PAGES

MISSING

The Canadian Engineer

Vol. XI.—No. 10. TORONTO AND MONTREAL, OCTOBER, 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.

A CANADIAN COMMISSION TO NEWFOUNDLAND.

The St. John's Trade Review, taking up the question of trade between Canada and Newfoundland, discussed in the August number of the Canadian Engineer, essays to give some of the reasons why United States firms have got ahead of Canadian firms in cultivating trade on the island. Our contemporary says United States manufacturers have gained most in those lines that are of their own manufacture, whereas in the past Canadian firms have been selling goods, a large proportion of which are not of Canadian manufacture, but imported and reshipped to the island. The Review then quotes the interesting letter of the Toronto Globe's special correspondent, in which attention was called to the work of the United States consul at St. John's, who, while personally very popular among the islanders, never loses an opportunity of giving hints of trade openings to United States manufacturers.

As to the first point raised, our contemporary proceeds to say: "All the United States goods we import are manufactured in the United States and have no previous duty handicap, while the most of the goods Canada has to sell us have come from some other country. If Canada is content in exploiting her own bona fide products here, we will show her a fair field and no favor, but products of other countries coming to us through the Dominion (except in bond) cannot be expected to get a foothold." We fancy there is a misconception here, due to the fact that a large retail trade by parcels post has sprung up between some of the Canadian departmental stores and Newfoundland; and these goods, which would be of all sorts and from all countries, are taken as typical of the business of manufacturers and shippers. This trade, it is said, is turning out rather unsatisfactory to the islanders, who, in many cases, find the goods unsatisfactory, but will not or cannot return them; but, lest it should work harm to the future trade of Canadian manufacturers and merchants, those concerned should get into closer touch with the island and make known the variety and extent of Canadian products which already find, or should find, their way to the island under their own colors.

The second point is equally serious to Canadians who wish to increase their trade with Newfoundland, and it is of importance from a national and political as well as an industrial and commercial standpoint. Canada has commercial representatives in Australia, South Africa, Great Britain, France and other countries. Why should she not have a commissioner in Newfoundland, who, through our Government, would keep Canadians posted on trade conditions and on opportunities for Canadian manufacturers? A discreet man of the type of the United States consul, so highly praised by the Newfoundland papers, would be a great power for promoting good relations between Canadians and Newfoundlanders. He would be a man who would have enough sense to keep himself out of the domestic politics of the island and take no part in sectional contests, but would go among the merchants and people, giving them information on the country, and showing them that we were a friendly and fraternal people, with a real interest in the island's prosperity. He could prove this by calling the attention of Canadian manufacturers to the openings for Canadian capital and enterprise there, and this feature of his work would be an earnest to the people of the island of the advantages of closer commercial and social relations with Canada above all countries except the Mother Land. A Newfoundland commissioner in Canada would be a complement to the work of the Canadian commissioner at St. John's. Such a commissioner would do good service to his country if all he accomplished was to direct the attention of enterprising Canadians to fields of investment in developing the resources of the island and giving better employment to its people.

THE MANUFACTURERS AND THE LABOR CONGRESS.

The annual convention of the Canadian Manufacturers' Association and the annual congress of the Trades and Labor organizations, both of which were held in Montreal in the same week last month, have proved the most important in the history of both bodies, not only because the attendance was the largest on record, but because of the character of the resolutions passed. The Canadian Manufacturers' Association, which now numbers 1,511 in its firm memberships, passed resolutions re-affirming previous resolutions calling for a general revision of the tariff on the broad lines of adequate protection to all native industries, even including the agricultural interests and the fisheries and forests. The preference in favor of Great Britain and the British colonies is approved of as against foreign countries, but the association does not favor a preference involving the extinction of a native Canadian industry; nor does it approve of a system of bounties as a substitute for protection. Whatever difference of opinion may exist among outsiders as to these questions, we fancy there will be a general endorsation of the resolution to organize a fire insurance company as a protest against the attempt of the regular insurance corporations to make the merchants and manufacturers of Toronto and the Province of Ontario pay for the fire of last April by an extra assessment that bears no relation to normal risks. We understand that steps will be taken to create this insurance organization at once. The proposal made for an association trip to the Old Country next summer is one which, if carried out, may have important results by bringing British and Canadian manufacturers into closer touch, and leading them into co-operation instead of competition.

The Trades and Labor congress, which comprised forty-eight councils and twenty-three federal unions, with an aggregate membership of 22,000, exclusive of twenty-one unions not affiliated, took high ground in the conduct of their convention. Indeed, the leaders viewed the facts around them with a breadth of vision and a statesmanship that did equal honor to their heads and hearts, and is in most favorable contrast to some of the eccentric legislation of similar bodies abroad. The congress passed a resolution in favor of better observance of the Sabbath, and one calling on all the unions to urge their members to abstain from intoxicants. Another very important resolution was one in favor of the Government ownership of telephones, and asking for legislation favoring the municipal ownership of local lines. This was carried unanimously. and another resolution passed asking the Quebec Government to appoint competent boiler inspectors to prevent loss of life by explosions. Not the least hopeful sign of a broader and more tolerant spirit in trades unionism in Canada was the resolution proposing a conference with the Canadian Manufacturers' Association with a view to arriving at a peaceful method of settling disputes between capital and labor. Such a proposal not only shows that the labor men recognize the enormous loss to both sides involved in a dispute as to wages, etc., but it also implies a recognition that capital has a right to a fair return for its use and investment. If, as we hope, the Canadian Manufacturers' Association and others representing capital, such as the railway and street railway corporations, will meet the Trades and Labor Committee with a serious determination to adjust differences, each seeing the other's side of the case, a new era will dawn in the industrial history of Canada. Millions of money would be saved that is now worse than squandered in contests that leave nothing but bitterness behind; and, what is more vital, the moral degradation of enforced idleness and the deprivations that innocent people have to suffer would be reduced immeasurably. But capitalists and employers of labor must remember that their responsibilities for the right use of money and position are heavy.

THE VISITING ENGINEERS AND ELECTRICIANS.

The visit to Canada last month of so many representative members of the Institution of Civil Engineers of Great Britain is a timely one, and should result in much good to both countries. Engineers are not much given to speech-making, but are men who "do things," and the few remarks made in public by our British visitors show that their practical minds have quickly grasped the importance of Canada as a pillar in the edifice of empire. The penetrating mind of Sir William White, for example, realizes instantly the potentialities of the colossal water-powers of Canada and the unspeakably lavish gifts of nature in the way of navigable lakes and rivers, to say nothing of sea coasts. We know something of the value of these water-powers from the industrial activities created by the use of the few that are already developed, but who can measure the industrial forces to be brought into the service of the country by the water-powers yet undeveloped and unknown? Within a radius of fifty miles of Ottawa a million horsepower has been measured, of which not one per cent. has been electrically utilized. In northern Canada we know, from the nature of the country and the source of the rivers and streams, that there are water-powers by the hundred yet unmeasured, or even explored. The statement that Canada contains 40 per cent. of the water-power of the world may prove to be within the mark rather than outside. These powers, combined with our enormous mineral, timber and agricultural resources and our vast systems of inland navigation are not put here by Providence for Canadians to boast possession of merely They are a trust which it is our duty rightly to use for the benefit of the world, ourselves included, and to turn to account in behalf of the millions who will shortly seek homes in the vast unoccupied lands of the British half of America. In this great task our admitted present lack is capital, and our British visitors can, and no doubt will, direct their friends at home to safer channels of investment in the country than many British capitalists have unfortunately been led in the past through the speculative promoter. It is not only in this respect that the visitation will do good to both countries, but our visitors on their return home will be able to confirm what the Canadian Engineer has preached from time to time—that British engineering firms have in the past ten or twenty years been asleep to the business opportunities that are passing in this country. There is no reason that we know of—except apathy—why orders for machinery to the extent of millions of dollars should not have been secured by Old Country makers instead of passing into the hands of United States, German and other foreign manufacturers. Our visitors can tell their friends at home that though they may regard with a supercilious smile the loss of a trade of the modest dimensions which the Canada of to-day has to offer, they or their sons will be fighting for their life for the same trade when this country has become a nation of twenty or thirty millions. It is easier to save a trade by a few timely reforms and a little attention to the wants of customers than to regain it after it has drifted into new channels. Whatever the results from a business point of view, it is pleasing to learn that not only the British civil engineers, but the British and Italian electricians who also visited us last month were gratified with the hearty hospitality of their Canadian confreres. It is pleasing further to hear that they are being received with equal cordiality by our generous professional friends in the United States who have done many mighty works in the engineering line which they can show with just pride.

* * *

—The trend of modern practice in protection against fire is toward the provision of permanent stationary fire-fighting apparatus. As an instance, the city of Philadelphia recently completed an independent system of high-pressure mains and pumping station. The value of private fire apparatus for the protection of individual buildings and adjoining property was thoroughly demonstrated in the Baltimore and Toronto fires; and, in fact, the fire departments of both cities admit that many buildings on the immediate margin of the devastated tract were saved only by the effective work of private apparatus. These buildings were supplied with either stand-pipes or pumps connected with wet-pipe interior sprinklers and dry-pipe sprinklers for protection from outside fires, storage tanks holding from 1,500 to 15,000 gallons being placed on the roofs. Besides saving the buildings in which they were located, these equipments stopped the advance of the fire, and undoubtedly many more buildings would have been destroyed in the absence of their efficient service. It is said that the buildings and contents protected by private apparatus in Baltimore were valued at five million dollars, and at Toronto the saving from private protection was similar in extent.

* * *

—A high-speed pump, driven without gears or belt directly from the shaft of an electric motor, was recently tested at the works of the General Electric Co. at Schenectady, N.Y., and showed an efficiency of 93 per cent. when running at a speed of 300 revolutions per minute. This is interesting, since electric-driven pumps of the reciprocating type involve heavy and expensive gearing. In mining operations especially the use of steam for driving pumps at a distance has drawbacks owing to loss of steam by condensation and owing to troubles with long lines of pipe, which, apart from their cost, are liable to leaks and danger of bursting, and the delays attendant thereon. Compressed air, so largely used in mining, is a convenient way of distributing power, but it has a low efficiency in the plant as a whole. Where first cost is not the chief consideration, the electric direct-driven pump should do good service, as the system would be capable of easy extension while admitting of the centralization of the power plant. In most Canadian mines, however, electricity is generated by water power, and first cost and simplicity rather favor the turbine pump, for low first cost seems to be the chief object in the installation of many Canadian plants. However, we understand that the John McDougall Caledonian Iron Works Co., of Montreal, are experimentally putting this type of pump on the market, and it will be interesting to observe how they are found to work.

