally very flat, level ground. His recommendations were that the 24-in. main be raised and the water of Windsor lake allowed to flow into and along the rock, cutting a distance of about 3,000 lineal feet. This channel in rock cutting to be mostly covered in and arched over.

At the end of the cutting, a concrete controlling chamber with sluice gates and screen house is being built, from which

Concrete Conduit on Surface.

a concrete conduit about 4 ft. in diameter and about 9,000 lineal feet runs on a uniform grade with several small drops to even up and conform to the ground elevation. This concrete conduit is built partly in deep cutting and partly on fill, as shown by the photo illustration herewith; one of which shows the conduit under construction and carried over on culvert bridge crossing an important stream. At the lower end of this conduit the water is discharged by natural gravitation into a concrete compensating basin provided with independent controlling sluice valves and straight-way bye-pass. A moderate fall from the lake to the compensating reservoir basin, a distance of about two and one-half miles, permits of a daily discharging capacity if required of over 15 million gallons, or fully four times the present requirements.

The City of St. John's is situated mostly on a steep slope rising from the sea level to a summit of nearly 300 feet. Windsor lake is situated about five miles from the city at an elevation of 500 feet above the sea half of which distance is a long, deep valley contiguous to the city, through which it is proposed to run duplicate iron pressure supply mains in differnt directions to the city. As the old 24-in. and two 16-in. iron mains will be reclaimed and raised after completion of new concrete supply conduit towards the lake end, the utilizing

Group of City Councillors and Others.—Smith Concrete Mixer in Background.

of same for conducting water across the valley renders the laying of duplicate pressure supply mains a fortunate thing for the city, preventing practically any loss or expense in the connection, while at the same time increasing fourfold the efficiency and supply of the whole waterworks system.

The work, so far, covers generally the improvements and enlargement to the supply, but it is the intention to follow this up by improving the system of distribution throughout the streets of the city proper. The municipal council of St. John's have undertaken the construction of this work by day labor, under the personal attention and management of their city engineer, John Ryan, with Mr. Galt as acting consulting engineer. Considerable money was spent in purchasing the necessary plant, such as steam hoisting derricks, rock crushers

Concrete Conduit in Trench.

and concrete mixers. All materials, excepting sand and cement, are found on the site. Mr. Ryan with his staff of assistants and foreman, also with the aid of 100 to about 150 men at different periods, has made excellent progress and done splendid work. Although starting late in the season, or about the

1st of July, the entire excavation has been completed and nearly all the concrete conduit built.

It is expected that before the season closes most of the concrete work, the conduit screen house and the compensating basin will be finished. Next year work will be confined to the canal at Lake end, also the laying of iron pressure mains across valley towards the city. The illustrations are from photos taken in September by James Vey, of St. John's.

TIDAL POWER.

The utilization of the tide for "power" purposes has long been an object that inventors in one way or another have sought to attain. A Manchester inventor, James Howarth, now claims to have completely solved the problem of utilizing the rise and fall of the tides, and other naturally elevated water, for commercial purposes; all that is wanted, in his view, being the requisite financial assistance for the introduction of the machinery and works for carrying out his project. What he proposes is to utilize the rising of the tide in compressing air. This is not by any means a new idea, but the method by which Mr. Howarth claims to have solved the problem of utilizing the pressure of the tide and of inland waterfalls possesses features of novelty, and may best be deecribed in his own words. The essential feature of his scheme is the construction of a number of chambers in suitable positions to which the tide has access, and, entering the bottom of these chambers, the air is compressed as the water rises. He claims that a twenty-four feet tidal rise would give over 10 lbs. per square inch pressure, and that one acre of beach surface of this rise would supply over 1,900 h.p. The compressed air is to be transferred into receivers situated on shore, through pipes. Pressure-impressed water is used as an intensifying medium, the pressure being impressed by the tidal rise, and air and water are pressure impressed ultimately as the process proceeds. The chambers are to be in series, the first receiving chamber storing 100 h.p. per head surface feet deep, and being 100 feet deep it contains 10,000 h.p.; the next chamber is to store 100,000 h.p., and the third 1,000,000 h.p. The storage chambers are all to be of equal size, but all of very different strengths, the pressures of these being, respectively, 10, 100, and 1,000 lbs. per square inch. The head plate surface of each is to be about 2,300 square feet, so that a third chamber in ten times larger size would store 10,000,000 h.p. with a pressure of 1,000 lbs. per square inch, although starting with only 10 lbs. of tidal pressure per square inch. In this arrangement it is claimed that the only mechanical power lost is that caused by friction, which is comparatively a mere fraction to the general loss in steam-using machinery. The quantity of horse-power storable per tide would, of course, be in proportion to the beach surface covered and the height of the local tide combined from which the power was to be drawn. The inventor submits that enough tidal power might be drawn from the British tidal coast to equal all the steam-engine power employed in Great Britain, including that of railway and tramway propulsion, if converted into electric driving power. Also, that his system of power utilization could be equally well applied with the most useful effect possible to waterfalls of any height, or to streams of not less than twenty feet descent from any near point of working.—Marine Engineer.

GAS ENGINE PROBLEM.

At the last meeting of the British Association for the Advancement of Science, held at Cambridge, Dugald Clerk gave the results of some experiments which, according to one of our English contemporaries, "marks another step in the progress of the internal combustion engine."

Mr. Clerk's paper is entitled "Flame Temperatures in Internal Combustion Motors," and his analyses of other experiments and those of his own establish several important facts, the salient ones of which may be stated as follows: If the density or pressure of the charge of an engine before compression be increased, the maximum and mean pressures may be increased without increasing the flame temperature; from which it follows that the mean pressure may be maintained the same as when the charge is drawn in at atmospheric pressure and the flame temperature reduced. It is also established that the heat loss to the enclosing walls of an explosion chamber does not increase in proportion to the increase of pressure or density of the gaseous mixture before explosion.

It is thus seen that engines may be made much more powerful for a given cylinder diameter, and cylinder losses may be greatly reduced, not only by the increased density, but by reduced temperatures capable of giving the desired pressures.

Mr. Clerk simply states the above facts, but their truth is easily grasped if we consider that an increase in the suction pressure increases the compression pressure and the heat generated by the combustion will raise this pressure a given amount. This heat is also applied to raising the temperature of a greater weight of gas, however, and if its specific heat remain constant, which it practically does, the maximum temperature will not be as high as if the suction pressure was normal, or in other words, the temperature will be reduced. The mean pressure is augmented by the added suction pressure inasmuch as the exhaust is into the atmosphere.

The author describes his experiments on gas engines in detail and the results show an increase in thermal efficiency of from 28.7 to 34.4 per cent. and a reduction in the maximum temperature of from 1,700 to 1,200 degrees centigrade; this in the case of an engine using an added charge of air compressed by an auxiliary compressor driven by a belt from the flywheel of the engine.

The suction pressure in another experiment was increased by introducing a portion of the exhaust gases cooled into the cylinder and so gain the higher pressure and density without the aid of an auxiliary air pump. The results showed a performance considerably above the best ever recorded for an engine of that type; the brake horse-power was increased by 5, and thermal efficiency from 28.7 to 32.5 per cent. and the temperature reduced to 1,300 degrees Centigrade. These advantages induced the National Gas Engine Company to build a 300 horse-power engine to carry out this fundamental idea of reducing flame temperature while increasing mean pressures. In this engine the head end of the cylinder is arranged as an ordinary four-cycle motor while the crank end is arranged as an air pump, and is enclosed with a cover through which the piston rod passes. The piston on its outward stroke overruns a series of ports placed around the cylinder and through which the compressed air charge is inserted. The success of this engine is that of the others and more; a mean pressure of over 100 pounds per square inch is obtained with the very low maximum temperature of 1,200 degrees centigrade.

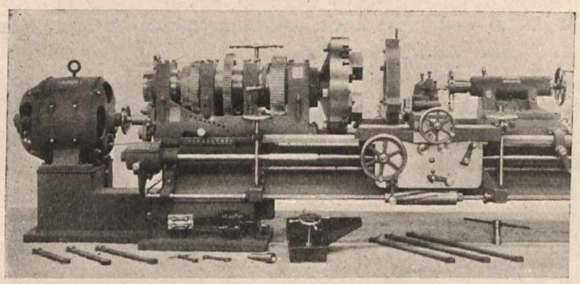
Notwithstanding the fact that the piston of this engine was not water cooled, it ran with full load, with consecutive admissions, at 160 revolutions per minute, the cylinder diameter being 21 inches and the stroke 34 inches.

That the increase in thermal efficiency is a matter of secondary interest is best shown by the author, who says:

"The difficulties with which the large gas engine is at present struggling are in main due to the high temperatures of the flame in the interior of the cylinder. So long as high-temperature flames are used within cylinders of relatively small dimensions, the difficulties due to unequal expansion of parts does not appear. The steam engineer is well aware of the care which has to be exercised in using large steam-cylinders in such a way as to avoid cracking, and he can quite well imagine that the difficulties of allowing for free expansion in a gas-engine cylinder are much more serious than his own when he considers the relatively low temperature of his steam. Even with superheated steam, 300 degrees centigrade is a fairly high temperature, while in existing gas engines of either large or small types it may be taken that the lower limit of maximum temperature at present is nearly 1,400 degrees centigrade. The water jacketing of a moving piston is an admirable expedient most carefully and ably carried out by many Continental and English engineers; but it is an expedient which has never satisfied me, and is, I believe, regarded with distrust by a considerable number of English engineers. In my view many of the troubles which have been experienced with large gas engines—cracking pistons, back covers, and the like—are due to the difficulties introduced of getting rid of very large heat flow through cylinder and piston walls, and it appears to me desirable, if possible, to reduce this flow to the lowest point consistent with maintaining the economy of the engines. In doing this, of course, it will not do to reduce the mean pressures of the engines. Large gas engines are at present undesirably heavy for the power, as compared with steam engines, and it will not do to increase the weight in any way by reducing the temperatures. This plan of artificially raising atmospheric pressure, either by the addition of air under pressure or by the addition of cooled exhaust gases under pressure, appears to me to furnish a very promising solution of the problem. In gas engines operated with producer gas or blast-furnace gas, the question of maximum possible economy is not at present a pressing one. The thermo-dynamic efficiency of all gas engines is now so much greater than any heat efficiency attained in steam engines that we can well afford to reduce economy, if need be, in order to make more certain of good practical results—that is, to make more certain of low cost for upkeep and repairs. In my view it would pay in large gas engines even to reduce fuel economy if by so doing entire immunity from breakdown was secured. So far the best means of limiting temperature in a simple way appears to be found in the addition of cooled exhaust gases to the charge before compression; and this method, although reducing flame temperature, has actually increased the efficiency instead of diminishing it."

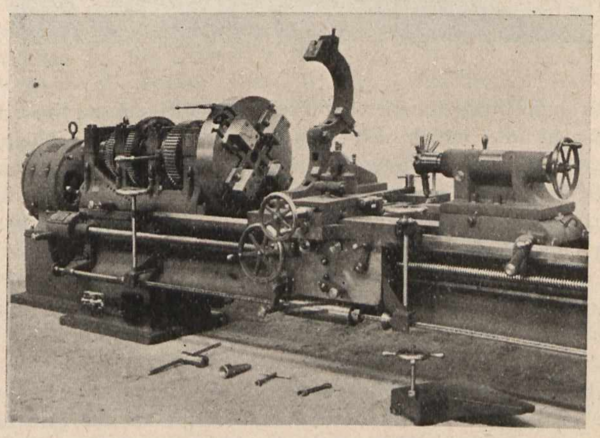
SPECIAL LATHE.

The Lodge & Shipley Machine Tool Co., of Cincinnati, have recently installed a special lathe in one of the projectile shops of the United States. Its novelty consists in its simplicity.



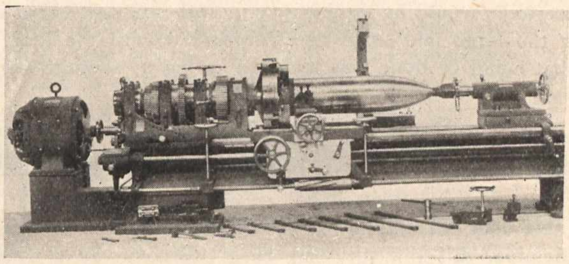
Projectile Turning Lathe.

The motor used is a Ridgeway 15-h.p. with speeds of 350 to 1,750. The controller has 20 speeds, and is, as shown, operated from the carriage, or at the head stock. The ratio of back gearing in the head is 1.62:1 and 2.62:1; the ratio of the motor shaft to the live spindle is 7.48:1 and 15.1:1. All gear-



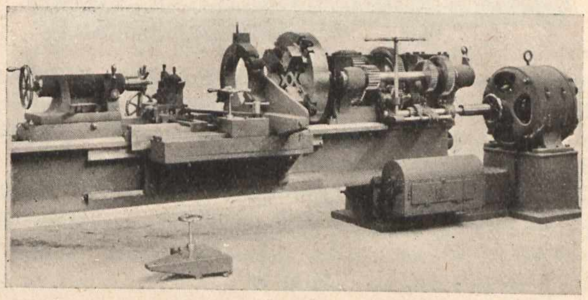
Projectile Turning Lathe—Side View.

ing in the head, that is, the main driving gears, are cast iron centres, with machinery steel rims of extra width. The size of the spindle bearings are: Front, 7⅞-in. diameter by 8¾-in. Back, 7½-in. by 5⅝-in. The spindle is of crucible steel, .55 carbon; the hole through the spindle is 2⅜-in. diameter. The lathe is designed at minimum speed of motor, to have a cutting speed for roughing on the body of the shell of 30 ft. per minute and for finishing of 60 ft. per minute. It will be seen that the



Projectile Turning Lathe.

milled cylinder on the speed control shaft, immediately under the apron, provides an automatic mechanical and full electrical speed variation for varying diameters, so that the cutting speed may be continuous from 2 inches diameter up to the largest diameter. The tool post is of steel. The special steady rest is quickly applied and removed, and the radial attachments



Projectile Turning Lathe—Rear View.

furnish several desired curves. The chuck is of a most massive and substantial design. The diameter gauges shown on the nose of the tailstock are in practice great economizers of time. This lathe is of 27-in. swing; the length of bed can be varied to suit the customer, the lathe shown having a 14-ft. bed.

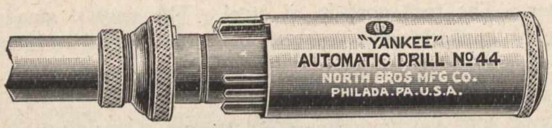
GEORGIAN BAY ENGINEERING WORKS.

The Georgian Bay Engineering Works, Midland, Ont., are manufacturers of the "Midland" gas and gasoline engines. These engines which are very simple in construction have rapidly come to the front, and as will be seen by this firm's advertisement in another page, are suitable for connecting with generators for electric lighting, etc. Besides stationary, marine and portable gas and gasoline engines, this firm makes engines and boilers of all kinds, contractors' hoisting engines, mine hoists, steam pile drivers, and general contractors' plants, as well as the "Midland" band saw wheel grinder, which has just been put on the market. As the company's shops are situated at the water's edge, and there is 20 feet of water in their slip, it is very convenient for boats needing repairs to go there. They are in a position to make a strong bid for this class of work, being equipped with compressed air and electric plants. They have just completed a fine Corliss engine for their own shop, as the immense increase in their business necessitated more power. They are prepared to duplicate this engine on short notice. They have several contracts closed for their boiler shop, and are just completing a fine little marine boiler to carry 200 lbs. pressure. They also have a contract under consideration for a 30 foot steel launch, to be fitted with one of their "Midland" marine gasoline engines. This yacht is to have a guaranteed speed of 23 miles per hour, and they are open to turn out speed launches with a guaranteed speed. Plans are under consideration for the extension of the business, and building operations will be commenced as soon as possible. The manager of the Georgian Bay Engineering Works, G. W. Thexton, is an expert in his line, and was connected for some time with The Canada Cycle & Motor Co., and also with Nathaniel Herreshof, the designer of most of the defenders of the America Cup.

"YANKEE" AUTOMATIC DRILL.

Hand drills have never been entirely satisfactory for general use. The trouble has been that no one strength of spring in these tools would be satisfactory in both soft and hard woods, or for the large and small drills furnished with the tool. The best that could be done was to use a spring of average strength.

In a new drill put on the market by the North Bros. Mfg. Co., Philadelphia, this difficulty has been overcome by a device to adjust the tension of spring, making it weaker or stronger according to requirement of character of wood to be drilled and size of drill to be used. The cap on top of drill has a screw attached to it, by revolving which the spring is made longer or shorter, thereby making the spring weaker or stronger. The spring is held at desired tension by a small bolt or lock which



engages in the cap and is operated by a small knob on side of handle. The method of operating is described in a leaflet published by the company. The tool is nickel plated and finely finished. The material and workmanship are of the best.

Eight drill points are furnished with each tool. The entire length of tool, inclusive of drill point, as in illustration, is 11¼ inches.

STEAM HAMMERS VS. DROP HAMMERS FOR PILE DRIVERS.

A committee appointed by the Association of Railway Superintendents of Bridges and Buildings, of the United States to deal with the above system has presented a majority and minority report. The majority state that the superiority of the steam hammer for some classes of work, such as foundation work under buildings, piers, etc., is apparent; while for road work, those who are using steam hammers would not exchange them for drop hammers under any circumstances. The committee believes the steam hammer is the best type of hammer for all kinds of pile driving, and when used with a bonnet makes pile driving a comparatively easy job. Piles can be driven without injury to the pile in almost any kind of earth with a steam hammer, where it would be rent from head to point by a drop hammer. The pile is held much more firmly under the steam hammer, and is guided home in much better fashion than can be accomplished with the drop hammer; besides there is not the injurious strain upon car and machinery that is felt from the drop hammer.

The cost of maintenance is much less for the steam than for the drop hammer, and the cost of driving piles is also much less. The first cost of the steam hammer is, of course, much greater, but it is a good investment notwithstanding. The size of the steam hammers may vary for different kinds of work—the No. 1 for foundation work and the No. 2 for road work, though some prefer the No. 1 for all classes of work.

The majority members were firm, and the minority one who held that for driving in hard clay the drop hammer was best. He adds:—"I think, also, that a drop hammer is more convenient to handle than a steam hammer, in a road driver, as the steam hammers are so very heavy that the driver needs lots of counter weight to balance them when it is swung. Also, they are so long that very long leaders must be used in order to get piles under them, and with a heavy hammer at the top of the long leaders the machine is very likely to tip over on the track with much elevation or a track which is very much out of surface, as the tracks frequently are where work is being done. If I could only have one hammer for general railroad pile driving I would prefer a drop hammer to a steam hammer, as I think the work in general can be done cheaper, everything considered, with a drop hammer than with a steam hammer. I understand, of course, that a steam hammer is very desirable in some kinds of work, but for a single hammer I would prefer a drop hammer. In regard to using a bonnet with a steam hammer, this same piece of head gear can be used fully as well with a drop hammer, and will take up proportionately less of the energy of the blow of a drop hammer than of a steam hammer."

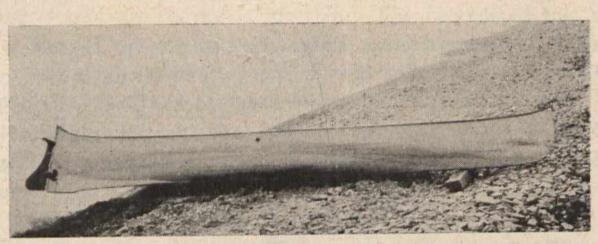
Another member reports his own tests which were in favor of the steam hammer. He says:—"I believe everything is favorable to the steam hammer, with the additional advantage that it does not damage the pile on the end, and does not require it to be banded, which saves considerable money in this direction. It makes no difference where the head of the pile is in the leads with the steam hammer. It is just as effective one place as another. The longer the piles in the leads the less the drop of the hammer and less effect the hammer has on the pile. We can drive four piles with it against two with the drop hammer."

A SUCCESSFUL MOTOR CANOE.

Editor Canadian Engineer:—

Sir,—Great interest is maintained in the development of small motor craft, and while there are many classes of motor boats, so far as we know the motor canoe described here is the first that has been a success in actual practice.

It is an ordinary stock paddling canoe, 18 feet long, 35 inches beam, 14 inches deep, built by The Canadian Canoe Co., Peterborough, and as shown in photo, there is built on from about the centre of the keel to the stern a "skeg," through which the shaft runs to a point sufficiently low to keep the propeller submerged under all conditions, which as far as I can find out was the main difficulty experienced by others. This "skeg" not only answers the purpose mentioned, but also provides a good long bearing for the shaft, and stiffens the canoe considerably. It is fastened through by

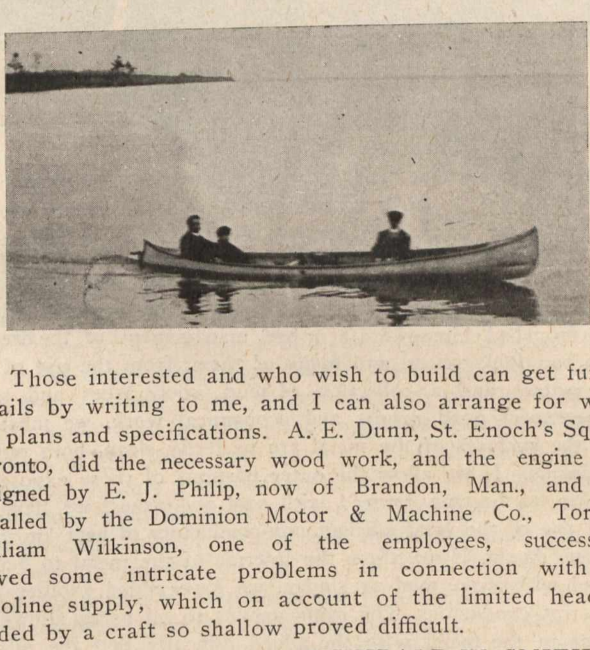


bolts sufficiently long to be riveted underneath to the 1 inch half-oval iron which serves as a protection to the keel, and is carried from the bow to the stern, at which point it projects as a shoe protecting the propeller blades from injury either while running or landing. The rudder is attached to this shoe, and steering can be controlled from any part of the canoe, as an endless cord runs through screw eyes and pulleys attached to the gunwales. Motive power is supplied by a two cycle, single cylinder, 1-h.p. gasoline engine, set up exactly in the centre of the canoe. It is fastened to a bed made from two 4 foot pieces of ash, laid longitudinally, with two cross pieces formed to fit the shape of the bottom of the canoe. These pieces also act as braces, and are fastened from the outside by brass screws. The propeller shaft from the engine to the "skeg" is encased in brass tubing, and is supported by two bearings about two feet apart. This stationary casing also acts as a bearing where it enters the "skeg," and the shaft can always be kept lubricated, and notwithstanding the 9-foot length of the shaft there has been no side play. The gasoline tank, (capacity 3 gallons), is in the bow under the decking, and a lead pipe conveys the gasoline to the carburetor. This worked all right in smooth water, but where rough water is the rule I advise cylindrical tanks placed amidships. Battery box, spark coil, and switch, together with the connecting wires are waterproof, and are within easy reach of the party running the engine. The discharge pipe from the water jacket is run through the muffler. A tool box is used as a seat by the party running the engine, and while one person can easily operate the canoe I found that with carrying two or three people better speed could be obtained. Four adults can sit comfortably in the canoe, and an average speed of a little over 10 miles per hour during the past season was obtained with the equipment described.

The cost of the canoe equipped is about $180, and when fully loaded the draught is less than 12 inches.

It is impossible in a short description to give details,

but I am confident that this type is not only the ideal one for pleasure seekers, but that it will also appeal to prospectors, explorers and surveyors, who need something portable, safe, speedy, and strong enough to stand hard usage. As an illustration I may state that in August with fairly choppy water, on Lake Ontario, we carried in the canoe four adults and two children, and towed for several hours an 18-foot row boat containing as many more people. I found the canoe very steady in the roughest weather, easily steered, and quite dry.



Those interested and who wish to build can get further details by writing to me, and I can also arrange for working plans and specifications. A. E. Dunn, St. Enoch's Square, Toronto, did the necessary wood work, and the engine was designed by E. J. Philip, now of Brandon, Man., and was installed by the Dominion Motor & Machine Co., Toronto. William Wilkinson, one of the employees, successfully solved some intricate problems in connection with the gasoline supply, which on account of the limited head afforded by a craft so shallow proved difficult.

ARCHIBALD W. SMITH.
75 Collier St., Toronto, Canada.

THE LARGEST TROOPSHIP IN THE WORLD.

The largest troopship in the world, the "Dufferin," was recently launched at the yards of Vickers, Sons & Maxim, Limited, Barrow, England. The dimensions of the vessel are: Length over all, 453 feet; breadth, 52 feet 6 inches; moulded depth, 39 feet. She is of the spar deck type, having four complete decks, and a boat deck about half her length amidships. Under the main deck the vessel is divided into a number of water-tight compartments, which are controlled from the bridge, and can be closed in a few seconds, making her practically unsinkable. Particular attention has been paid to the ventilating and sanitary arrangements on the vessel, and electric fans are fitted all through to help the natural draught. She is lighted electrically. The propelling machinery consists of two sets of inverted, vertical, direct-acting, triple expansion engines, each set having three cylinders, working on separate cranks, and capable of developing 9,400 h.p. at 115 r.p.m. The cylinders are 30 in., 47 in. and 75 in. respectively, with a stroke of 48 in. Steam is supplied from four double-ended boilers of the multitubular type, each fitted with six Morison's suspension furnaces, and carry a pressure of 180 pounds. The equipment of the vessel is equal in all respects to that of a first-class liner, and everything is provided for the comfort and health of the troops, of which she will accommodate 1,520. If necessary she can be quickly converted into a cruiser, as she carries eight 4.7 and eight three-pounder quick-firing guns.—Marine Engineer, London.