* * *

RAILWAY DISASTERS.

A head-on railway collision, at Richmond, Que., in which eleven people were killed and over a score injured; a rear-end collision, at Sintaluta, between an express bearing the Governor-General, and a freight, in which five were killed and as many injured; a rear-end collision, between two freights, at Eastwood, Ont., in which five were killed, besides a number of cattle burned to death and nine cars destroyed; a wreck at Streetsville, Ont., through a broken axle; a collision at Oak Point, Man., resulting in injuries to four; the derailing of an express near Moosomin, N.W.T., from which seven people were injured; the derailing of a freight near Milton, Ont., from which one was killed and two injured—these, with a few minor accidents, make a dark record of disaster on Canadian railways within the space of thirty days. The direct loss to the railways in wrecked rolling stock and damages will not be less than a million dollars; but the grief of widows and children, and the loss to the State of good citizens, cut off generally in the prime of life, cannot be measured in terms of money. We have not followed the disaster list in the United States for September, but the case of the head-on collision of two passenger trains, near Hodges, Tenn., on the 24th ult., where 54 were killed and 125 injured makes in itself a frightful catalogue of death and damage. In all but the minor cases these accidents would have been practically impossible had the block signal system of Great Britain and European countries been in operation on these railways. Apart from the defects of the present signaling system, the railways of this country and the United States—perhaps more particularly the latter—are suffering in reputation by a fit of severe economy in the operating department, while maintaining a generous expenditure in the directorate and high official lists. We do not say that many of these high officials do not richly earn their large salaries, for their responsibilities are very heavy in more ways than one, but as regards the train men, station agents, etc., it is certain that they cannot efficiently fulfil the duties assigned to them and live up to the rules laid down for their direction. It must be confessed that in care and efficiency of operation, Canadian and United States railways cannot compare with British roads. The London and North-

Western and other British railways have run a whole year at a stretch without losing the life of a single passenger. Contrast this with the record of the fiscal year in Canada, in which 420 people were killed and 1,453 injured on the railways. An investigator of railway accidents was recently appointed by the Dominion Government. The idea of such a reporter is a good one, but the public has so far seen little or nothing of the results of his work. If these reports are to be pigeon-holed, they are not much advantage to the country. The new Railway Commission has got fairly to work and has already justified its existence, but the casualty record of the past month shows that it has before it more serious work than it has yet contemplated.

MACHINE SHOP NOTES FROM THE STATES.

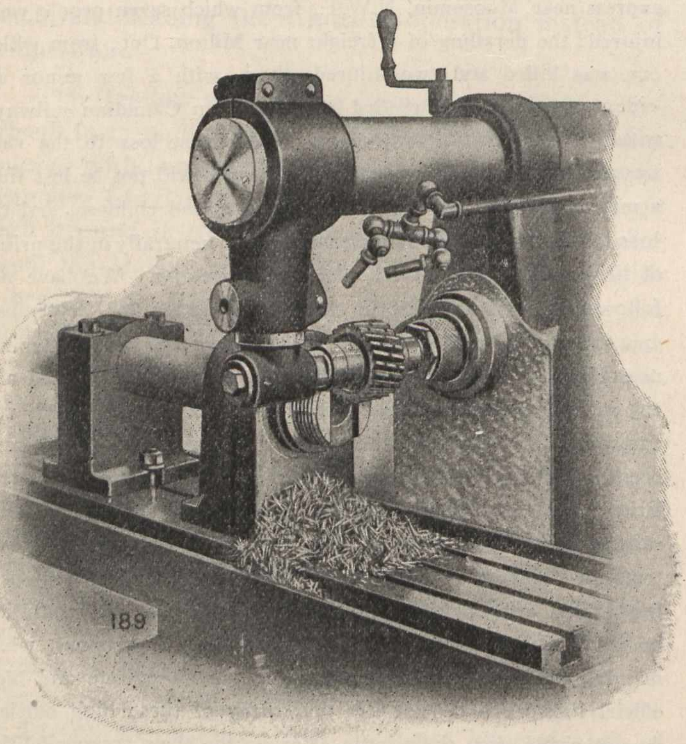
By Chas. S. Gingrich, M.E.

VIII.

"Don't bother about changing all your patterns so that you can use castings in the rough, because by allowing 'finish' you can mill them quicker than file the lumps off." This statement was made to me while going through the milling department in the shops of the Cincinnati Milling Machine Company recently.

This seemed like pretty strong talk, but before I had a chance to question it I was shown a job which fully bore out the truth of the statement. Permission to make a photograph was granted, and it is reproduced herewith.

This is one of the braces that go with each milling machine. It is a simple cast iron bar having a long bolt slot through its centre by which it is clamped in position, the slot allowing for a great deal of vertical adjustment. It had been the custom for years to core this slot in the casting, accuracy being of no particular importance; but no matter how careful the moulder was, it was always necessary to smooth the slot with a file before the pieces could be used.



No. 2 Plain Cincinnati Geared Feed Miller, with Power Vertical Feed.

The slots are about 22 inches long, and if a man cleaned one of these up by hand in ten minutes he was doing very well; but to refer to their present practice: The pieces are now cast solid. A single hole is drilled through the bar at one end of the slot. It is then secured to the milling machine table, and adjusted to bring this hole in line so that the piece can be slipped over a small end-milling cutter of proper size, which is held in the spindle of the machine, and the slot is then milled out of the solid metal and finished to size at a single cut. It takes just about five and a half minutes to mill one of these slots. The cutter used is 13-16 inches diameter, Novo steel, and runs about 480 revolutions per minute. The bars are 1¼ inches thick.

There were other machines at work on a variety of pieces, which proved conclusively that the above statement, that it does not pay to file up rough castings, applies just as well in the case of bearing caps, couplings, etc., as it does in the case of the particular piece illustrated.

The Victorian, the first of two turbine-driven ships for the Allan Line, has been launched at Workman, Clark & Co.'s yard, Belfast, and it is expected that she will be ready for service before the end of the year. She will be fitted with Parsons turbines.

The Minister of Railways has appointed E. J. Walsh, C.E., to be engineer in charge of surveys in connection with the Trent Valley Canal. One of these will be along the Port Hope route to Lake Ontario, and the other will be for the purpose of determining the best channel between Lake Simcoe and Georgian Bay.

The Department of Marine and Fisheries has begun the making of a hydrographic survey of Lake St. Francis, which will dovetail into the similar work done by the United States Government a few years ago. The party consists of about sixteen men. The work will be under the charge of Mr. Chapleau, Chief Engineer of the Department of Marine and Fisheries.

—Two Sheffield workmen, John Creswick and Herbert Shaw, after three years of experimenting, have discovered a process of electroplating with aluminum. Thousands of pounds have been spent by silversmiths of Birmingham and Sheffield in developing an aluminum electroplating process, but no method could be devised of making this metal "take" on another metal. Creswick and Shaw have found a solution which, by immersion before being subjected to the battery, will accomplish the result. The process, which is patented, is applicable to any articles now made in nickel or Britannia ware, and the inventors have started a small factory for plating goods.

NEW INCORPORATIONS.

The Continental Contracting Co.; capital, $500,000; head office, Ottawa. Directors: W. H. Curle, J. T. C. Thompson, J. Connolly, A. R. Fraser, and G. A. Brown, all of Ottawa.

Compagnie Générale d'Entreprises; capital, $1,000,000; head office, Montreal. Directors: F. Allard, L. Coiseau, A. Couvreux, J. Dollfus, A. Duparchy, L. Wiriot, contractors, all of Paris, France; J. Nyssens-Hart and J. Cousin, both of Bruxelles, Belgium, and J. de Shryver, of Raismes, France.

Canadian Pipe Co.; capital, $25,000.

The Ontario Independent Telephone Co.; capital, $100,000; head office, Windsor. Directors: C. W. Taylor, J. R. Brooks, J. A. McRae, P. T. Chesley, and A. D. Prosser, all of Detroit.

The charter of the Niagara Falls Park and River Railway Co. has been transferred to the International Railway Co., incorporated in New York State.

The Minnehaha Mining and Smelting Co., of Arizona, is licensed to do business in Ontario to the extent of $40,000 capital.

The Crown Oil Co. is incorporated with a capital of $300,000; head office, London. Directors: D. S. Robb, of London; B. G. Baker, of Buffalo, and others.

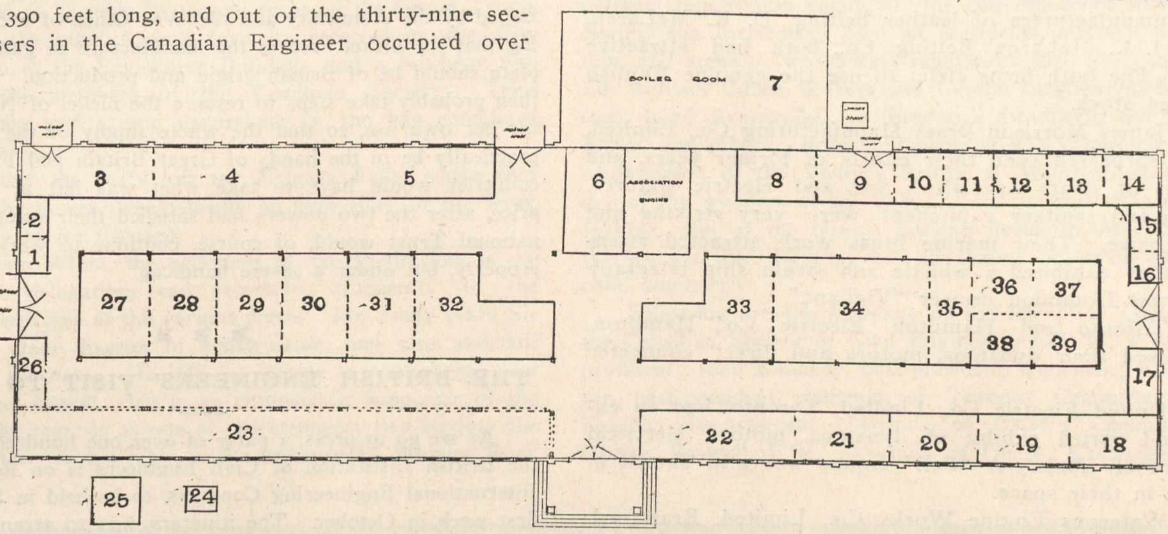
The Mount McKay Brick and Tile Co.; capital, $40,000; head office, Fort William. Directors: K. O. Brune, F. Waldberg, and others, all of Fort William.

Simplex Coal Saver, Limited; capital, $40,000; head office, Toronto. Directors: P. H. Patriarche, F. B. Allan,. and W Eacrett, all of Toronto.

MACHINERY AND ELECTRICAL HALL, CANADIAN NATIONAL EXPOSITION, TORONTO.

The Exposition of 1904 saw Machinery Hall unable to accommodate the exhibitors requiring space, and as a consequence many of them were forced to secure accommodation in other buildings not so well suited.

The below plan and list will convey an idea of the number of firms who were accommodated in a space 100 feet wide by 390 feet long, and out of the thirty-nine sections advertisers in the Canadian Engineer occupied over 50 per cent.



- *4. American Tool Works Co., Cincinnati, Ohio.
- *31. Babcock & Wilcox, Limited, Toronto.
- 9. Biggar-Samuel, Limited—Canadian Engineer, Canadian Journal of Fabrics, Pulp and Paper Magazine.
- *23. Canada Foundry Co., Limited, Toronto.
- *24. Canada Foundry—Fountain.
- 13. Canada Metal Co., Toronto.
- 20. Canadian Bearings, Limited, Hamilton, Ont.
- 9. Canadian Engineer, Toronto.
- 9. Canadian Journal of Fabrics.
- 39. Carey Mfg. Co., The Philip, Toronto.
- 35. Chapman Double Ball Bearing Co., of Canada, Limited.
- *19. Cling Surface Co., Buffalo, N.Y.
- 29. Consolidated Electric Co., Toronto.
- *11. Dominion Belting Co., Limited, Hamilton, Ont.
- 30. Dodge Mfg. Co., Toronto.
- 14. Engineer's Office.
- *19. Eureka Mineral Wool & Asbestos Co., Toronto.
- *4. Fairbanks Co., Toronto, Montreal, Winnipeg and Vancouver.
- *9. Georgian Bay Engineering Works, Midland, Ont.
- *32. Goldie & McCulloch Co., Limited, Galt, Ont.
- 5. Goold, Shapley & Muir Co., Limited, Brantford, Ont.
- *36. Hamilton Motor Works.
- 21. Henderson Roller Bearing Co.
- *34. Jones & Moore Electric Co., Limited, Toronto.
- *16. Ker & Goodwin, Brantford, Ont.
- *4. Merrell Mfg. Co., Toledo, Ohio.
- 6. McLachlan Gasoline Engine Co., Limited, Toronto.
- 6. McLachlan-Joy Electric Co., Limited, Toronto.
- *12. McLaren, D. K., Montreal, Toronto.
- *10. McLaren Belting Co., The J.C.
- *22. Morrison Brass Mfg. Co., Limited, The James, Toronto.
- 9. Pulp and Paper Magazine of Canada.
- 18. Queen City Cycle and Motor Works, Toronto.
- *19. Quaker City Rubber Co., Philadelphia.
- 17. Shankland, W. S., Toronto.
- 17. Sinclair & Sons, G. S., Wiarton.
- *36. Smart Turner Machine Co., Hamilton, Ont.
- *19. Smooth-On Mfg. Co., Jersey City, N.J.
- 8. Syracuse Smelting Works, Montreal, P.Q.
- *37. Toronto and Hamilton Electric Co., Hamilton, Ont.
- 25. Toronto & Niagara Power Co.—Tower.
- 7. Underfeed Stoker Co., Limited, Toronto.
- *33. United Electric Co., Limited, Toronto.
- 28. Vessot & Co., S., Joliette, P.Q.
- *7. Waterous Engine Works Co., Limited, Brantford, Ont.
- 38. Weddell Bridge & Engineering Co., Trenton, Ont.
- *26. Westinghouse Electric Mfg. Co., Pittsburg and Hamilton.
- 3. Wilson & Son, Chas., Toronto.
- 17. Williams, Wayland, Montreal.
- 27. Williams Machinery Co., A. R., Toronto.

**Names marked with star are those of advertisers in the Canadian Engineer.*

The arrangements made by H. G. Nicholls, chairman of the Machinery and Electrical Committee, who was ably assisted by A. M. Wickens, superintendent, and W. G. Blackgrove, engineer, were very much in advance of former years, and on the closing night of the Exposition an address was presented to the chairman, a wallet was given to the superintendent, and a sum of money to the engineer and his assistant, to which every exhibitor in the building contributed. The recipients expressed their appreciation in short speeches.

Through the courtesy of G. W. Thexton, manager of the Georgian Bay Engineering Works, the publishers of the Canadian Engineer were allowed desk room in his space, the position at the western entrance formerly allotted to the Canadian Engineer, and again promised us this year having by some misunderstanding been given to another exhibitor.

Notes of the Fair.

The Canada Foundry Co., Limited, and the Canadian General Electric Co., Limited, had the most extensive exhibit in the Hall, as well as an outside exhibit on the south side showing the style of tower being erected for the long distance line of the Toronto and Niagara Power Co., and also several fountains.

Dr. W. D. Young, of the Cling-Surface Co., Buffalo, visited the Fair during the opening days and installed the testing machine in the exhibit of the Eureka Mineral Wool and Asbestos Co.

Mr. Walker, manager of the Dominion Belting Co., Limited, Hamilton, Ont., spent a few hours at their exhibit.

The Eureka Mineral Wool and Asbestos Co., Toronto, in addition to their own products had an attractive exhibit of packings manufactured by the Quaker City Rubber Co., Philadelphia, and cements made by the Smooth-On Manufacturing Co., Jersey City, N.J.

The Fairbanks Co., in addition to the standard products made in their own factories, such as scales and valves, exhibited the "Fairbanks" brand of leather belting and wood split pulleys made in Canada, named the "Fairbanks." Their exhibit was crowded with interested visitors, who were either getting weighed on one of their handsome weight-registering scales or admiring the new high-speed lathe, made by the American Tool Works Co., Cincinnati, Ohio, or watching the operations of "Fairbanks" gas and gasoline engines. They also showed a pipe-threading and cutting machine made by the Merrell Manufacturing Co., Toledo, Ohio; Foster pressure regulating valves; Goddison's magnetic igniter for gas and gasoline engines, a new method which will supersede the use of batteries. There was also a "Fairbanks" power hammer and the products of the Burt Manufacturing Co., Akron, Ohio, comprising "Cross" oil filters and "Burt" exhaust heads.

The Georgian Bay Engineering Works, Midland, Ont., showed a 4 h.-p. gasoline engine, which attracted much attention owing to its simplicity and easy-running qualities, details of which will be found in their advertisement.

The Goldie & McCulloch Co., Limited, Galt, Ont., whose engine supplied the power for the main drives in Machinery Hall (one being a Wheelock and the other a high-speed Ideal) also showed a milling separator, wheat steamer, four-sided moulder, double-surface planer, and a power feed cut-off saw.

The Hamilton Motor Works and the Smart-Turner Machine Co., Limited, Hamilton, Ont., exhibited marine gasoline engines and steam pumps of great variety.

The Jones & Moore Electric Co., Limited, Toronto, had an extensive line of bi-polar and multi-polar generators and motors up to 80 h.p., and supplied a number of the exhibitors with lights. All their motors were connected up, and their switchboard was fitted up with the necessary switches of the most approved types. They also displayed a line of Adams-Bagnall arc lamps, special lamps in great variety, fans, blowers, telephones, etc.

The "Imperial" lathe chuck, manufactured by Ker & Goodwin, Brantford, Ont., had its many good points explained by the members of the firm.

The manufacturers of leather belting, D. K. McLaren, and the J. C. McLaren Belting Co., both had attractive exhibits. The both firms claim to use the genuine English oak-tanned stock.

The James Morrison Brass Manufacturing Co., Limited, Toronto, surpassed even their efforts of former years, and their lines of steam specialties, gas and electric fixtures, bathroom and sanitary equipment were very striking and comprehensive. Their marine brass work attracted attention, as they exhibited a whistle and steam ship telegraph for the new Dominion cruiser "Vigilant."

The Toronto and Hamilton Electric Co., Hamilton, Ont., showed their dynamos, motors and direct connected sets.

The United Electric Co., Limited, Toronto, had an extensive and varied exhibit of dynamos, motors, electrical supplies of all kinds. A "Bell" engine was also shown in operation in their space.

The Waterous Engine Works Co., Limited, Brantford, had a McEwen engine in the boiler-room running the blower for the Underfeed Stoker Co., Limited.

The Westinghouse Electric Manufacturing Co., Limited, Pittsburg and Hamilton, Ont., had arc lamp circuit regulators in operation.

Babcock & Wilcox, Limited, Montreal and Toronto, manufacturers of water tube boilers, showed in addition to a permanent boiler exhibit samples of their solid steel boiler forgings and manhole covers. They also distributed very interesting reading matter, and a limited number of their publication called "Steam" were secured by interested visitors.

NATIONALIZING THE NICKEL INDUSTRY.