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The following is a list of members elected in the various classes at the meeting on 17th November:

Members.

Charles Evan Fowler, of Seattle, Washington. Francis H. Leonard, Jr., of Montreal. Francis C. McMath, of Walkerville, Ont. William James Stewart, of Ottawa, Ont.

Associate Members.

Ernest Burchell Bartlett, of Quebec. Henry Stanley Carpenter, of Gamebridge, Ont. William Hugh Coverdale, of New York. Alexander McIntosh MacGillivray, of St. Margaret's Bay, N.S. Martin J. Murphy, of Halifax, N.S. George Phillips, of Esquimalt, B.C. Francis Alexander Pickering, of Halifax, N.S. Owen Phillipps Schreiber, of Ottawa, Ont. Thomas Taylor Simpson, of Deschenes, P.Q. David Rees Thomas, of Rossland, B.C. Robert Mauson Wilson, of Montreal, P.Q. Charles Osborne Wood, of Billing's Bridge, Ont.

Transferred from the Class of Associate Member to the Class of Member.

Basil Hall Fraser, of Ottawa, Ont. Arthur Edward Hodgins, of Johannesburg, South Africa. Frederick Perry Shearwood, of Montreal.

Transferred from the Class of Student to the Class of Associate Member.

John Lorn Allan, of Halifax. Arthur C. D. Blanchard, of Niagara Falls, Ont. Harold Langmuir Bucke, of Thunder Bay, Ont.

Associate.

Thomas Arthur Morrison, of Montreal.

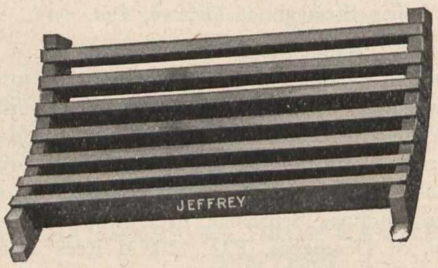
Students.

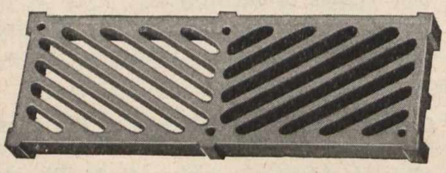
Augustine Bradt, of York, Ont. Leonard M. Bidwell, of North Bay, Ont. Paul Albert Beique, of Montreal. Charles Frederick Bristol, of Montreal. Alexander I. M. Bowman, of Montreal. Harry Gordon Budden, of Montreal. Edward Leroy Burgess, of Ottawa. Austin Lewis Cumming, of Cornwall, Ont. Ernest Frederick S. Dawson, of Charlottestown, P.E.I. James Vidal Dillabough, of North Williamsburg, Ont. Kenneth William Dowie, of Lachine, P.Q. George Patrick G. Dunlop, of Montreal. William Milton Edwards, of New Liskeard, Ont. Thomas Urquhart Fairlie, of Kingston, Ont. Delmer Clinton Findlay, of Montreal. J. R. Freeman, of Brooklyn, Queen's County, N.S. Albert Coleman Garner, of South Qu'Appelle, Assa. George Ackland Gillies, of Carleton Place, Ont. Harold St. George Hamersley, of Vancouver, B.C. John Handley, of Ottawa, Ont. Ernest Stillman Hill, of St. Stephen, N.B. Victor J. Kent, of Fort William, Ont. Royal Lesage, of Montreal. Douglas Clemont Livingstone, of Montreal. Fred. Hunder Lytle, of Toronto, Ont. Thomas Clarkson McConkey, of Guelph, Ont. John J. Macnab, of Montreal. John Goodwill MacPhail, of Niagara Falls South, Ont. Pierre Adolphe Masson, of Montreal. Sydney Albert Meade, of Sherbrooke, P.Q William Charles Meyerstein, of Montreal. Henry Belfrage Miller, of Montreal. Herbert Harrison Moore, of Deer Park, West York, Ont. Arthur McIntyre, Morrison, of Dartmouth, N.S. John Eric Newlands, of Montreal. Emile D. Normandeau, of Ottawa. Fredrick Hatheway Peters, of London, Ont.

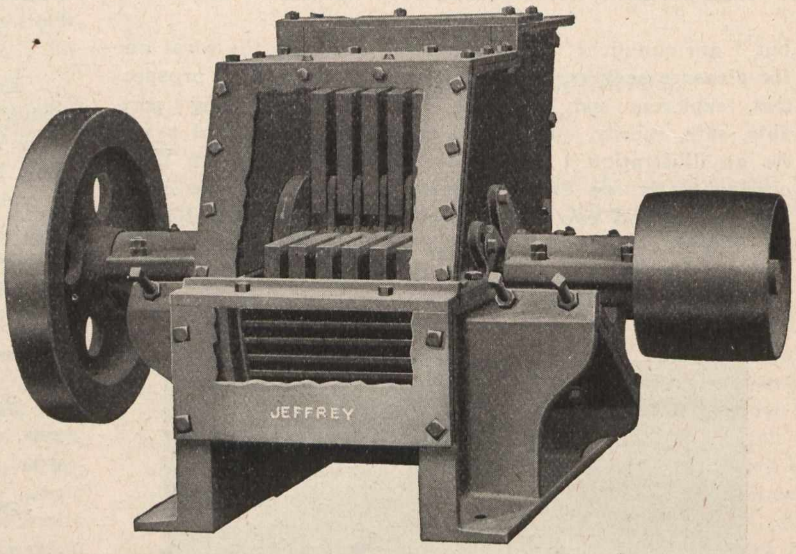
Archibald McEachren Phillips, of Ottawa, Ont. Alfred Allan Putnam, of Halifax, N.S. Arthur Reginald Roberts, of Montreal. Peter Albert Shaver, of Grantley, Ont. Joseph Drummond Shepley, of Leamington, Ont. John H. Sills, of Belleville, Ont. Duncan Sinclair, of Toronto, Ont. George Singers, of Montreal. Richard Henry Smith, of Sydney, N.S. Richard Lane Squire, of Kingston, Ont. Guy Tooker, of Montreal. Arthur Vincent Trimble, of Toronto, Ont. David Thomas Townsend, of Woodstock, Ont. George Edward Vansittart, of Toronto. Horace Walker, of Kingston, Ont. Alexander Thompson Wilson, of Moncton, N.B.

JEFFREY HAMMER PULVERIZER.

The manufacture of this type of pulverizer has recently been taken up by the Jeffrey Manufacturing Company, of Columbus, Ohio, being under the Schoellhorn-Allbrecht patents acquired by it. The first illustration shows the pulverizer with its interior or crushing parts; the others show the sectional screen frame, which is one of the special features in this machine. It is designed for crushing and pulverizing material such as coal, clay, shale, rock and many other materials. The manufacturers claim it to be the simplest machine of its kind made. Strong features are its simple beater hammer, its "V" shape bar screening surface, its







simple adjustment of the beater arms to accommodate wear, its substantial adjustable dust-proof pillow blocks, its top feed hopper insuring large capacity and permitting material to be partly crushed while in suspension; all of which go to make this machine as nearly perfect as can be made. The accessibility of its inner parts is also one of its strong features. The taking off of the rear plate and the hand-hole plates on the side of the machine make it possible to change the beater arms as well as the screening surface when necessary. The screening surface is made up in sections, so that it is the work of but a few moments to take out or change from one size mesh to another. Many of these machines are in use so there is no experimental period to be gone through with. It is made in many sizes to suit the various requirements, for instance in coal the capacity varies anywhere from fifty to one hundred tons of coal per hour depending entirely upon the degree of fineness. In pulverizing material such as rock, its capacity is any where from a ton to twenty-five tons per hour. The "Jeffrey" Company make free crushing tests for interested parties thus demonstrating before sale, what the machine is capable of doing. Complete catalogues on this subject can be had by addressing the manufacturer.

Willard N. Sawyer, of Pittsburgh, has been appointed general manager of the Soo industries, in the place of the late Cornelius Shields, whose untimely death was noted last month. Mr. Sawyer is a steel expert and contractor, and a member of the firm of Wellman, Seaver & Morgan, one of the largest engineering firms in the United States.

BOILER FEED WATERS AND SCALE.*

BY A. M. WICKENS.

I may say that after having spent my whole lifetime in connection with engines, boilers and steam plants generally, as an erecting engineer, as an operating engineer, and latterly as an inspector, I have arrived at some conclusions that are very strongly impressed upon my mind regarding feed waters, scale and other troubles that are met with continually in all steam plants. In many of our factories, the boiler part of the outfit seems to be the part of the whole establishment that receives the least consideration or attention, by the owner or manager. A steam boiler is not a very handsome-looking piece of apparatus; it is generally associated in the owner's mind as a miserable, dirty affair, buried in brick, soot and ashes, and with the assistance of the architect of the building, it is relegated into some dark, out-of-the-way place in the basement, crowded and pinched for room. No adequate means is provided to keep it clean, either inside or outside. This, to my mind, is very strange, because as a matter of fact, the boiler in reality is the heart of the whole establishment and the source of all the mechanical motion required in the factory and should have every advantage that ingenuity and carefulness can afford. Where boilers have been thus treated, the subsequent treatment of them is usually of a very poor and meagre character, and the result is a short and wasteful life. We have many forms or kinds of waste going on all the time in connection with our boilers, some from faulty construction or defective setting, some from bad chimney draft or bad management of the fires or from bad fuel, others, and many of them, from the use of bad feed waters and a collection of mud, soot, ashes and scale. If we expect good results and economical work, we must see that the surfaces of the metal are perfectly clean, both outside and inside. If we allow the outer portions of those exposed to the fire to become covered with soot and ashes, we have applied one of the most efficient non-conductors of heat known to science. Again, if we allow the interior of the metal to become coated with scale, mud or sludge, we have added another first-class non-conductor. The same applies to oil being allowed to gather in the metal with the added difficulty that the oil will surely make the rivetted joints leak. The efficiency of a boiler is the amount of heat the metal will transmit from the fire and hot gases to the water, and a well set, well fired, clean boiler will utilize from 70 to 75 per cent. of all the heat given off by the burning coal, consequently it behooves us to do everything possible to keep up to that standard.

All waters carry more or less mineral, earthy and organic matter, some of them are charged so heavily that they cannot be used for boiler purposes. Taking the evaporation of 34 lbs. of water per hour to represent one horse-power, a 100 horse-power boiler would need for a day of 10 hours 34,000 lbs. of water, this would be 3,400 gallons and as each gallon of water carries a certain amount of mineral or other matter that will

*A paper read before the Canadian Society of Chemical Industry, Toronto.

not evaporate, we soon, even with the best of feed waters, accumulate scale-making material in our boilers. A feed water carrying from 20 to 40 grains of solid matter per gallon, may be called a good water for use in boilers. In the boiler above, if we have 20 grains to the gallon, it will deposit 50 lbs. per week of sixty hours' run, using three for the specific gravity of the scale, it would cover 250 square feet of the surface to a thickness of .0144 inch or 1-16 inch thick per month; with waters carrying more solid matter the deposit would be proportionately greater. From this you can readily conceive how quickly scale would form over the whole surface of the boiler below the water line. There have been many experiments and tests conducted to determine the loss in heat caused by scale of different thickness and different compositions. It is now generally accepted that hard scale 1-16 inch thick requires from 10 to 13 per cent. more fuel, and that as the scale thickens the extra fuel required also increases until at a thickness of ⅜-inch it is 40 per cent. In our river, well and lake waters, we have principally, as scale-forming matter, carbonate of lime, sulphate of lime, carbonate of magnesia, and some silica with traces of other solids, to deal with. The carbonate of lime, chemically speaking, is chalk, selenite, marble, and limestone, and is held in solution in the water; by an excess of carbonic acid, this is driven off by heating the water and the carbonate is precipitated. A portion of all scale-forming matter floats upon the water in the boiler, while it is making steam, and only settles when the boiler is at rest. This is more particularly the case, when the water contains magnesia. The precipitated particles are carried with the water as it circulates in the boiler, and part of it will lodge in the stillest places, consequently, we have some parts showing thicker scale than others. We also find that the scale is always heavy near the discharge from the feed water pipe; this is because the incoming water soon receives heat enough to precipitate part of the solids, after it mixes with the hotter water in the boiler. Carbonate of lime and carbonate of magnesia deposit a fine powder and form a sludge with the water, but they also often solidify in combination with sulphate and form a very hard and tenacious scale. It is a decided advantage to all boilers to be fitted up with a surface blow-off, that all floating matter upon the water may be blown off frequently; this should be done, at least twice a day. A very hard thin scale, 1-64 inch or less in thickness of sulphate of lime, that is fast to the plates, will not be a detriment to the steaming of a boiler; the disadvantage of it is that it makes a good foundation for other scale-forming matter to build upon, and soon gets to be too thick. We frequently notice upon breaking a piece of scale that it is composed of different layers, all of different thicknesses and colors, and interspersed with thin layers of earthy matter. The face of this incrustation next to the plate is very often of a black color, and adhering to it is found a thin film of oxide of iron. The plate in all these cases bears unmistakeable signs of wasting away; this is caused where the water carries iron salts, and in brackish water it is the chloride of magnesia which will attack the metal of the boiler very quickly. The circulation of the water in all boilers, while making steam, is continuous, and it is quite rapid from the hottest places, thus carrying scale-forming precipitates to cooler places and depositing them in the stillest spots; this helps the life of the boiler and assists in keeping the part that evaporates the most water the cleanest. All boilers generate twenty times more steam immediately over the grates than at any other point, thus making the ebulition so great and the circulation of the water so rapid, that most of the precipitates are carried away and are lodged in the portions of the boilers where the circulation is slow. We usually find scale between the tubes upon the boiler heads, upon the sides of the boiler opposite the tubes, and upon the tubes. We very seldom find any upon the active portions of the shell, that is, immediately above the fire or grates; when it does appear there, we soon need the services of the boiler-maker for repairs. Sometimes we find a pile of loosened scale directly over the fire; this is caused by pieces that are too heavy to be carried away by the circulation, dropping down from the tubes; several of them lie close together, and the lighter pieces in floating by lodge with them, then some clay or silica stick to them, and we soon have a mass. This packs closer and closer until it is close enough to keep the water from the sheet, and the result is the sheet becomes red hot; the steam pressure then forces the sheet outward and makes a bulge or buckle. If this action goes on long enough, the sheet stretches at the apex of the buckle, until the thickness is reduced to such an extent that the pressure ruptures the sheet, hence an explosion, such as occurred at the Toronto Bolt and Forging Works on Sep. 14th of this year.