The following comes by way of London, through the Daily Chronicle: An important proposal is likely to be made by the Dominion of Canada to the British Government. In the Sudbury district of Ontario there are situated the largest known nickel mines in the world. For commercial purposes there are at present only two sources from which the world's supply of nickel is drawn. One is at Sudbury, and the other is in the French penal settlement of New Caledonia. In the manufacture of guns and armor-plate nickel is an indispensable ingredient. The whole present supply, however, Canadian and French, is controlled by the International Nickel Company, an American trust, which has managed to crush out all its smaller competitors. At the head of this combination is C. M. Schwab, ex-president of the Steel Trust. It has, however, occurred, not for the first time, to some Canadian patriots, that it is absurd that the nickel used in the construction of the iron walls that defend Great Britain, should be purchased second-hand from an American trust while the great source of the supply is on British soil; and it has accordingly been suggested that the invaluable supply in the Sudbury district should be reserved for British use. Apart from patriotism, Canadians have, of course, an eye to business in making this proposal. The International Trust puts an arbitrary price on nickel. Its present commercial value is about 40 cents, or 1s. 8d. a pound, but experienced miners and smelters say it can be mined, smelted, refined, and put on the market at a price not exceeding 6d. a pound. In that case, within the past ten years, the period during which nickel has begun to be extensively used in the building of ships of war, the supply purchased by Great Britain has cost at least 200 per cent. more than it need have done. That 200 per cent., it is urged, might have been used in increasing the efficiency of nickel as a defensive material of war.

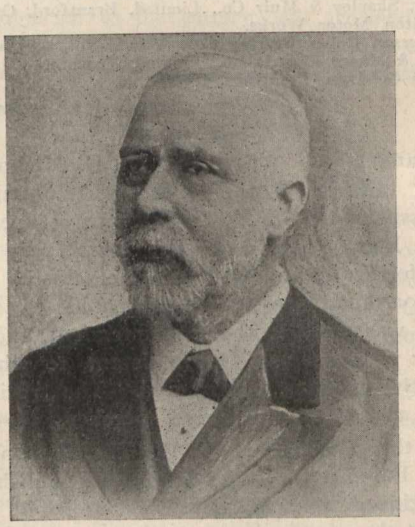
Some months ago the Canadian Government expressed a willingness to make an offer to the British Government of all the nickel in the Sudbury district, provided that the offer was certain of acceptance. It is understood that, before Mr. Chamberlain left the Colonial Office, an undertaking was arrived at on behalf of the British Government that the offer would at least receive most careful consideration. It was added, however, that it would be impossible for the Government to interest itself directly in the production of nickel, but it was pointed out that there would be no objection to the insertion in all contracts issued by the Admiralty and the War Office of a clause specifying that the nickel used in the manufacture of guns and armor-plate should be of British origin and production. France would then probably take steps to reserve the nickel of New Caledonia for her own use, so that the whole supply of the world would practically be in the hands of Great Britain and France. Other countries would have to take what was left at an enhanced price, after the two powers had satisfied their wants. The International Trust would, of course, continue to work its freehold property, but under a severe handicap.

THE BRITISH ENGINEERS' VISIT TO CANADA.

As we go to press, a party of over one hundred members of the British Institution of Civil Engineers is on its way to the International Engineering Congress, to be held in St. Louis the first week in October. The itinerary was so arranged as to include a trip through part of Canada, visiting Montreal, Quebec, Ottawa, Toronto, and Niagara Falls.

The Institution is nearly a century old, and for the first time the members have, as a body, left their headquarters in Great George St., London, and gone abroad. They were received in New York by the American Society of Civil Engineers, at whose invitation they made the trip, and some days were spent in viewing the sights of engineering interest in and about that city.

On Monday, September 19th, the party was conveyed on a special train on the New York Central Railway from New York to Montreal, where they were received by the Canadian Society of Civil Engineers, who were their hosts throughout their visit to Canada.



Sir Wm. White, K.C.B., D.Sc., F.R.S., President, Institute of Civil Engineers.

Tuesday and Wednesday were spent in Montreal. The Canadian Pacific Railway shops were visited, where luncheon was served by the company. Special street cars then carried the party on a trip around the city. Wednesday morning the visitors were taken by special Grand Trunk train to Victoria Bridge, and after a short visit, they proceeded to Lachine, whence a boat, chartered by the city for the occasion, conveyed them to the Soulanges Canal. The return trip was by way of the rapids. In the evening a reception was tendered by the Governors, Principal, and Fellows of McGill University.

Thursday was spent in Quebec, visiting the harbor, the graving dock, the site of the new bridge, and Montmorency Falls. The party left in the evening by the Intercolonial Railway and Canada Atlantic, arriving in Ottawa the following morning.

A busy day was spent in the capital. A reception was held at the City Hall, a luncheon at Hotel Victoria, Aylmer, and a garden party at the residence of T. C. Keefer, who is a member of the Institution. The party also visited the Chaudiere.

Saturday was spent in Montreal further investigating the objects of interest in that neighborhood, and on Sunday the party travelled to Toronto by special train on the Grand Trunk. On Monday, the visitors were formally received at the City Hall and also at the Legislative Building, and a luncheon was tendered by the members of the Canadian Society. Trips around the city and sailing excursions on the bay completed the day.

On Tuesday the party left for Niagara Falls, where they investigated the power developments on both sides of the river, afterward leaving for Chicago.

Sir William White, the president of the Institution, is the head of the delegation, and responded eloquently to the addresses of welcome at the various places. For many years Sir William was chief director of construction, and also assistant controller of the navy. He left the service in 1902, being now a private naval expert. He is an enthusiastic supporter of the navy, which he regards as one of the strongest ties binding the Empire together. In his reply to the welcome by Premier Ross, he remarked that it humbled him when he learned that Ontario is about twice as great as the United Kingdom. "We cannot expand our geographical boundaries," said he, "but we make it up in ships, and we go wherever the ocean rolls, and wherever a British ship floats, there the flag of the British Empire is seen, and that flag must be respected. We claim no exclusive right to the sea, but the sea must always be open to British commerce."

Speaking for the party, Sir William said: "We have seen more than we anticipated, both in work already achieved, and work in hand, and we hear on all sides of works in contemplation. We have seen a nation in its infancy. Although your numbers are small, you have already done wonders, and are facing greater tasks in developing this part of the continent. Those of us who are blessed with this world's goods can find opportunity here for investment, with a security which, combined with patriotism, gives a field for our surplus millions that cannot be surpassed."

In proposing the healths of the King and the President of the Institution of Civil Engineers at the luncheon at Toronto, E. H. Keating, who presided, mentioned several interesting facts relative to the Institution. Among the honorary members of the council are the Emperor of Germany, the King of the Belgians, the Duke of Connaught, and Lord Kelvin, while King Edward is a patron of the Institution. The Institution is now in its 86th year, having been incorporated in the reign of George IV., "for the general advancement of mechanical science and more particularly for promoting the acquisition of that species of knowledge which constitutes the profession of the civil engineer, being the art of directing the great sources of power in nature to the use and convenience of man." The first president of the Institution was Thomas Telford, who is known in this country through his having been connected with an undertaking in Nova Scotia, which was then supposed to be of national importance, partly for the conveyance of troops. Following him there have been 39 presidents, all men of distinction, and some of world-wide reputation, such as Joshua Field, Sir William Cubitt, Robert and George Stephenson, Mr. Bateman, Lord Armstrong, Sir Frederick Bramwell, Sir Benjamin Baker, and others. Robert Stephenson was connected with the construction of the Victoria Bridge at Montreal, at that time one of the wonders of the world. Mr. Bateman constructed at Halifax one of the largest graving docks in America, where the speaker, Mr. Keating, had the honor of acting as resident chief engineer.

Following are the members of the Reception Committee of the Canadian Society of Civil Engineers: Col. W. P. Anderson, president; John Kennedy, past-president, chairman; E. H. Keating, past-president, chairman of Toronto Committee; C. H. Keefer, vice-president chairman of Ottawa Committee; St. George Boswell, B.Sc., chairman of Quebec Committee; C. B. Smith, B.Sc., chairman of Niagara Committee; E. Marceau, vice-president; K. W. Blackwell, past-president; Phelps Johnson, R. B. Owens, D.Sc.; D. Macpherson, P. W. St. George, M. J. Butler, W. McLea Walbank, B.Sc.; J. B. Porter, Ph.D.; R. J. Durley, B.Sc.; H. Irwin, C. H. McLeod, M.Sc., secretary.

The Visiting Engineers and Their Friends at the Residence of Mr. S. Nordheimer, Toronto.

The members of the visiting party were: Sir Wm. White, K.C.B., D.Sc., F.R.S., president; C. A. Brereton, member of council; Alexander Ross, member of council, chief engineer, Great Northern Railway; W. C. Unwin, B.Sc., F.R.S., member of council, professor of engineering at South Kensington; J. H. T. Tudsbery, D.Sc., member, secretary; H. T. Ashton, D.Sc., member; John A. F. Aspinall, member; J. B. Aspinall, H. O. Baldry, member; William Barrington, member; Charles E. Botley, member; J. A. Brodie, member, City Engineer of Liverpool; A. Havelock Case, member; William Collingwood, member; John D'Aeth, member, Government Engineer, Jamaica; D'Aeth, Jr.; H. H. Deane, B.A., member; C. E. W. Dodwell, B.A., member; R. A. Hadfield, member; C. P. Hogg, member; S. G. Homfray, member; H. Ross Hooper, M.A., member; R. B. Hooper, John G. Hudson, member; W. Henry Hunter, member, chief engineer, Manchester Canal; A. C. Hurtzig, member; W. H. Jaques, member; H. E. Jones, member; Joseph Lobley, member; H. A. F. MacLeod, member; Walter P. Meik, member; F. C. Murray, member; H. D. Pearsall, member; David E. Roberts, member; Leslie S. Robertson, member; Walter Rowley, member; Percival W. St. George, member; W. A. P. Tait, D.Sc., member; R. J. Thomas, member; Robert Thompson, member; G. H. Thomson, member; W. J. Turnbull, member; H. H. Wake, member; W. H. Wellsted, member; H. P. Allison, associate member; Thomas Arnold, associate member; T. Scott Anderson, associate member; C. J. Seymour Baker, associate member; Robert S. Ball, associate member; Thomas R. Bayliss, associate member; H. F. T. Bode, associate member; E. F. S. Bowen, associate member; F. W. T. Brain, associate member; W. H. Brinckman, associate member; T. Copley Calvert, associate member; J. Campbell-Thompson, associate member; Alfred Chatterton, B.Sc., associate member, Madras, India; Francis G. Coles, associate member; Arthur Coles, O. F. Wheeler Cuffe, associate member, Burma; William Eckstein, associate member; Fred. J. Edge, associate member; S. E. Fedden, associate member; J. M. Gavin, associate member; James Goodman, associate member; Robert Campbell Grant, associate member; C. D. M. Hindley, M.A., associate member; E. P. Hooley, associate member; M. Rhys Jones, associate member; H. Birch Killon, associate member; J. W. Malcolmson, associate member; Mr. Malcolmson, Jr.; R. J. Gifford Read, associate member; Frank Roberts, associate member; R. W. Roberts, F.C.H., associate member; C. P. Sandberg, Jr., associate member; J. R. Sharman, associate member; E. R. Stokoe, associate member; W. C. Wallace, associate member; Francis Wilton, associate member; J. T. Middleton, associate; E. K. Middleton, Joseph Randall, associate, Woolwich dockyard; G. R. Redgrave, associate; F. C. Appleton, student; J. H. Burman, student; F. W. Cable, student; E. C. Q. Henriques, student; O. B. Lacey, student; E. T. Newton-Clare, student; L. T. Payne, student; G. B. Hunter, A. H. White, of H.M.S. Ariadne, son of Sir Wm. White; H. T. Griggs, assistant secretary.

A TIMELY WARNING.

The following circular has been issued by the Canadian Casualty and Boiler Insurance Co., and is being distributed to engineers:

We herewith enclose you a newspaper report of the recent boiler explosion at the works of the Toronto Bolt and Forge Company's mills, Toronto, which you will see was quite disastrous.

This boiler explosion is the third which has occurred during the last three months in the province of Ontario, and in each case the cause has been traced to negligence, demonstrating that boilers do explode, consequently, we now write requesting that you caution your engineer concerning the safety valves, glass water gauge, try cocks and blow-off pipes.

These should always be kept in perfect working order, the first, that it may relieve the boiler of any undue increase of pressure, the second, that the exact height of water in the boiler may always be correctly known, and, the third, that they may not leak and cause a dangerous shortness of water.

SOME USES FOR THE WASTED HEAT OF GAS ENGINES.

One of the most difficult problems in the transmitting or the generating of power is to reduce to a minimum the waste. For instance, in the steam engine every effort is made to reduce, as far as possible, the amount of heat (for heat is recognized as a form of energy) that is radiated from the steam pipes, the cylinder, etc. Not only this, but the amount of steam that is exhausted is usually returned eventually to the boiler in order to avoid heating that much cold water. It is found that the apparatus required more than pays for itself in the end.

The same precautions are used, in a different way, in the gas engine. Here, owing to the very high temperature of the burning gases, it is found inadvisable, even if it were possible, to prevent the carrying away of a portion of the heat by using cooling water, or other means. Nor has it been found possible to avoid the waste of a great deal of this heat in the escape of the burned gases when exhausted. Still, considerable progress has been made within the last twenty years in reducing the losses of this character, and thereby increasing the efficiency of the gas engine.

Mr. Dugald Clerk, the noted English expert on the subject of internal combustion engines, called attention to this very matter in a lecture delivered some months ago before the Institution of Civil Engineers. He presented a table of tests of engines from 1882 to 1900, which is given on this page.

It will be seen from this that the amount of heat transformed into work has increased from 16 per cent. to about 28 per cent., and even as high as 30 per cent. has been claimed in some cases. The amount of heat lost through the water jacket has changed from slightly over 50 per cent. to a little over 24 per cent. On the other hand, the amount of heat lost through the exhaust has increased from about 30 per cent. to about 40 per cent., or even higher. While, therefore, there has been a gradual increase in the total amount of heat utilized, yet of that portion wasted there has been a change in the proportion lost in the exhaust and that lost in the cylinder cooling.

		Heat Distribution.			
Experimenter.	Year.	Jacket. Per cent.	Exhaust. Per cent.	Difference. Per cent.	Work. Per cent.
Slaby	1882	51	31	2	16
Thurston	1884	52	15.5	15.5	17
Society of Art Trials	1888	43.2	35.5	....	22.1
" "	1888	35.2	39.8	3.9	21.1
Capper	1892	38.9	40.5	....	22.8
Robinson	1898	33	38.3	....	28.7
Humphrey	1900	24.2	48	....	27.8
Witz	1900	52	20	....	28

What to do to utilize this wasted energy is a thing that has appealed to many a user of a gas engine, after he has learned that he must not expect to be able to prevent some waste in the operation of his engine.

In the first place, the water from a water-cooled engine usually should issue from the engine cylinder at about 160 to 190° F. in order to get the best results from the engine. If the water is kept cooler, it carries away too much heat, and the object is to keep the water as hot as possible and get efficient results. If the water is kept hotter than 200° F. it is very close to the boiling temperature, and when it turns to steam in the water jacket it ceases to prevent overheating of the engine.

This hot water is used for a number of purposes. Factory employees use it for washing purposes. Where low pressure boilers are used for heating or other service, as in steam laundries, the hot water is carried to the boiler just as the condensed water from a steam engine exhaust is returned to the boilers.

When used in hot water heating pipes the water will do more or less heating, depending on the size of the engine. In some factories, flour mills and elevators it is not necessary or desirable to maintain a very great heat, even in cold weather, for the employees are working and do not require very much heat, unless the weather is very cold. In such cases the hot water, combined with the use of the exhaust, as will be described later, will usually suffice for heating service at least the greater portion of the year, unless a very large building is used. Many small machine shops use such a system with the best of satisfaction.

In pattern shops the hot water is used to heat the glue pots. In fact, almost any requirement for a medium quantity of hot or warm water can be met by utilizing this waste water from the engine.

Of course, where a water tank is used it is often not advisable to use the water for the reason that by returning it to the tank it reaches the engine again before getting as cold as fresh water would be, and there is less heat carried away than if only cold water entered the cylinder. But in such cases the water may still be used for heating purposes by passing it through radiating pipes before returning to the supply tank.

The exhaust gases from the engine may also be utilized in heating service by passing the hot water pipes through the exhaust pot, or muffler, close to the engine. In such cases the pot, or muffler, must be of sufficient size to permit a free escape of the burned gases without excessive back pressure. In other words, if the usual exhaust pot is of the proper dimensions to permit of easy escape of the exhaust, the insertion of a number of hot water pipes might so reduce the cubical contents of the exhaust pot as to be equivalent to using too small a pot, resulting in back pressure and its accompanying difficulties.

One of the common uses of the exhaust gases in regions where low-grade liquid fuels, such as crude oil, are used is to pass the exhaust through the generator, and thereby furnish the necessary heat to assist in the vaporization of the fuel.

In some cases it has been found advantageous to use heated air, or warm air, in very cold weather, and at least one engine company has supplied a three-way valve whereby cold air, hot air, or both cold and hot air may be drawn in by the engine. The air is heated by having come in contact with the exhaust pipe before reaching the valve.

There are numerous ways in which the heat usually wasted in the cooling water or the exhaust can be utilized. In fact, there is hardly a plant, where a gas or gasoline engine is in use, that does not require heat or hot water more or less of the time, and surely there is no excuse in such cases for not using what otherwise becomes a waste. By the advantageous use of the heat from the engine conveniences may often be devised as well as effecting a saving of money otherwise made necessary.—Albert Strittmatter, in The Gas Engine.

INDUSTRIAL NOTES.

Listowel, Ont., will erect a library building at a cost of $10,000.

R. Gillis' woodworking factory, at Sydney, N.S., which was destroyed by fire in August, is again running.

The first blast furnace of the Nova Scotia Steel and Coal Co., at Sydney Mines, was blown in on August 30th.

The Soo ˙eel plant resumed operations on August 23rd, and is now making steel rails at the rate of 500 tons per day.

The Dominion Atlantic Railway intend erecting a 200-room hotel, at Digby, N.S., to be ready for next year's tourist travel.

The Nipissing Foundry and Machine Co. are erecting a machine shop, 25 by 40 feet, and a foundry 35 by 50 feet, in North Bay.

Oil is being struck in several new wells in Moore Township, Lambton County, Ont. Over twenty drilling rigs are at work in the field.

The compounding department of the Canadian General Electric Co.'s works, at Peterborough, was gutted by fire on September 2nd.

The Art Metal Co., of Galt, is beginning the manufacture of metal shingles and sidings. This is the fourth company in Ontario making these goods.

Arrangements are being made to put the Canada Cabinet Co., of Gananoque, again on a business footing. The company has been shown to be solvent.

The Government is paying steel bounties to firms at the Soo, Sydney, Hamilton, Midland, Deseronto, Radnor, Drummondville, and some minor places. The rate is now $2.75 per ton.

On October 4th, Waterloo is to vote on a by-law granting a loan of $16,000 to the Canada Furniture Manufacturers, to enable them to rebuild their factory in that town, recently destroyed by fire.

The Imperial Dry Dock Co., of St. John, propose erecting a large dry dock at that city. The company expects to receive subsidies from the Dominion and Provincial Governments and from St. John.

Clark & Demill, of Galt, manufacturers of woodworking machinery, may move to Hespeler. The business is growing too large for the present premises, and Hespeler is offering the inducement of a $15,000 loan. A by-law ratifying the offer will shortly be put to a vote.

The Edmonton, N.W.T., Brewing and Malting Co. has ordered from Chicago an outfit of machinery for a new malting house.

The puddlers and rollers in the Hamilton Steel and Iron Company's works have struck against a reduction of 7½c. in their wages.

The peat plant at Caledonia Springs, Ont., erected by Alex. Dobson, of Beaverton, is almost completed. It is the largest plant yet erected in Canada.

The Ontario Lantern Co., Hamilton, suffered by fire to the extent of about $10,000 last month. A wing of the building was gutted and some valuable machinery damaged.

Fairbanks, Morse & Co. are looking for a location for a Canadian branch factory. F. H. Crane, their representative, was well impressed with Fort William as a site.