Again, we have scale forming in such quantities upon the tubes that the passages between them are entirely blocked; this retards the circulation to such an extent that the efficiency of the boiler drops from 50 to 60 per cent., and means that no amount of fuel will get the power out of the boiler, and it also means ruined boiler heads, and flue ends, and an astonishing bill for repairs. The effects of heavy scale are first of all an increase of fuel required, next the shortening very materially the life of the boiler with attendant repairs, accompanied all the time by a liability to a bad rupture or serious explosion. There are a large number of of boiler compounds or purgers, some of them lauded as a cure for all kinds of sediment and scale, and they are composed of nearly all kinds of foolish mixtures, some of which are very injurious to the metal; in fact, some of them will attack the metal and leave the scale entirely alone. The principle or base of many so-called compounds is common soda and soda ash. Tri-sodium phosphate, caustic soda, and concentrated lye, chloride of barium catechu, nut galls, tannic acid and sal ammoniac, and even hydrochloric or muriatic acid, and to assist these some kind of slimy substance is added to prevent the scale from adhering to the metal. These are Irish moss, potatoes, oil, linseed, sugar, molasses and other similar ingredients; some of these mixtures are surprising, and it is a wonder they do not clean out the boiler, engineer, scale, and all else about the factory. Some people will spend several hundreds of dollars per year for compound, and say: Well, we are doing all we can to keep our boilers clean, whether the compound is really just what is needed or not; others will not use anything, but spend money every three or four years to clean the boiler by removing the tubes, scaling off the shell, cleaning tubes, and replacing them. No matter which method is adopted, it is expensive, but if studied out carefully the fixed cost should not be great. An ordinary return tubular boiler well taken care of and using good water will last for thirty years and be safe the whole time, while if the water be bad, and the care worse, ten or twelve years is all the life we can expect to get out of them. Whether we will or no, all our waters have more or less scale in them, and we have, therefore, to do something to counteract it. All scales can be modified by some treatment, either in the boiler or while on the way to the boiler, or in the tank or well, before being pumped to the boiler. The first, by some suitable solvent; the second, by treatment in heaters in which enough heat is applied to precipitate the scale-making properties, and the last by chemical treatment before the water enters. Modern practice in large plants is adopting the last very generally, and water-softening plants for steam boilers are becoming common. These cost from $3 to $5 per horse-power for the apparatus, and from 1 to 2½ cents per 1,000 gallons for chemicals, and are proving to be a paying investment in many large plants. We meet another very serious trouble in many of our boilers in the shape of oil. This occurs more particularly in plants where exhaust steam from engines and pumps is utilized for heating buildings or other purposes, and the water of condensation returned to the boiler. There is nothing that will ruin a boiler or reduce its efficiency so quickly as a thin film of oil combined with some of the solid matter in the water. As a result of recent experiments, Sir A. Durston says, although too often neglected, grease and greasy water have a very dangerous influence on boiler plates, because grease being a bad conductor greatly checks the transmission of the heat. With a layer of grease, however thin, upon the boiler plates, although the temperature of the furnace may be no higher than before, the heat cannot pass out of the plates at the same rate at which it is received, and over-heating ensues. He conducted experiments with tubes and found that by a thin coating of grease, the decrease in the efficiency reached 11 per cent. He also found that in an experimental boiler the temperatures next the water were, with a clean plate 430 degrees, and with a greased one 617 degrees, or 187 degrees higher, thus showing the great loss upon the greasy plate. In practice we meet grease or cylinder oil in boilers, and always find it accompanied by leaky joints and tube ends, also by buckles and waves upon the bottom of the boilers if it settles. Oil can always be prevented in boilers by suitable separators and filters, consequently we should not be troubled by this difficulty. In conclusion, I may say that if we use our boilers well and accord to them the same amount of carefulness and study we do to the rest of our factory, they would last longer and give us more economical service, and we would not have to lie awake o' nights wondering what that old boiler will do next.

THOMAS S. CLARKSON SCHOOL OF TECHNOLOGY.

The Clarkson School of Technology, of Potsdam, N.Y., exhibited several features of its work at the Louisiana Purchase Exposition, St. Louis. The exhibit comprised six hundred sheets, ranging in size from 8 by 10 inches to 22 by 28 inches, illustrating the written and graphic work of the students as regularly executed in the several courses of instruction. It included the subjects of chemistry and chemical engineering, physical and electrical laboratory work, courses in home science, elements of mechanism, mechanical drawing, machine drawing and design, descriptive geometry, electrical charts and diagrams and shopwork exercises. The work of the School was further exemplified by bound volumes of catalogues, circulars, sets of administrative blanks, photographs of laboratories and workshops, etc. Nine bound theses were sent, embodying some of the original research work of the School in civil, electrical and mechanical engineering.

The International Jury in Group III., Higher Education, Technical Schools, etc., awarded a bronze medal to this School. De Lancey M. Ellis, director of Education and Social Economy, said the exhibit was warmly commended by the members of the jury, and was a source of interest to visitors throughout the summer.

STATE RAILROADS IN VICTORIA.

Thomas Tait, formerly superintendent of transportation for the C.P.R., now has control of the State railways of Victoria, Australia, and has recently made his first annual report, showing that for the first time in fifteen years the Victorian railways have paid their way. His report is thus summarized by the News:

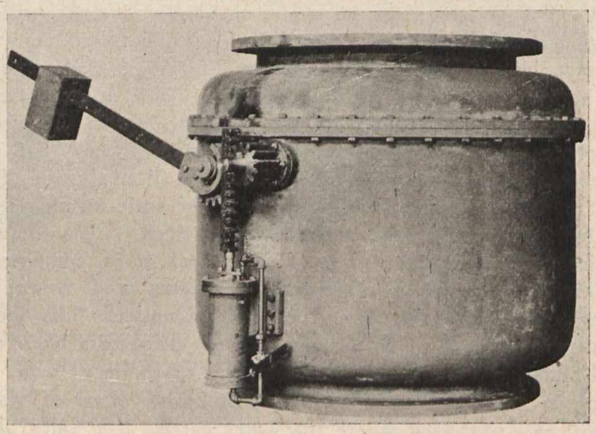
When Mr. Tait went to Australia, the railway conditions in the State of Victoria were about as bad as they well could be. He found himself in a position where it was essential that he should grapple immediately with all those objectionable conditions to which twenty years of mismanagement had given rise. Mr. Tait, for example, found himself confronted with a railway system, having numerous branches, that had not paid at any time, and could not be expected to pay for many years to come—a situation that had resulted for years in a loss of £1,000 a day. To the task of prescribing a remedy, Mr. Tait at once addressed himself, and with what success is made apparent in the report for the financial year ending June 30th, 1904. The gross revenue for the first half of the year was lower than it had been in any of the five years preceding, but for the last half of the year it was the highest ever obtained. For the whole year it was £70,297 more than was earned in any previous year. Notwithstanding the fact that in reducing the number of unnecessary trains, a very large reduction was made in passenger and mixed train mileage, the revenue from passenger traffic exceeded the average revenue from that source during the preceding three years.

The net revenue was the largest ever obtained, and per mile of railway and per traffic train mile the highest for many years. It was £220,806 more than the net revenue for the years 1900-01—the year with the largest previous traffic—and it was equivalent to 3.64 per cent. on the railway debt of the State. While there were deficits during the three preceding years—deficits which promised to be recurrent—(£80,808 in the year 1900-01, £163,227 in 1901-02, and £304,094, in 1902-03), there was a surplus for the year ending the 30th of June last of £519. That surplus is a small one, no doubt, but when the conditions that had obtained for twenty years are taken into account, the commissioners, Mr. Tait, the chief, and his associates, W. Fitzpatrick and C. Hudson, are to be congratulated upon a notable financial achievement. Especially is this the case when it is mentioned that the credit balance was not obtained at the cost of the staff, the management having avoided the percentage reductions and short time working which was in vogue in 1902-03.

The task which the State of Victoria set the commissioners was to rehabilitate the finances of her railways. That has now, in a large measure, been done. The commissioners have contrived, as has been said, to collect, in their first year, the highest gross revenue ever recorded, and to make the highest net revenue for more than twenty years. Having succeeded so well in that department, the people of Victoria are now looking to the commissioners to provide what they consider more adequate railway facilities. How well Mr. Tait succeeds in this respect will only be known after another year has elapsed.

GREAT RELIEF VALVE.

What is probably the largest valve of its type that was ever constructed has recently been made by the G. M. Davis Regulator Company, Chicago, Ill., and is to be installed at the Donora works of the Carnegie Steel Company, Donora, Pa. It is for a 46-in. pipe and weighs complete 7,800 pounds. It will be placed at the end of an exhaust line in a vertical position about 18 ft. above the level of the floor. This exhaust line into which five large condensing blowing engines exhaust, is approximately 215 feet in length and is gradually increased in diameter at different intervals from 28-in. at the beginning to 46-in. at the end. The low pressure cylinders of the engines work under vacuum, and the object of the valve is to automatically provide a free relief to the atmosphere, if for any reason the vacuum is lost. If such provision were not made there would be danger of damaging the engines by the accumulation of back pressure. The valve body is of cast iron. The inner disc, which is guided at the top and bottom by spiders cast in the body, is of cast steel. It is faced with babbit metal and sits on a cast iron seat. A



2½-in. cold rolled steel shaft runs horizontally through the body of the valve on which there are two cut steel pinions, one of which is inside the body and meshes with a cast steel rack on the disc side. The other is at the end of the shaft just outside the body and meshes with a rack which leads to the hydraulic cylinder, and also with the segment to which is attached the lever carrying a cast iron counter-weight of 130 lbs. The valve is provided with this counter-weight to act as a safeguard by throwing the disc wide open as soon as pressure accumulates under it, and thus preventing any injury to the seat by pounding. On account of the unusual size of the valve and the weight of the disc, it was found not practical to make the valve wholly automatic. It opens automatically, but the closing is controlled by hydraulic pressure; an hydraulic cylinder 5 inches in diameter is connected at the top and bottom by a ½-in. pipe on which there is a four-way cock. This cylinder is under a constant pressure of 25 lbs. and when the valve is closed the cock is set to turn the pressure into the lower end of the cylinder. When it is desired to close the valve after it has been thrown open, this cock is set to turn the pressure into the upper end of the cylinder. A gradual closing is thus effected and the cock is again set at normal position.

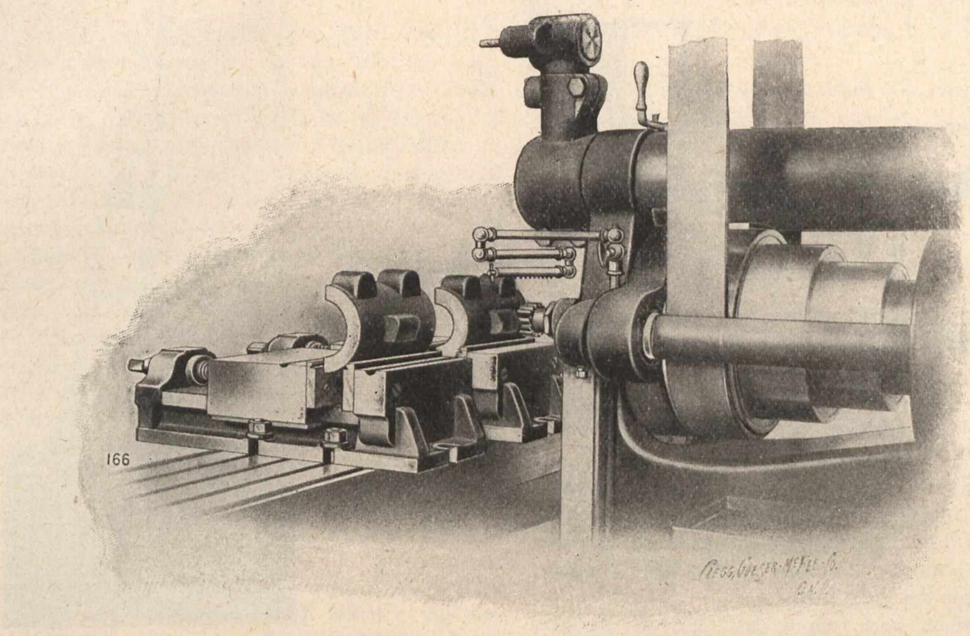
With the order for this valve was one for a 36-in. valve to be installed at the same works of the Carnegie Steel Company. The weight of this valve complete is 4,900 pounds.