The Dominion Iron and Steel Co. have started blowing in their blast furnaces, which have been idle since the strike in the summer. They expect to have all four working by Oct. 1st.

The Toledo Stock Company, which manufactures shovels and kindred hardware, is contemplating a Canadian branch employing about 150 hands, to be located probably at Hamilton.

The Guelph Axle Works have added a spring making plant to their equipment, and will be known in future as the Guelph Spring and Axle Co. The new building is 120 by 40 feet, and equipped throughout with high-class machinery.

There will be over 400 individual claimants for the bounty on crude oil of 1½ cents per gallon. There are some 2,000 producing wells in Ontario, but many groups of these are owned by companies.

The five woolen mills properties of the Canada Woolen Mills, Limited, have been purchased by Wm. D. Long, of Long & Bisby, wool dealers, Hamilton, for $253,000. The mills will be reorganized under new management.

Malcolm Booth, a Yale graduate at Yarmouth, N.S., has developed a peat process, by which the raw material is dried, compressed, and coked. Tests of the peat coke have been made at the Yarmouth Street Railway Co.'s power house, and on one of the naval launches at Halifax, and reports show the fuel to be a steam producer equal to, or better, than Welsh coal.

The J. A. Craig Lubricant Co., Limited, of Toronto, to whom a charter has recently been granted, are putting on the market an improvement in oil and grease compounding which they believe will revolutionize the business. They have testimonials from some large manufacturers and mill men as to reduction in lubricating accounts by fully one-half, by the use of this compound.

The introduction of the $7 duty on steel rails has led to the revival of the rumor that the United States Steel Corporation is collecting data as to the feasibility of establishing a plant in Canada. The plant, if established, would include a steel rail mill, blast furnaces, and finishing department, and would cost about $12,000,000.

Heavy rains raised the water in the Chaudiere almost to the level of spring freshets, and the temporary works erected across the river and the coffer dam and machinery in connection with the railway bridge under construction were swept away on September 4th. This bridge was part of the work of the Quebec Bridge Company, and was intended to connect the railway lines east of the Chaudiere with the main bridge across the St. Lawrence river. The loss to the contractors will be heavy, as it practically destroys their summer's work at that point.

The first meeting of the Northern Iron and Steel Company, Limited, successors to the Cramp Steel Company, Limited, of Collingwood, was held in Toronto on the 22nd ult. The following officers were elected for the new company: Major J. A. Currie, president; Duncan Donald, secretary-treasurer; F. Asa Hall, J. T. Duguid and W. J. Lindsay, directors. The rolling mills, steel furnaces and other plant will be formally turned over to the new corporation at once.

—The first autumn session of the Canadian Society of Civil Engineers will take place on the evening of the 13th inst. at the Society's rooms, in Montreal.

MINING MATTERS.

A discovery of gold is reported from Shelburne, Ont.

Two new iron zones are reported in McTavish Township, New Ontario.

Two Melbourne inventors claim to have a process for producing steel from ore without making pig iron.

C. A. Millican, C.E., has been making surveys for a branch line to the gypsum beds of the Little Saskatchewan.

Rich strikes of copper sulphide ore have been made at Franklin Camp, forty-five miles north of Grand Forks, B.C.

An ore consisting of a mixture of specular red hematite and brown hematite, averaging 64 per cent., is being mined at Barrasois, N.S.

A large mica mine, near Cantley, Ont., owned by J. D. King, has been sold to the Westinghouse Co., of Pittsburg, who will begin extensive operations.

The Nova Scotia Steel and Coal Co. will begin mining dolomite in the George's river district, the product to be shipped to the steel works at Sydney Mines.

The coal mine, at Cochran's Lake, C.B., is now being worked by English capitalists. Mining operations are being pushed, and the quality of the coal is improving as the work proceeds.

The joint committee inspecting geological formations in Michigan and New Ontario on behalf of the United States and Ontario Governments have agreed on a common nomenclature for various formations.

The Government bounty on lead is developing that industry in Eastern Canada. A smelter has been erected at Bannockburn, Ont., and the owners are prepared to compete with British Columbia producers for the Canadian market.

A deposit of tin over a mile in length, and from 50 to 100 feet wide, is reported to have been located in eastern Manitoba, south of Cross Lake, about twelve miles from the Ontario boundary line. This is the first tin discovered in Canada.

The Black-Donald graphite mine, near Calabogie, Ont., which was flooded two years ago, is being pumped out by the Globe Refining Co. The company has a factory containing $250,000 worth of machinery, and water-power capable of developing 1,000-h.p.

Deposits of zinc in the vicinity of Quatsino Sound, B.C., have been investigated by a representative of the Lanyon Zinc Co., of Iola, Kansas. Some samples from the deposits run 50 per cent. in zinc. It is thought that the company will develop the property, shipping the ore to their works in Kansas.

One of the Montana smelting companies is now putting up an electrical smelter, and if successful, others will probably follow the example. Thus the market for coke in that region will be reduced, but the Crow's Nest Pass Coal Co., whose coke ovens are 600 miles from these works, are laying plans to supply a share of the Montana market, which requires several hundred tons a day.

Under the auspices of the Provincial Bureau of Mines, a summer mining class for the benefit of the prospectors and miners, was held at the camp of the Laurentian Mining Co., near Gold Rock. The instructors were: Professor W. L. Goodwin, director of the School of Mining, Kingston, and J. Walter Bain, a graduate of the School of Practical Science, Toronto.

The Big Master Mining Co., operating near Gold Rock, Rainy River district, has been incorporated in New York, with a capital of $300,000. The provisional directors are: F. J. Kendrick, of Mount Clemens, Mich.; C. P. Russell, of Cincinnati, Ohio; B. Hammond, of Fishkill; W. Schaler, of Albany; and G. V. Blackstone, Jamestown, N.Y. The offices are at Fishkill, N.Y. The mine has been worked intermittently since the fall of 1902, and produces ore worth about $8 per ton.

Different deputations of marine experts have examined the Turbinia during the summer, and the results in every case have been most satisfactory. A board of naval engineers from the United States have examined the boat, and will advise the use of turbine engines in scout ships.

RAILWAY NOTES

The Pressed Steel Car Co. will erect a shop in Montreal.

The Pere Marquette shops in St. Thomas are approaching completion.

Construction has commenced near Richmond Hill at the Toronto end of the James' Bay Railway.

A company is about to instal automobile stage lines in New York City, in competition with the street railway systems. A three-cent fare will be charged.

The Canadian Pacific has leased for 999 years a twenty-one mile line of the Northern Colonization Co., terminating at Nominingue, Que.

The Toronto and Mimico Railway is to run through Lorne Park, subject to certain conditions relative to speed, crossings, and automatic signals.

Negotiations are in progress for the construction of a railway in Southeast Kootenay, B.C., to open up the coal lands on the Flathead river.

As forecast in the Canadian Engineer recently, the Canada Atlantic has now passed into the control of the Grand Trunk Railway, to be used in connection with the transcontinental system.

The passenger rolling stock of the Pere Marquette Railway, on the London and Port Stanley line, will be renewed before next summer. The condition of the present cars has been the subject of complaints from the city of London, the owner of the line.

The Interborough Rapid Transit Co., of New York, will equip all elevated trains with a controller such that with the removal of pressure on the handle, power will be shut off and the brakes set. The object is to avoid danger in the case of a motorman's sudden death or his falling asleep.

The Locomotive and Machine Company, of Montreal, have turned out the first two large locomotives for the Grand Trunk Railway. The railway had their own engineers superintending the entire construction of the engines, and in taking them over expressed entire satisfaction.

The Ontario Railway Taxation Commission met representatives of the railways on September 16th, when Chairman Pettypiece intimated that the companies will be expected to contribute $2,000,000 in provincial taxes. Statements by the railways will be presented at a meeting to be held on October 8th.

The New Brunswick Southern Railway are about to improve the metal bridges of their system. Contracts for steel structures for the crossings at Meadow Brook, Lepreau, Big New River, and Lilly Brook have just been closed with the Dominion Bridge Company, of Montreal, and the shop inspection work placed in charge of the DeLano-Osborn Engineering Co., of Toronto.

On September 1st, the Hamilton street railway withdrew the scale of limited (8 for 25c.) tickets to any but "workingmen," and also stopped the sale of such tickets on the cars. The city has applied to the courts for an interpretation of its contract with the company. The court has ordered the sale of the tickets on the cars, but the question of discrimination of passengers is left to the trial judge.

The Canadian Northern has filed plans for its proposed air line from Hartney to Regina. The line, which is 198 miles long, will cross the Manitoba boundary into the Territories on section 1, township 10, range 30 west, and will run in an almost air line northwest to Regina, about midway between the C.P.R. main line and the Arcola branch. It will pass through or near the post offices of Kissina, Montgomery, Montmartre and Hicksvale.

Some of our railroads are reported to be working a scheme by which they will comply with the letter of the law and yet avoid the duty on steel rails. They are getting in large shipments this month, and will lay these rails on their main lines in substitution of the present ones, which will be set aside for use on branches and extensions. The law states that rails bought before the passage of the order-in-council, imported before November 1st, and laid before February 1st, are exempt from the new duty.

Construction work is beginning on the Klondyke Mines Railway, recently financed in London, England, by E. C. Hawkins, formerly manager of the White Pass and Yukon Railway.

H. Osborne has been appointed general superintendent of the new Angus shops of the C.P.R. in Montreal. At the same time, the position of master mechanic of the Delorimier shops has been abolished.

About 3,000 men are now employed on the main line of the C.N.R. from South Sackatchewan to Edmonton, a distance of 400 miles. The track layers are near Clark's Crossing, and by winter it is expected that grading will be finished to within 75 miles of Edmonton.

Hon. Charles D. Haines, of Kniderbrook, N.Y., has been in conference with the Wentworth county council regarding his project for an electric railway between Hamilton and Brantford. He does not ask for a bonus, and he is willing to put up one-third of the $300,000 required to equip the road. Ten cars would be run each way per day, and the fare would be 25 cents.

After the banquet of the Canadian Manufacturers' Association, at Montreal, last month, a special train was made up by the Grand Trunk for Toronto. Starting at 2 a.m., the train made the distance to Toronto, 333 miles, in five hours and ten minutes, the fastest time ever made between these two cities. A few years ago twelve hours was the express train time between Montreal and Toronto.

The first annual meeting of the Brockville, Westport and Northwestern Railway Company was held last month at Brockville. The president, John Gerkin, of New York, urged the extension of the road beyond Westport, and a committee was empowered to take action. The following officers were elected: John Gerkin, New York, president; Clarence P. King, Philadelphia, vice-president; Sarsten Heilshorn, New York, secretary; W. J. Curle, Brockville, superintendent.

While the railroad world is discussing the various projects of J. J. Hill to secure new feeders for his Great Northern line from Canadian territory, no attention has been paid to the work done in southern Alberta. The line from Lethbridge to Coutts, with its westward extension to Cardston, is being considerably improved, and the narrow gauge railway is being transformed into a standard gauge. Parties of surveyors are locating a line to the Crow's Nest Pass, which would meet the Hill lines in British Columbia, at Fernie. At the rate of construction, this link will be completed next year, and then the coal and other minerals of the Kootenay will have an eastern outlet to the American frontier, which will be shorter to reach the markets of Montana, Dakota, Nebraska, and Iowa. At the present time, the coal of the Kootenays has little chance to compete with Galt coal in southern markets, but the new line will make a great change. It should develop a great local trade between the farming section of southern Alberta and the British Columbia mines.—Winnipeg Free Press.

MARINE NEWS.

Steamer Viking, from Halifax, for Hamilton Inlet, Labrador, went ashore near Belle Isle.

The Hazel Dollar Steamship Co. has been incorporated in British Columbia, with a capital of $200,000.

Canadian Lines, Limited, has inaugurated a direct steamship service between Canada and France.

It is reported that the Turbine Steamship Co. will next season put a second turbine boat in commission on Lake Ontario.

The Dominion Atlantic Railway intend establishing a line of steamers from Boston to Digby, N.S., where they are erecting a hotel.

The Russian barquentine, Neikelson, 450 tons, with salt, for Shediac, went ashore near Louisburg, C.B., on September 4th, and is a total loss.

Plans for the new lift lock at Kirkfield, on the Lake Simcoe section of the Trent Canal, will soon be complete, when tenders will be called for.

A. A. Wright, M.P., is engaging a party of men to conduct a preliminary survey of the Ottawa and Georgian Bay Canal for the Government.

A typographical error in this column last month made us say that the Dominion Coal Co. would build steamers capable of carrying 1,500,000 to 2,000,000 tons of coal. As the reader would perhaps guess, the item should have stated that this capacity is per season, not per cargo.

The Dominion Government is taking over control of certain waters in Victoria, Haliburton, Peterborough, and Hastings Counties, which act as feeders for the Trent Canal system. By the use of dams, several lakes have been converted into reservoirs, and these works will be enlarged. An agreement with the Provincial Government will protect the rights of all concerned.

The steamer Arctic (formerly Gauss), left Quebec on September 17th for a three years' cruise in northern Canadian waters. Major Moodie is commander-in-chief of the expedition, Inspector Pelletier is head officer of the Mounted Police detachment on board, and Capt. Bernier is sailing master. Some doubt has been expressed as to whether the Arctic will be able to reach Fullerton before the close of navigation. For the first year the Arctic will confine its explorations to Hudson Bay, Hudson Straits, Davis Strait and Baffin's Bay, and will not go further north than Kennedy Strait.

Galveston, Texas, has just completed a sea wall which, it is believed, will afford ample protection against such calamities as that which recently overtook the city. The wall is 17,593 feet long and is composed of crushed granite and cement, well mixed, and formed into one solid rock 17 feet high above mean low tide—16 feet wide at the base, curving in on the gulf side to 5 feet in width at the top. It is firmly founded on piling driven 40 feet to clay, with an extra row of sheet piling along the front and a rip-rap of huge granite boulders in front extending 27 feet out in the gulf. The contract price of the wall was $1,198,318.

The fisheries protection cruiser, Vigilant, for service on the Great Lakes, was launched at the Polson Iron Works on September 3rd. The Vigilant is 176 ft. on the waterline, 22 ft. beam and 14 ft. 3 in. deep. Her engines are twin-screw, triple-expansion, 13½, 22 and 36 in. cylinder diameters by 21 in. stroke. Steam is supplied from two Clyde boilers 11 ft. 6 in. in diameter by 12 ft. 8 in. long. allowed a working pressure of 200 lbs. The propellers are of Thornycroft construction. Her armament will consist of four rapid-fire guns. The steamer has a flush main deck and bulkheads with a ram bow and elliptical stern of a design similar to the cruisers in the British navy. She has a commodious deck house aft of the foremast containing chart room and gallery, and also a deck house abaft the main mast. The bridge extends from the forward deck house to the ship's side. The vessel is schooner rigged with jib, head, 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 a powerful searchlight. Her cost complete will be about $150,000.

Hon. Chas. Hyman, Acting Minister of Public Works, has made the following appointments on the surveys along the route of the proposed Ottawa and Georgian Bay Canal from North Bay to Montreal. The chief engineer will be E. D. Lafleur, and the engineer in charge A. St. Laurent. The divisional engineers will be: Nipissing Division, J. Chapleau, Ottawa; Ottawa Division, E. J. Ramboth, Quebec; Montreal Division, Geo. P. Brophy, Ottawa. The following will be sectional engineers: E. E. Perrault, North Bay; Wm. Cross, Toronto Junction; C. E. McNaughton, Montreal; L. R. Voligny, Ottawa; H. P. Bell, Victoria, B.C.; A. C. MacDougall, Ottawa; Geo. L. Griffith, Winnipeg; A. Robert, Ottawa. The following are first assistants to the sectional engineers: E. A. Forward, Iroquois; A. J. McDougall, Cornwall; J. H. Armstrong, St. Catharines; C. R. Cortlee, New Glasgow, N.S.; A. L. Ghysens, Montreal; Mr. Jennings, Toronto; R. H. Barrett, Pembroke. The following are second assistants: C. H. Mathewson, London; E. H. Pense, Kingston; A. Birch, Westmount, Que.; S. Ouimet, St. Rose, Que.; F. R. Smith, Chatham; E. G. Goodspeed, Penniac, N.B.; P. Davis, Windsor, Ont.; Henry Robertson, Montmagny, Que.; Edgar Miles, Fredericton, N.B.

The Niagara Navigation Co., which has had very trifling losses by accident in the past few seasons, had its first mishap this summer on the 26th ult., when the Chicora had a piston-rod broken and a cylinder head stove in. The damage was estimated at $10,000 to $15,000. The Chippewa, which was laid up for the season, has been put on the route to take the Chicora's place. Through the prompt work of the engineer, the disabled steamer was brought into Toronto under her own steam.

MUNICIPAL WORKS, ETC.

Montreal is to establish a municipal insurance fund.

Whitby has recently purchased its electric light plant.

The city engineer of Ottawa has recommended an improvement in the waterworks amounting to about $7,000.

Wentworth County has bought the last toll road in the district, the Barton street road. The price paid was $6,000.

The Waterous Engine Works Co., of Brantford, have been awarded the contract for two fire engines at $13,440 each for the city of Toronto.

The Allis-Chambers-Bullock Co. has the contract for the pumps for the Medicine Hat waterworks. These will be installed before December 15th.

A special committee on renaming and renumbering Toronto's streets has decided on a block plan, and will recommend a by-law to permit of the work being proceeded with at once.

A system of waterworks and sewage is being rapidly constructed at Lethbridge, N.W.T. The town also has a system of irrigation ditches used for watering trees, lawns and gardens.

Hamilton has just put its new James street reservoir in commission. The reservoir is 240 feet above lake level, and has a capacity of two and a half million gallons. The sides and bottom are constructed of concrete.

A C.P.R. official has been in Morden, Man., looking over the ground with a view to placing a long distance telephone on their line, which would be operated in connection with a municipal telephone system in the town.

St. Thomas intends to purchase the gas and electric plants from the operating company. The offer of the city has been refused and arbitrators have been appointed. T. W. Curry is arbitrator for the city, Judge Morgan for the company, and Judge Snider the third arbitrator.

The Toronto delegation, which visited various United States cities, investigating fire-fighting appliances, has returned and presented its report which calls for a separate water-main system in the business part of the city; the purchase of a fire-boat, and three 750-gallon steam fire engines and an addition of fifty men to the fire brigade.

St. Thomas has managed its own street railway for nearly two years. Last year the road just paid its way, and this year there will be a small surplus, which would have been very much larger if last winter had not been so severe. eight tickets are sold for twenty-five cents, and limited tickets ten for a quarter. It is proposed to extend the line to Port Stanley.

The Ontario Municipal Association met in Toronto on September 8th. Among other business they passed a resolution favoring Government purchase of trunk telephone lines, and approved a scheme for a Dominion Municipal Insurance Corporation. Officers were elected as follows: Mayor W. A. Boys, of Barrie, president; Mayor Greer, of Owen Sound; Controller Hubbard, and the Mayor of Belleville, vice-presidents, and S. H. Kent, Hamilton, secretary.

The Montreal Gas Co.'s franchise expires in May, 1905, at which time the city has the option to purchase the plant at a price to be fixed by the experts, provided six months' notice is given, failing which, the franchise continues for five years. The city council will probably introduce a by-law shortly, and submit it to the ratepayers, so as to be able to give notice before November 1st. Prices of gas are now $1.20 per thousand for illuminating, and $1 for cooking.

Oshawa has begun the construction of a waterworks system.

Newton Ker, city engineer of Ottawa, was recently offered the position of engineer on the G.T.P., between Winnipeg and Lake Nepigon, but the city council retained him by increasing his salary to $3,800, with an annual increase up to $4,000 should he remain in the city's employ.

The reclamation of the drowned lands in Osgoode Township, Carleton County, is progressing steadily. The work of dredging Castor river, which covers an extent of about fourteen miles, is about half completed. By the dredging of the Castor the water is allowed to return to its natural channel, and hundreds of acres of land are being reclaimed for cultivation.