MACHINE SHOP NOTES FROM THE STATES.

BY CHAS. S. GINGRICH, M.E.

X.

The art of making steel castings for machine parts has been so successfully developed, that these castings are now made by some steel founders to a degree of accuracy in regard to size equal to brass castings, and they are homogeneous in structure, easily machined, and are delivered to the customer entirely free from sand, and specifications usually require that all projections, such as stub ends of grates, sprues, etc., must



be machined off flush with the casting. This presents somewhat of a problem to the foundry men, as they do not, as a rule, maintain an efficient machine shop.

Of the tools that have been reasonably successful for this work, the draw cut shaper gave probably the best results until quite recently, when the Isaac G. Johnston Co., Spuyton Duyvil, N.Y., conceived the idea of using a miller. They made their first experiments on a No. 3 Plain Cincinnati Geared-Feed Miller, and proceeded in the manner shown in illustration herewith. The sprues average about 2½-in. long by 1¾-in. wide, and from ½ to ¾-in. high, and these are removed at a single cut in less than two minutes, using a Novo steel cutter 2½-in. in diameter and working at a surface speed of 80-ft. and feeding 2-in. per minute.

This is doing the work in about one-half the time in which it was done on the shaper.

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NOVA SCOTIA'S GREATEST ASSET.

Nova Scotia has its farms, its fisheries, and its forests; but, although not so very long ago farming was held to be the backbone of the Province, to-day it is recognized and admitted, as the Hon. Robert Drummond points out in a recent issue of the Nova Scotian, that coal is king. Coal mining began to play an important part in the Province's development about the year 1825, when the General Mining Association expended some £300,000 in opening collieries. In 1858 the Legislature of Nova Scotia concluded an agreement with the General Mining Association, whereby the monopoly, so-called, was broken, and, though the agreement met with much opposition, they did that for the Province which, in the days to come, would put millions in its treasury. "For nearly 50 years, or from 1825 to 1875, it did not look as if the royalty from coal would ever assume the character of a bonanza, and become the Province's principal asset, but from 1875 forward the amount flowing from royalty, year by year, swelled, and last year formed the principal item in the returns of income. The percentage of increase of royalty from coal has been remarkable during the past five years. There are those who predict that in ten years the output of coal will have reached 10,000,000 tons. At any rate, if nothing happens to hinder development, the Province should, in ten years, be receiving $750,000 in the way of coal royalty. Looked at merely from a dollar standpoint, coal is the Province's most valuable asset. But royalty is not everything. It is not even the point of prime importance." Coal mining gives employment to a large number of persons, and it is calculated that at least $5,000,000 is paid in wages, which is a considerable sum coming from one industry in a Province with a population of 500,000 people.

Coal is known to exist in five counties in Nova Scotia. In four of these it is being extensively worked, and in the fifth, Richmond, no practical mining is at present being done. The coalfields of Nova Scotia having seams of the thickness of 4½ to 15 feet (or over) cover 902 square miles. The secondary coalfields with seams up to three feet thick cover 1,500 square miles. The probable coalfields under the newer rocks of the Gulf shore cover 1,500 square miles. As Mr. Drummond points out:

In the discovered coalfields of 4½ feet and upwards, the probable quantity of coal is from 7,320 to 8,000 million tons, according as the thickness of the seams is estimated.

The mileage and acreage for the several counties may be allotted as follows:

Name of County.	Square Miles.	Acres.
Cape Breton	450	288,000
Cumberland	300	192,000
Inverness	128	81,920
Richmond	84	53,760
Pictou	30	19,200
Total in acres		634,880

The thickness of the seams in the several counties average as follows:

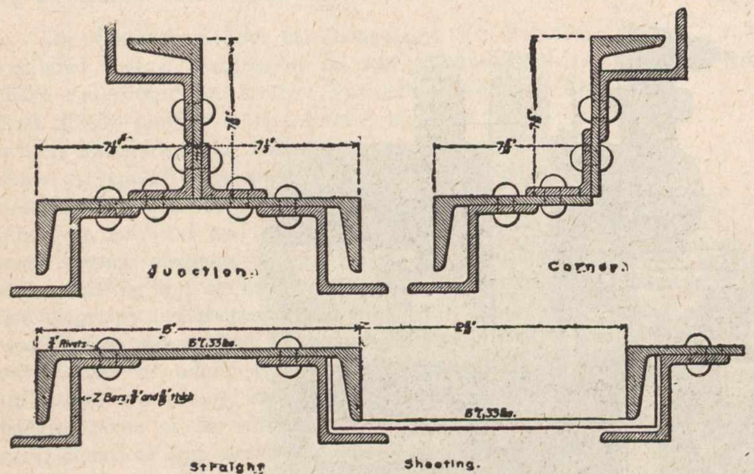
	Approximate Thickness.
Cape Breton	10 feet.
Cumberland	6 "
Inverness	15 "
Richmond	6 "
Pictou	11 "
	48 divided

by five, giving an average thickness of, say, 9½ feet.

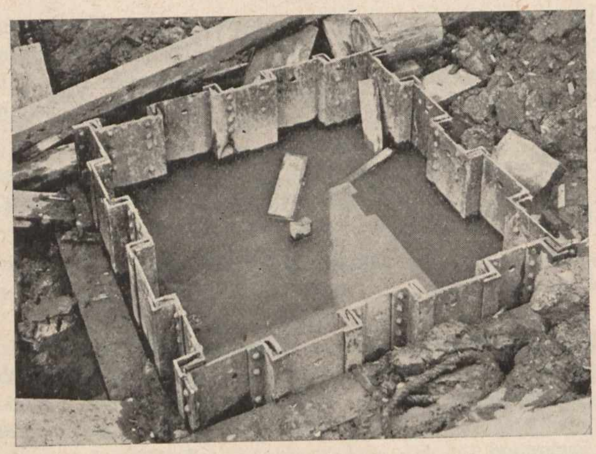
Compromising with the rule given by Merrivale in his "Notes and Formulæ," allowing 100 tons per inch for thickness per acre, and the rough way of calculating in Nova Scotia giving 10,000 tons per foot per acre, Mr. Drummond supposes there were 6,348,800,000 tons of coal in the field. Of this amount some 66,000,000 tons have been extracted, which still leaves about 6,250,000,000 tons in the fields of first importance. Outside this field, no one can estimate the quantity, but calculating the total amount to be won in all Nova Scotia as 10,000,000,000 tons, it can hardly be disputed that coal is Nova Scotia's greatest asset.

INTERLOCKING SHEET STEEL PILING.

We reproduce herewith photographs taken during the construction of foundation piers for Marshall Field & Co.'s warehouse on Polk St., Chicago. The foundation piers are of the caisson type and were planned to penetrate to a depth of 90 or 100 feet to bed rock. The soil is blue clay, soft sliding clay, quicksand, silt, and a stratum of about 15 feet of hardpan on top of bedrock. From the Manufacturers' Record we take the following description of the construction:

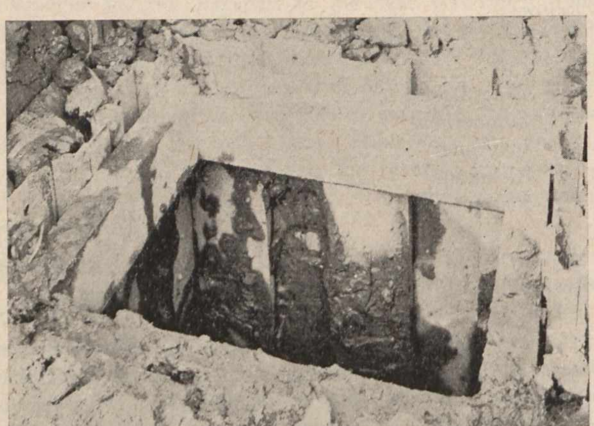


The first caisson was started with a wood curbing seven feet in diameter, with interior adjustable hoops made in two pieces and intended to hold the wood curbing in place. No trouble was experienced until a depth of 30 feet was reached, when all attempts to sink the well further were blocked by the clay and quicksand, which rose within as fast as it was



Steel Caissons Ready for Excavating.

removed. The surface of the street 30 feet away sank so much that Polk street bridge had to be closed for a time, owing to the sink-hole apparently caused by the removal of earth.

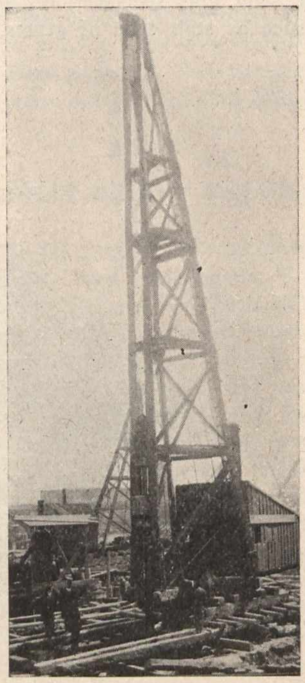


Steel Caissons Ready for Concrete.

A shield was then constructed of ½-inch steel plates in four sections to assemble in circular form. The shield had a sharp cutting edge and was forced down with hydraulic jacks, but this plan also failed, and the work was at a standstill.

Interlocking channel-bar piling was then provided and assembled in the form of a square, the piling being forty feet long, which was considered sufficient to pass through the soft strata. A No. 1 Vulcan steam hammer was used to drive the piling, which easily penetrated the upper strata that had effectually prevented the sinking of the caissons.

A cornerpiece was first placed in position between the leaders of the pile-driver, plumbed, and the hammer lowered to the steel cushion, which rested on the top of the piling to prevent battering by the hammer. The weight of the ham-



Method Employed in Driving.

mer alone—10,000 pounds—sufficed to force the piling down 25 or 30 feet, and eight or ten blows drove it into place. After the driving of a corner was accomplished, the ensuing piles were driven in turn until the square was completed. The perfect closing of the square was attained by the use of a special arrangement furnished with the piling.

The makers of this piling are the Friestedt Interlocking Channel Bar Co. The piling has been used in Chicago in connection with foundation work for the past two years, and is now in use extensively throughout the Western States for retaining walls, coffer dams, bridge piers, etc. It has many advantages over wood piling. It can be driven to a greater depth and with greater ease; being interlocking it closes up and prevents water coming through; and where it is used, as in the illustrations, it requires no cross-bracing, which in wood caissons forms a serious barrier to the removal of the soil. In the Marshall Field warehouse, the piling is about twenty feet longer than has been used before in similar work, and it is not yet known whether or not the sheets can be pulled out and used again. This, however, is a point of minor importance.

The item of cost has been considered by the manufacturers and owing to the method of rolling employed, the channel bar used is almost perfect in construction and at the same time comparatively low in cost.

PRODUCTION OF PETROLEUM.

The annual report of the United States Geological Survey upon the production of petroleum in 1903, presents a most comprehensive view of the industry. Following is an abstract of the Canadian section of the report:

Canada—Ontario—The production of petroleum in Canada comes almost entirely from the Petrolia and Oil Springs district in Lambton County, and Bothwell, in Kent County, Ontario. One of the first productive wells was put down at Oil Springs, in 1862, which flowed vigorously. For nearly twenty-five years the quantity of petroleum produced in Canada has been gradually declining, notwithstanding the opening of a number of smaller pools within the past four years. One of the most important of the recently developed pools is known as the Dutton district, in Elgin County. There was also some production in the southeastern portion of Essex County.

Nearly all of the crude petroleum produced in Canada comes from the coniferous limestone, and contains a considerable proportion of sulphureted hydrogen, which imparts an unpleasant odor to the finished product, unless removed by special treatment.

The wells are usually from 330 to 400 feet in depth, and are cheaply drilled, as only one string of casing is required. Owing to these conditions, there are a great number of wells in operation, compared with the production secured. The present production in Canada does not amount to more than 40 per cent. of the quantity consumed, the deficiency being supplied by the United States.

In Quebec a number of deep wells have been drilled in the last ten years on Gaspe Peninsula. In all, fifty-two wells have been drilled in this locality, from 500 to 3,700 feet in depth. A number of these have shown traces only of petroleum of good quality, one variety being much lighter in gravity than the other. There are several well defined anticlinials in a general southeast-northwest direction, more or less faulted. The strata containing the petroleum are sandstone, alternating with red or brown shales, which are supposed to be of Devonian age.

The recent developments south of Moncton, New Brunswick, are still progressing, and deeper drilling has developed more productive lands. The production in this field at the close of 1903 is estimated to be close to one hundred barrels per day, the product of fifteen wells, if pumped to their capacity. The depth varies from 1,000 to 1,500 feet.

Several deep wells drilled within the last four years near Lake Aimslie, Cape Breton, have failed to find petroleum in paying quantities, although the succession of shales and sandstone deposits are quite similar to those of the Pennsylvania productive region.

The development of petroleum, already mentioned in a former report, in southeast Kootenay district, Alberta, has not as yet taken place. There are some evidences of petroleum springs in this region, and the structural conditions are considered favorable.

Newfoundland—During 1903 another well was drilled near Parson's Pond, on the west coast, to a depth of 1,204 feet, which developed a flow of petroleum. Two other wells, drilled to a depth of 600 feet, developed considerable natural gas, but no petroleum. Up to this date, six wells have been drilled at this locality to sufficient depth, and five of them have found petroleum. The quantity is yet to be determined by pumping them a sufficient length of time to test their output. No new developments have recently been made at Long Point, where a number of small wells were drilled in former years.

The following is a statement of the production of crude petroleum in Canada for the years 1902 and 1903, by districts, in barrels of forty-two gallons:

District.	1902.	1903.
Petrolia	397,628	350,390
Oil Springs	60,747	56,405
Bothwell	50,141	48,880
Dutton	8,867	21,483
Raleigh	2,462	1,161
Wheatley	....	1,995
Leamington	....	1,190
Total	519,845	481,504

INDUSTRIAL NOTES.

A new post-office is to be erected in Winnipeg.

A cement brick factory willl be started at Galt by George Howes and George Booty.

The Norton Manufacturing Co., Hamilton, can manufacturers, are building a large addition to their factory.

John O'Leary, of Ottawa, has been awarded a contract to repair the leaks along the Galops Canal. The price is $40,000.

The Saginaw Salt and Lumber Company, of Sandwich, Ont., has closed down its plant until the latter part of next spring. Over a hundred men are thrown out of employment. The reason attributed for the shut-down is that the company has a quantity of cut lumber on hand sufficient to last until the middle of the coming summer.

The American Axe and Tool Co., which has three factories in the United States, is looking for a suitable site for a Canadian factory.

The new boiler works of the Goldie & McCulloch Co., in Galt, are practically completed, and are expected to be in operation before Christmas Day.

As a result of a trip through Canada by a party of French and Belgian bankers, headed by A. Demmee, of Paris, capital from France and Belgium will be invested in this country.

Plans for Toronto's new Union Station, on lines that will make the cost about three million dollars, will be drawn up by Architects Darling and Pearson, E. J. Lennox and Alfred Chipman.

The American Horseshoe Co. has acquired land in Hamilton, and will begin the erection of a factory in the spring. The plans call for a building 300 by 75 ft., constructed chiefly of steel.

An oil gusher, bigger than any yet discovered in Moore Township, was struck on October 31st by Messrs. Duncan, Dunfield and Wilkinson. This opens up a new oil field six miles from Petrolia.

The C.P.R., during the summer, laid down nearly four hundred miles of new track in the North-West, built several new bridges, straightened out curves, altered gradients, did some double-tracking, and commenced work in connection with the irrigation scheme in the North-West.

The Brotherhood of Maintenance of Way Employees, in convention in St. Louis last month, chose Toronto as the place of meeting for the next biennial convention. The new officers are: Grand president, John T. Wilson, St. Louis; first vice-president, A. B. Lowe, Kingston, Ont.; second vice-president, W. S. Powell, Greensboro, N.C.; grand secretary, C. Boyle, Merrickville, Ont.

The contract for the construction of the new Victoria Museum, at Ottawa, has been awarded to George Goodwin, The figures of his tender are understood to be slightly over $1,000,000, and it was nearly $300,000 lower than the next tender.

W. H. Wattman, late of Toronto, is starting a carriage factory in Perth, Ont. He will build the woodwork for broughams, landaus, hearses, etc.

Paul Bloch and Jules Weill, representing the Compagnie General des Products Metallurgiques de France, are now in this country investigating the iron deposits, and the prospects for a market for steel products. The company they represent have large factories in the south of France, and propose erecting steel plants in the United States and Canada. The Canadian plant would probably be located in Ottawa or Montreal.

Tenders are invited for a $200,000 lift lock, at Kirkfield, on the Trent Canal. The location will be between Lake Simcoe and Balsam Lake, or about one hundred miles from the Peterborough lift lock. The Kirkfield lock will be about ten feet shorter than the one at Peterborough, and the lift will be fifty-five feet, or ten less than at Peterborough. The towers at Peterborough are of concrete; at Kirkfield they will be of steel. The lock, as well as that portion of the canal on which it is located, will be completed next autumn.

It is reported that the Packard Automobile Mfg. Co., of Detroit, is negotiating to establish a branch factory in Canada. It has a factory at St. Catharines for the manufacture of incandescent globes, and will erect an addition to the establishment for the manufacture of motors. The St. Catharines council has agreed to submit a by-law to fix the assessment on the new industry at $12,000, and this will be voted on shortly. The company is required to pay $25,000 annually in wages and to have the plant in operation by February.

The Pictou smelting plant has been bought by the Inverness Copper Co., Limited, of Halifax, which has valuable mineral property at Cheticamp, C.B. The smelting plant was originally erected at a cost of $175,000, and two years ago it was improved at a further cost of $45,000. The present capacity is 100 tons per day. The new owners are putting it in condition for operation, and later will increase its capacity to about 300 tons. Besides smelting ores mined by the Inverness Co., the smelter will do custom smelting of copper, gold and lead. The original owners got into litigation and were forced to sell soon after completing the plant.

It is reported that the C.P.R. will build another elevator at Fort William, next spring, to have a capacity of 2,000,000 bushels.

Sandon & Sutherland, of Kingston, have been awarded the contract for erecting the Canadian mint in Ottawa. The price is $262,000.

The North American Saw Co., of Philadelphia, has purchased a site in Toronto, upon which it intends to erect a branch factory.

The gold medal for surveying and drawing instruments was awarded to W. F. Stanley & Co., of London, Eng., by the jury at the St. Louis World's Fair..

The Peterborough Radiator and Boiler Company will establish a factory in Peterborough for the manufacture of the Sturgeon heater, invented by a local plumber.

There is a proposal to establish an electric iron smelter at Peterboro. Power can be obtained cheaply, and ore from the Belmont mines is particularly adapted to electrical treatment, samples having shown 70 per cent. iron after magnetic separation.

The Dominion Iron and Steel Co. report so many orders in the wire department that double shifts of men will be put on. It is expected that the rail mill will be in operation in April. The company has purchased the machinery for its projected plate mill.

The Taylor-Forbes Co., of Guelph, are going into the manufacture of radiators, and hot water and steam-heating boilers. For this department a new plant is being constructed. J. P. Hockin, formerly superintendent of the Dominion Radiator Co., is associated with the mechanical department.

The large new shops of the Grand Trunk Railway, at Stratford, are rapidly nearing completion. Several carloads of machinery have been received from the John Bertram & Sons Company, Limited, Dundas, Ontario, which firm was awarded the contract for the entire equipment of iron-working tools.

The Montreal Water Committee will call for tenders for one 12-million gal. steam pump, one 12-million gal. electric pump, and one five-million gallon turbine pump. As but one 12-million gallon pump is needed, the committee will pick out the most advantageous tender, whether it is an electric or steam pump.

Ahearn & Soper, of Ottawa, have been awarded the contract for supplies for the Welland Canal, amounting to $60,000.

The sardine business of Eastport and Lubec, Me., is estimated at about $3,000,000 a year, and about two-thirds of the fish used come from Canadian waters. The Government Fish Commission is about to make a report, and, it is understood, that this will recommend drastic measures for the purpose of securing the sardine industry for the Maritime Provinces.

The contract for supplying 10-inch tubing for the pneumatic postal tube systems in Toronto and Montreal has been awarded to Messrs. MacLaren, of Glasgow. Forty thousand lineal feet, at a cost of $1.32 per foot, is being contracted for, and excavation for the work will begin next spring, as soon as the frost is out of the ground, and the system is expected to be in operation in both cities by the beginning of winter. John Galt, C.E., of Toronto, will be in charge of the construction work.

The Mond Nickel Company, of Victoria Mines, are roofing their new smelter with galvanized corrugated iron, supplied by H. S. Howland, Sons & Company, Limited, of Toronto. The iron is the "Orb" brand, made by John Lysaght, Limited, of Bristol, Eng. It is heavily coated and made specially for exposure to fumes, such as those at the smelting works. A. C. Leslie & Company, of Montreal, are general agents in Canada for this celebrated galvanized iron firm, who make iron for any special purpose, as well as for the ordinary requirements of the trade.

Four years ago James Clarke bought out the old Cape Breton Foundry and Machine Co., now called the Sydney Foundry and Machine Works, Sydney, N.S. After purchasing, he enlarged the works to twice their former size. This year Mr. Clarke bought over half an acre of adjoining property, on which he is going to build new boiler and construction shops, offices and stock rooms. The property is situated in the centre of the town, close to the railway and water front. The new works will comprise a modernly-equipped foundry complete with crane, tumbling barrels, brass furnaces, etc. Machine shop, and forge equipped with modern tools and appliances. Mr. Clarke's son, W. E. Clarke, is interested in the business in the capacity of superintendent. This year the firm added a 104-in. radial drill, and a 21-in. punch and shears, made by the London Machine Tool Co. of the latest design, and an hydraulic wheel press was added to the machine shop. The specialties of the establishment are C. I. water, and steam pipe and fittings, service and valve boxes, manholes and corporation castings, car wheels, bottle chocks and mining machinery, building columns and ships' propellers. Among new machines ordered are a set of power plate bending rolls and steam hammer. With these they will have one of the best-equipped shops in the Maritime Provinces. Mr. Clarke will be remembered by many of our readers as traveller for John Bertram & Sons Co., of Dundas, Ont., and as having been chosen by the Canadian Government to take charge of the machinery hall at the Colonial and Indian Exhibition, in London, in 1886.

MAP MOUNTING.

Maps or plans that are worth printing or drawing should be worth preserving, and cannot be so kept unless they are properly mounted. There are many ways of doing this, namely, mounted to hang on the wall neatly, either varnished or unvarnished, or on spring rollers to place in a cabinet, or for dissecting and folding to carry in the pocket or file away in a bookshelf. This work can only be done by experienced workmen, and our readers will no doubt be pleased to know that the Steinberger-Hendry Co., Toronto, whose card appears in our advertising columns, make map mounting their special business. They will give estimates on any work of this kind. They also carry in stock maps and atlases of every description and invite correspondence.

—A paper on Failures of Masonry Dams was read before the Engineering Society of the School of Practical Science, Toronto, on the 26th ult., by John S. Fielding, consulting engineer. About two hundred were present, and a hearty vote of thanks was tendered the lecturer. We hope to be able to publish this instructive paper in an early number.

—Prof. Gilbert, of the United States Geological Survey, predicts that the waters of the St. Lawrence upper lakes will in 3,000 years from now pass entirely by way of the Mississippi to the ocean, leaving Niagara Falls escarpment dry. In 500 years the process of tilting will cause an intermittent natural discharge at Chicago. For 1,500 years this discharge will be continuous. In 2,000 years the discharge at Chicago will be equal to the discharge over Niagara Falls. In 2,500 years the Niagara river will have become an intermittent stream. In 3,000 years all its water will be flowing to Chicago to pass down the Illinois river to the Mississippi. It will probably be worth while, however, for the companies at Niagara Falls to continue the installation of their power plants with the hope of at least 500 years' business.

—A contemporary having investigated the waste of coal, due to the dissipation of heat through improperly insulated steam pipes, comes to the conclusion that "from 5 to 25 per cent. of the coal can be saved by the proper insulation of pipes. Look out for the small pipes. If we run a battery of ten boilers with a 12-inch main, and perhaps a large engine, say 100 feet distant, we would lose, by condensation, in an ordinary uncovered pipe, from 400 to 500 pounds of coal daily. But if we divide the 12-inch main into twelve or fifteen 3-in. unprotected mains, and run them around indiscriminately within a radius of 75 or 100 feet, we can easily waste from 500 to 2,500 pounds of coal daily." In this connection it is interesting to note that the steam user is becoming appreciative of the saving of coal by good insulation, as is demonstrated by the growing demand for "Remanit," the remarkably efficient non-conductor of heat, made by The James Morrison Brass Mfg. Co., Limited, of Toronto, as a covering for pipes and steam mains.

STEAM TURBINE PROPULSION FOR MARINE PURPOSES.*

By Professor A. Rateau, of Paris.

There is no need, in a country which has given birth to the Parsons turbine, to insist upon the interest attached to the application of the steam turbine to the propulsion of ships. The remarkable results which the distinguished inventor of that engine has obtained are matters of common knowledge, and the author is one of those who have most admired and appreciated the methodical manner in which these results have been achieved.

There are, at the present time, two ships fitted with our turbines, namely, the French torpedo boat No. 243, and a first-class torpedo boat built by Yarrow & Co. The latter alone has been constructed according to our ideas, as the restrictions imposed by the naval authorities upon the French torpedo boat, and the conditions laid down for its propellers have created such difficulties that it has been impossible up to now to obtain a satisfactory speed with this vessel. It was, however, only a trial boat, and the speed was not required to exceed 20 knots; in point of fact, we have obtained over 21 knots. With Yarrow & Co.'s boat, on the other hand, the conditions are such as to utilize the full value of the turbines, and the latter have been further supplemented by a small reciprocating engine for economical working at reduced speeds. The trials with this boat are, therefore, of considerable practical interest, and I have much pleasure in acknowledging our debt to Mr. Yarrow for the breadth of view which he has shown in dealing with these new conditions.

Another small vessel, the "Libellule," was to have been fitted with a turbine of our manufacture, and the engine has been completed for some time past, but the trials have not yet taken place, as the special boiler with which it was desired to make the experiments was not ready.

Before going into the details of each of these applications of our system of turbines it may be well to set forth some of the obstacles which arise in using turbines for the propulsion of vessels, obstacles which, in the author's opinion, can only be satisfactorily overcome by a joint use of reciprocating engines and steam turbines.

As to the advantages of turbines, these are well known: absence of vibration, great reduction of weight, ease in handling, absence of wear and tear, etc. There is no need further to insist upon them.

The three principal difficulties in applying turbines to the propulsion of ships are as follows:

(1) Design and arrangement of propellers for a high speed of rotation.

(2) Efficiency of turbines at low speeds.

(3) Reversing and manœuvring powers.

(1). Arrangement of Propellers for a High Speed of Rotation.

When the turbines are not restricted to any particular speed of rotation, a very high efficiency can be obtained, certainly higher than that of the best reciprocating engines.

The author's experiments confirm this fact, which had already been shown by the published trials of the Parsons turbine. Unfortunately, the best speed for turbines is usually much too great for screw propellers. In high-speed vessels, by some give and take between engine and propeller, a working agreement can be arrived at; but it is not easy to do. The gearing of the rings has to be higher than with a turbine for other purposes, and the turbine itself must be divided up into several sections in series; and, further, it is necessary to devise some arrangement for the propellers by grouping them either singly, in pairs, or in threes on several shafts, and to so increase their surfaces that the extreme outside diameter shall be greater than the pitch, all of which tends to reduce the total efficiency of the engine and propellers.

If, therefore, the turbine is theoretically superior to the reciprocating engine as regards consumption of steam at full speed, it is not by any means certain, *a priori*, that the joint efficiency of both engine and propeller is better, or even as good.

The practical difficulties, moreover, increase as the speed diminishes, for in the first place the total surface (and consequently the size of the propellers) is mainly determined by the principal cross section of the ship, whereas, on the other hand, the size of the turbines is limited only by the speed of rotation, and not by the power developed. The speed of the turbine must be reduced in proportion to the speed of the ship, so that the dimensions of the former are increased, either by the number or the diameter of the moving rings, whilst the power diminishes approximately as the inverse of the cube of the speed. There is, therefore, a lower limit of speed, below which the use of turbines cannot be recommended. The author has already expressed the opinion (in a paper read before the Association Technique Maritime in 1902) that this limit is in the neighborhood of 20 knots. The author is aware that certain ships now under construction for transatlantic service, and of a proposed speed of seventeen knots, are being fitted with turbine engines, but the future will show how these will turn out.

(2). Efficiency at Low Speed.

If the steam turbine is capable of giving good results at the maximum power, it cannot be gainsaid that the results are certainly unsatisfactory at reduced speeds, not so much on account of the reduction of power as on account of the reduction in the speed of rotation, which involves a lowering of what is termed the "hydraulic efficiency" of the turbine. Curves showing the steam consumption per horse-power of a turbine, compared to that of a reciprocating engine, in terms or the speed of the ship assuming that this consumption is about the same in both cases at the maximum speed, indicate that at reduced speed the consumption of steam per horse-power for the turbine is much higher than for the reciprocating engine. This drawback is not important in the case of merchant vessels that keep at about their maximum speed. On the other hand, it becomes a serious one for warships that are rarely working at full power. The increase in the coal consumption at speeds of, say, 12 to 15 knots, at which they are usually working, would however, greatly diminish their radius of action. A partial remedy, as used by Mr. Parsons, may be effected by adding a supplementary turbine for cruising purposes, into which the steam first enters when proceeding at low speeds. This, however, does not improve the hydraulic efficiency of the turbine, and the steam consumption nevertheless remains high.

The author considers that under no circumstances can turbines alone be economically worked at low speeds, and that the only satisfactory solution is the employment of a reciprocating engine of more or less power, according to the circumstances, in conjunction with turbines. With this combination economical results can be obtained at all speeds, and an example of this will be given later.

(3). Reversing and Manoeuvring Powers.

With a reciprocating engine stopping and reversing are effected in the simplest possible manner, whereas the very principle of the turbines is essentially opposed to this. Various inventors have tried to solve this problem by means of special blades to enable the same rings to be used for both directions of motion, but these attempts do not appear likely to come to anything, as one can only obtain reversibility by a considerable sacrifice of efficiency in forward motion. It is, therefore, necessary to supplement the turbine by special engines for going astern, and, as it is obviously impossible to have the latter as powerful as the former, one must be satisfied with a very much smaller speed astern than ahead. This difficulty in freely going astern makes manœuvring very awkward. The engine for going astern may be a reciprocating one, which would also be of

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*From a paper read at the Institution of Naval Architects of Great Britain.

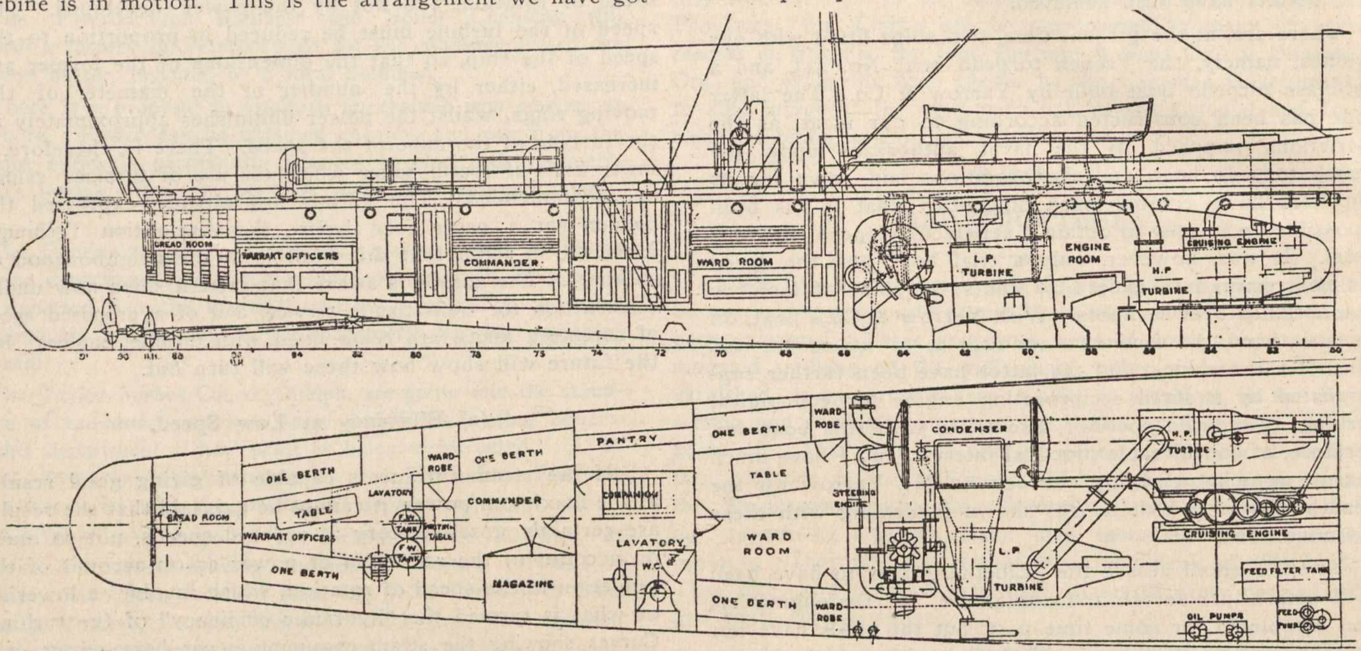
use for going ahead, but it can just as well be a steam turbine. From the very start, Mr. Parsons used in his vessels special turbines for going astern, and these were attached to the same shafts as the main turbines, but this arrangement has the inconvenience of taking up a good deal of space lengthways.

In my patent of 1898 I have indicated how these can be fitted so as to be, as it were, hidden inside the main turbines on the low-pressure side, and without taking up any additional space. When they revolve freely, the astern rings offer no appreciable resistance while the main turbine is at work, and, conversely, the latter is idle when the astern turbine is in motion. This is the arrangement we have got

almost as easy as with ordinary twin screws. An effective horse-power astern of 75 per cent., or more, of that when going ahead can thus be obtained.

The power of the reciprocating engine should not be less than one-sixth of the total, and it can quite well be increased to one-third or even to one-half of the maximum horse-power. It may be urged that this arrangement is complicated, and that if such an important reciprocating engine is to be retained, it is better to stick to the present system. In reply to this objection, however, the following advantages may be shown:

(1) Reduction of weight, although rather more space is taken up in plan.



Section and Plan of Yarrow & Co.'s Torpedo Boat, Fitted with Rateau Turbines.

in torpedo boat No. 243 and in the "Libellule," and it has the advantage of great simplicity. I think that Mr. Parsons has also made use of a similar arrangement in a certain number of his recent vessels.

According as the astern turbine is more or less developed, so the astern speed is more or less increased. With a single live ring, as on torpedo boat No. 243, and for the same expenditure of steam, the stern speed will be about 40 per cent. of the speed ahead, but with two rings it can be increased to 50 per cent. Adding more rings, however, adds very little to the speed, unless the number is so greatly increased as to make this engine almost as important as the principal one.

For quickly stopping a vessel turbines are apt to be inconvenient. After steam is cut off, the propellers continue to revolve by the action of the water, and they usually carry around with them the live rings, for the resistance to rotation is very slight. One can, however, increase this resistance by admitting steam in the opposite direction on the astern rings.

This question of stopping, reversing, and manœuvring is one which, in the author's opinion, may prove a serious hindrance to the extensive use of turbines for ship propulsion. It is particularly important for warships to be able to manœuvre with ease, and it will necessarily lead to the adoption of a combined system of turbines and reciprocating engines.

Combined Use of Turbines and Reciprocating Engines.

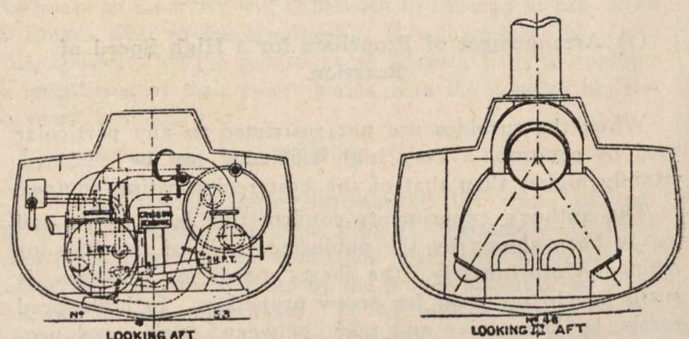
For the various reasons given above, the best solution appears, therefore, to be the simultaneous employment of a reciprocating engine and turbines attached to independent shafts, in order that the reciprocating engine may be used at any speed. Each kind of engine is thus adapted to the work which suits it best. The reciprocating engine does for slow speeds, while the turbines come into play progressively as the higher speeds up to the maximum are required. They can, moreover, be equally well arranged for going astern, and the combination of the two then makes manœuvring

(2) Easier working and maintenance, and subsequent saving in personnel.

(3) Reduction of the vibration due to the reciprocating engines.

(4) Increased efficiency, as the turbine is particularly suited to utilize the expansion of steam up to its extreme limit. It may be estimated that the increase in power for the same consumption of steam would amount to 15 to 20 per cent., or, in other words, that 5 or 6 per cent. increase of speed would be obtained by the arrangement here proposed.

Moreover, this arrangement will make it possible to bring the turbines advantageously into play at a lower limit of speed. With turbines alone, this limit is about 20 knots, whereas, with the combined system, it is possible to begin at 15 knots, or perhaps even less.



The Rateau Turbine.

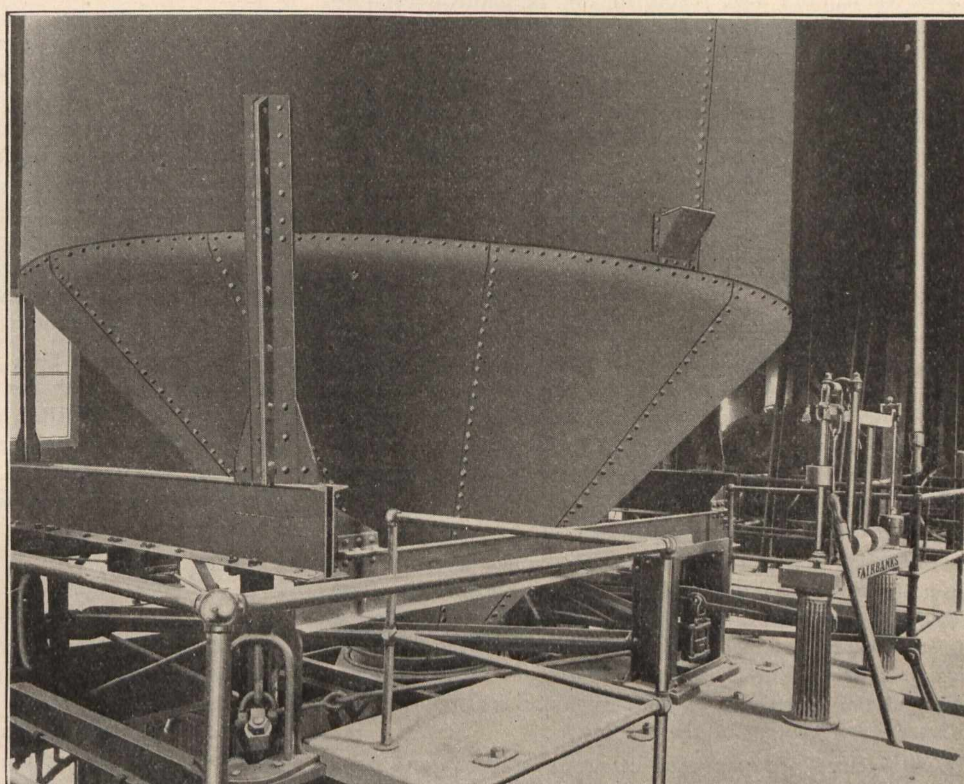
The author's design of turbine consists of a series of flat moving rings, varying in number according to the requirements, and fitted on a single shaft. These rings are placed between circular discs whose rims fit into grooves on the inside of the casing. The shaft traverses these diaphragms through bushes, which allow but little play. Elsewhere, the clearance between the moving and the fixed parts generally exceeds 3mm., and can even be as much as 5 or 6 mm. without causing trouble. With this arrangement, and by using the work by "impulse" instead of work by "reaction," we have sought to obtain an engine using as little steam as possible, simple in construction, needing but little care in working, and capable of running for a long time with but little wear and tear, which, although inevitable, can yet be reduced to a very small amount. The loss of steam is entirely confined to the clearance allowed around the shaft. Moreover, the live rings are so constructed as to be very light, and this is of advantage in reducing the gyroscopic effect which comes into play when the vessel pitches.

It has been said that with this system, supposing one could reduce the loss of steam to a minimum, it would, on the other hand, greatly decrease the efficiency by the friction between the rings and the steam contained in the chambers in which the rings rotate. As a matter of fact, however, the friction in our engines of 1,000 to 2,000 horse-power amounts to only 2 or 3 per cent. of the maximum power—an insignificant proportion—whereas in turbines without diaphragms the loss by the escape of steam reaches 10, 15, and even 20 per cent. of the maximum horse-power directly the clearances increase at all. All the trial results so far obtained show that our system of turbines is extremely economical in steam consumption. The author concludes with examples of the work of some of his turbines.

FAIRBANKS HOPPER SCALE.

The accompanying illustration is one of four 1,800-bushel Hopper Scales installed in the Government elevator, "Commissionaires du Havres," No. 1, Montreal. This elevator has a capacity of one and one-half million bushels, and was erected by the Steel Storage and Elevator Construction Co. The entire elevator was built of steel and cement, and the scale frame-work of structural steel, as shown in illustration. These scales are of a type which have recently come into use in these new elevators and possess some advantages over the old type.

As shown in this illustration, the levers are hung from yokes which rest upon the steel frame-work of the floor on which the scales are set, thus bringing the working parts of the scale up above the floor-level and in plain view, so that any displacing of scale parts can be readily observed, and they can be kept free from dust and dirt. The scales are equipped with Fairbanks Patented Type Registering Beams, which print a ticket giving the weight of the load.



Fairbanks Hopper Scale.

The test of these scales was remarkably successful; out of a total capacity of one hundred and eight thousand pounds, the maximum variation that could be detected was 7 lbs., on one scale only 2 lbs. The scales are easily sensitive to 2 lbs. or one-fifty thousandth part of the load.

THE STANDARDIZATION OF ELECTRICAL MACHINERY.

London Engineering contains the interim report of the sub-committee of the Engineering Standards Committee on generators, motors and transformers, dealing with the principal conditions with which it is desirable that these articles should conform. The committee determined not to risk hampering the trade with standard dimensions and shapes which might easily become obsolete as designs improved, but confined themselves to the more immediate necessity of securing uniformity in pressures and frequencies, rating of plant and conditions of test. The standard voltages recommended are as follows:

Alternating or direct-current at the terminals of the consumer	110, 220, 440 and 500 volts.
Alternating current at the generating terminal	2200, 3300, 6600 and 11,000 volts.
Standard pressure at primary terminals of alternating-current transformers	2000, 3000, 6000 and 11,000 volts.
Standard pressure at secondary terminals of alternating-current transformers	115, 230, 460 and 535 volts at no load
Standard pressure at terminals of direct-current traction motors	500 volts.

A variation of 10 per cent. either way is permitted in the above figures, so that plants built to the standards recommended may be employed on the great majority of the existing systems, although it is hoped that in course of time such latitude will become unnecessary. For alternating current a frequency of 50 periods per second is to be adopted as the standard, although in special cases, where a lower frequency is advisable, a secondary standard of 25 cycles is allowed. The difficulties in connection with the rating of generators and motors have been met by dividing the machines into two classes, according as they work continuously or intermittently. Machines of the former class must be capable of giving the rated output continuously for six hours, and the latter for one hour. When not otherwise specified, continuous working is always to be understood, and every machine is to bear name-plate giving such particulars of the output, voltage, frequency, revolutions per minute, exciting current and power factor, as bear upon its particular type. The output of generators is to be measured in kilowatts, and that of motors in brake horse-power. Direct-current generators are in future to be made in six standard sizes—from 6 to 100 kilowatts, inclusive—and a suitable speed has been recommended for each size. From 100 to 1,000 kilowatts, inclusive —there are nine sizes—machines up to 250 kilowatts having two alternative standard speeds, while above this size an additional slow speed is added, making three speeds in all. Alternating-current generators are required to give a sine wave as nearly as possible under all conditions. The field excitation for simple alternators should be at either 65, 110 or 220 volts. The variation of pressure at the terminals between full load and open circuit under the same conditions of speed and excitation must not exceed 6 per cent. of the normal on a non-inductive load, or 20 per cent. on a load with a power factor of 0.8. Motors are classified as open, protected, ventilated or totally enclosed, a "protected" motor being one in which the interior is shielded from accidental contact without interfering with the ventilation; and a "ventilated" motor, one in which, although ventilated, access to the interior is only possible by opening or removing the casing. Direct-current motors are standardized in 15 sizes, from ¼ to 100 brake horse-power, inclusive; single-phase motors in 11 sizes, from 1 to 25 brake horse-power, and two and three-phase motors in 17 sizes, from 1 to 100 brake-horse-power. The speeds at full load are given for every size; and in the cases of alternating-current motors the figures are the synchronous speeds at no load, and a reduction of speed from 7½ per cent. in the smaller sizes to 2½ per cent. in the larger at full load must be allowed for. In connection with the work of the committee, experiments are being carried out at the National Physical Laboratory to determine the safe temperature rise allowable in the coils of dynamos and transformers. The results are not quite ready for publication, although the report indicates that they will be of considerable value, and will result in the recommendation of higher temperatures than have been advised by either the German or American standardization committees. Meanwhile, it is of interest to note that the temperature of the hottest part of a coil, as determined by measurements with a thermo-couple, never exceeds the mean temperature of the coil, by more than 25° C.

THE SIROCCO FAN.

Among the instructive exhibits at the World's Fair, St. Louis, is a set of fans made by the Sirocco Engineering Co., of New York. This consists of a steam driven 30-in. fan, an electrically driven 30-in. fan, and a 12½-in fan, electrically driven, for high pressure service. There is also a testing apparatus for comparing the efficiency of the various types of fans.

This fan, which is now to be placed on the Canadian market, is of British origin, the principle upon which it works having been discovered by a Mr. Davidson, of Belfast. In form the fan looks like a squirrel cage, and is composed of shallow blades set closely together with their outer edges inclined, strange to think, in the direction of rotation. The inlet for the air, and the outlet for its discharge, are approximately of a diameter equal to that of the fan itself.

These features are a reversal of previous theory and practice in regard to fan construction; but the practical effect of this new construction is, that in this centrifugal fan the volume of air discharged per revolution is several times greater than in other centrifugal fans of equal diameter. In describing this fan, the makers say: The inlet and discharge openings for the air passing through the "Sirocco" centrifugal fans being (relatively to the fan diameter), about four times larger in area than in centrifugal fans of other standard makes, the frictional resistance to the passage of a given volume of air per minute through the "Sirocco" is therefore only a sixteenth of what it is in other centrifugal fans; consequently "Sirocco" centrifugal fans show a higher efficiency in actual work done for the power applied, and much less weight and bulk, in relation to output. The velocity of air into the inlet opening of the fan is equal over the whole area of the intake, the air entering the fan inlet, so to speak, as a solid cylinder. The adjustment and arrangement of the other edges of the blades, relatively to the inner edges, are such that "Sirocco" fans possess the remarkable peculiarity, that the velocity of the air issuing from the discharge or delivery pipe of the fan exceeds the circumferential speed of the blades by about 80 per cent.; whereas in other centrifugal fans it seldom equals, and is generally less than, the circumferential speed of the blades. As a consequence, for a given duty, "Sirocco" fans can be run at much lower speeds than other makes; or, at a given speed are capable of imparting a much higher velocity to the air than other fans of equal diameter. In "Sirocco" fans, the construction of the blades is such that the detrimental eddies which occur in other fans are obviated, as the circumferential speed of the inner edges of the blades is only slightly less than that of the outer edges, the difference between the diameters of the respective circles being unusually small. The organ-like "note" caused by such internal eddies, when the flow of air is at a very high velocity, is thus avoided, so that the "Sirocco" fan is practically silent in operation, even when running at high speeds. Another remarkable thing is that there is no end thrust on the fan shaft, even when the air is drawn into the fan on one side only. "Sirocco" fans are made in a number of different types to suit various requirements, and are applicable for driving by belt or rope any form of motor, or may be direct-coupled to such motors. A difficulty which is often experienced in regard to the employment of direct-coupled fans to motors, is the fact that the speeds for which standard types of motors are wound, relatively to their power, are usually more or less unsuitable for the duty required from the fan. For instance, one fan may absorb 2-h.p. at 500 revolutions, while another fan may only absorb this amount of power at, say, 1,500 revolutions. Now the standard speed of a 2-h.p. motor may be about 1,000 revolutions, and, obviously, therefore, stock sizes of motors cannot always be used for such varying requirements, and a necessity has existed for getting the motors specially wound to suit each individual case. To meet this difficulty, the makers have designed and patented an arrangement of back-gearing, which is applicable to any form of motor, and by means of which the full power of the motor can be transmitted at any required speed to the fan shaft, while at the same time the arrangement is so designed that, if it is desired for any reason to withdraw the armature of the motor for examination or repairs, it is not necessary to dismantle the gearing. This gearing, however, is itself detachable, so that the motor can be converted at will either from an ordinary into a back-geared motor, or vice versa.

The fans have been remarkably successful for induced draft on boilers, both for stationary and marine use. One of these has been installed in the new Canadian Government cruiser launched in September from the shipyards of the Polson Iron Works, Toronto. A reference will be made to that in a description of the cruiser.

RULES FOR THE ENGINE ROOM.

1st. When you enter the engine room spit on the floor. We have water, lye, soap and brushes, and we will clear up as soon as you leave.

2nd. Rub your hands on the polished work, it will give some one work to use the surplus polish.

3rd. Put your hands on the engineer's bright work, you will know whether it is smooth, hot or cold. Tell others to do the same.

4th. Stop in the engine room as long as you please. The engineer has nothing to do but entertain visitors.

5th. Be sure to tell the engineer that his engine is pounding or not running right, as he will not know unless you do; he will stop and make repairs while you wait.

6th. Don't tell the engineer who you are, he is a mind reader, and already knows who you are. Go anywhere in the engine room and you will please him.

7th. Advise him what to do, as you know best. The engineer is only there every day and does not have a chance to see as much as you will in an hour.

8th. When the engineer is busy making repairs, tell him a good story and if possible get in the way.

9th. Be sure and tell him all you know, it will not take long.

10th. Call again and repeat as long a story as you can.

11th. Pull out a cigar and light it, don't ask him to have one for if you do he will accept it.