In a report to council, a few days ago, George Janin, superintendent of the Montreal Waterworks, stated that a new battery of three Caldwell boilers, recently ordered by the city, is being built. These boilers are destined to replace the condemned battery of three Lancashire boilers and to supplement the work of the other boilers, when the turbine pumping decreases. The pumps at the low level station raise the water up to the main reservoir of the city, situated at an altitude of 204 feet above the river, and 165 feet above the intake basin of the low level pumping station. A building erected on the land adjoining the above mentioned reservoir contains the high level pumping machines, which consist of two pumps operated by steam. A Worthington power pump, worked by electricity, which has been recently added, is prohibited from being used at present by an order of the court, on account of the inconveniences of the neighborhood from its vibrations. An arrangement is likely to be arrived at whereby the electric pump will be moved to the wheel house.

Regina, the capital of the North-West Territories, which two years ago contained 2,500 inhabitants, now has a population of 7,000. In 1902 that city collected taxes on a valuation of $998,000. In 1903 it had grown to $1,024,966, and in 1904 the taxable value of the real estate within the city limits amounted to the sum of $1,872,630. The value of new buildings erected during the present year amount to no less than $311,730. The city is putting in an electric light plant, the power house of which is now finished. The system will be ready for operation about the end of the year. A water and sewage system is also being installed at a cost of over $15,000. It is a gravitation system, the source being a stream in a series of hills about seven miles distant. This source, which was recommended by John Galt, of Toronto, the designer of the system, although criticized locally, has turned out far better than anticipated both in quantity and quality. The water system will be complete by the new year, and work on the sewage system will be begun in the spring. All these utilities are owned by the municipality. The Arcola extension of the C.P.R. will be opened up for traffic in October, thus bringing another very rich section of country into touch with Regina. The completion of the Canadian Northern Railway, from Hartney to Regina, will make Regina an important railway centre.

TELEPHONE AND TELEGRAPH.

The Grand Trunk Railway has put in a telephone line between Palmerston and Owen Sound and Wiarton. The same wire is used for telegraphing.

Since the decision of the Brantford City Council to instal a municipal telephone plant, the Stark Telephone, Light and Power System, Limited, of Toronto, has sent in a revised offer, which has led to the council rescinding the by-law for municipal ownership, and the city will receive tenders for a franchise until October 18th. The Stark Co., in their offer, agree not to sell to or amalgamate with the Bell Telephone Co. or their successors.

The light and telephone system of the Stark Co. is now being installed in Toronto Junction. The first two stations were put into operation on September 30th This is the first public system using an automatic system to operate in Canada.

The Pittsburg Railway Co. is experimenting with telephones in street cars.

The town of Neepawa, Manitoba, is practically doubling its public service telephone system by rebuilding its line construction, putting in a large amount of lead-covered cables in its main leads and putting in an enlarged self-restoring drop central office equipment. The construction work and installation is being done under the supervision of J. A. Gordon, of the International Telephone Mfg. Co., Chicago.

A Marconi wireless telegraph station is to be erected immediately at Cape Ray, Nfld. Cape Race will then be similarly guarded, and it is expected that these two stations will be finished by the end of October. It is intended also to have stations at Sable Island and Canso before winter. The St. Lawrence stations will be closed for the winter.

The American De Forest Wireless Telegraph Co. has recently purchased abandoned Marconi stations in Chicago, and in Havana, Cuba. The De Forest Co. claim to have a perfectly satisfactory tuning device, thus solving one of the greatest problems of wireless communication. Ten stations on the St. Louis Fair grounds are working satisfactorily, and recently an overland record was made when messages were sent from St. Louis to Chicago, a distance of over 300 miles. In the United States the De Forest system seems to be proving superior to the Marconi system, and large holders of Marconi stock appear anxious to unload.

LIGHT, HEAT, POWER, ETC.

Natural gas was struck at Highland Creek, Ont., recently.

The Canadian Westinghouse Co. has located its Winnipeg offices, which will be in the new Union Bank building, the first of Wininpeg's sky-scrapers.

A company has purchased the water power in the Gaspereaux River, N.S., and proposes to furnish light to the entire western peninsula of the Province.

St. Andrew's and Carillon, Argenteuil County, Quebec, are to have electric light. The power is taken from the North River at Isle au Chats, west channel, and is being carried out by the Selby Company, of Montreal.

A power house for the Berlin and Waterloo Street Railway Co. is to be completed by December 1st. The main building will be 88 x 30 and the boiler-house 30 x 40. The plant will have a capacity of about 200 horse-power.

The North Bay electric light plant, owned by John Bourke, has been sold to a syndicate of which A. F. Leggatt, president of the North Bay Gas Co., is the representative. The company will control the gas and electric lighting business of the town.

M. P. Davis is duplicating the machinery in the power house at Cornwall, Ont. This will give a total of 2,000 horse-power, which will allow for the new demands which will be made when the new paper mill and new cotton mill are running.

The Woodstock Railway, Electric Light and Power Co., of Woodstock, N.B., is constructing a wood and concrete power dam, about two miles from that town, on the Meduxnakitt river. The dam is 420 feet from bank to bank with a 175-foot spillway, 25 feet above low water. 500-h.p. will be developed. Work was begun in June and the company expects to deliver power by December.

The Canadian Westinghouse Company, Limited, of Hamilton, Canada, have opened offices in Winnipeg, Man. The offices are located in the Union Bank Building. The representative in charge of the district covered by this office is W. E. Skinner, who was formerly associated with the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa.

The American Conduit Company, Manhattan Building, Chicago, has been awarded a contract by the Electrical Commission of Baltimore to furnish that city with 200,000 feet of bituminized fibre conduit. This contract was awarded after a series of exhaustive tests and investigations, and thus forms another link in the chain of evidence favorable to bituminized fibre conduit for underground construction.

On the 9th ult. one of the large generators of the Toronto Railway Co., costing nearly $40,000, was burnt out. The short-circuiting of some of the underground wires was reported to be the cause.

On the 14th ult. contracts were awarded for the power distributing station to be erected for the Toronto and Niagara Power Company on the Davenport road, just outside the city limits of Toronto. The cost will be slightly over $100,000, the building to be completed in a year. Among the successful tenderers were: E. Gearing, for brick, stone, cement, carpenter and cut stone work; J. Gillen, the galvanized iron work; the Canada Foundry Company, the steel and iron work.

In order to handle their rapidly increasing business, the Packard Electrical Company, Limited, of St. Catharines, Ont., have recently organized and greatly enlarged their Sales Department, the management of which has been given to George C. Rough, formerly manager of the eastern office in Montreal. Cecil Doutre, who is favorably known to the electrical trade, will look after the interests of the company in the East, occupying the place vacated by Mr. Rough. The Ontario district will be covered by J. M. Leamy, formerly with the Westinghouse Company, George A. Powell will continue to look after the important Western territory, as manager of the Western office in Winnipeg. L. R. Grimshaw will prove an invaluable addition to the office end of the Sales Department, at St. Catharines.

PERSONAL.

James Bannan, engineer at Toronto City Hall, has been elected fourth vice-president of the International Union of Steam Engineers.

Patrick Fitzpatrick, for fifty years lockmaster on the Lachine Canal, died last month at the age of 73. He succeeded his father as lockmaster.

L. B. McFarland, of Montreal, was elected to the Executive Committee of the Old Time Telegraphers' Association, at a convention held in Atlanta, Ga.

A. Price, C.P.R. superintendent of Fort William, formerly of Toronto, has been appointed superintendent of transportation of the western lines, with headquarters at Winnipeg.

R. C. Carter, general manager of the Bay of Quinte Railway, the Oshawa Railway, Thousand Island Railway, and the Deseronto Navigation Company, died of paralysis a few weeks ago.

William King, late general storekeeper of the Dominion Iron and Steel Co., is now superintendent of the American Asbestos and Mining Company, Black Lake, P.Q., in which Henry M. Whitney is interested.

Clark Caryl Haskins, well-known in the electrical world as writer and inventor, is dead. His most notable achievement was evolving the multiple switchboard, now used for telephones all over the world.

John Stewart, of Woodstock, N.B., died on September 6th. Mr. Stewart became superintendent of the New Brunswick Railway System in 1882, and in 1890, when the C.P.R. took over the system, he was made superintendent of the Northern Division.

There is an agitation in Montreal to erect a memorial to John Young, the father of the St. Lawrence canal system and several other public works. He inaugurated the Victoria Bridge, and the subsidizing of the line from Montreal to Liverpool, and his efforts had much to do with the inception of the Intercolonial Railway and the holding of the London Exhibition of 1851. In 1851, Mr. Young held the portfolio of Commissioner of Public Works.

A. McPhail, B.Sc., has been appointed professor of general engineering, and W. O. Tague lecturer in mechanical engineering in the School of Mining, Kingston. Mr. McPhail graduated from McGill University with honors. He has recently been engaged in large engineering works in the vicinity of Boston. Mr. Tague is a graduate of the Massachusetts Institute of Technology. After his graduation he spent a summer abroad, visiting large manufacturing concerns and foreign shipyards. He has been recently employed by the New York Shipbuilding Co. and Fore River Shipbuilding Co., Quincy, Mass.

Wm. Irving, a former city engineer of Kingston, Ont., died a few days ago at Riverside, California.

Charles Brandeis, electrical and mechanical engineer, of Montreal, has moved into more spacious offices in the Guardian Building.

E. J. Pennington, inventor, and promoter of automobile, air ship, and other companies with big claims, was recently arrested in St. Louis for conspiracy and fraud. Last year he visited Toronto and claiming to have millions behind him, attempted to exploit a company, but was not successful.

Dr. Hans Goldschmidt, inventor of Thermit, for which Wm. Abbott, of Montreal, is the Canadian agent, will visit the United States, as delegate of the Bunsen Society, and as such will attend the International Electrical Congress at St. Louis. A lecture with numerous demonstrations on his invention, Alumino-Thermics, will be one of the features of the congress.

J. H. McClellan, of Peterborough, has been appointed superintendent of the Trent Valley Canal. Mr. McClellan ran for Parliament at the last election, and is one of the most prominent business men in the Trent Valley. He was at one time manager for the Dominion Bank, and entered commercial life as a grain merchant. He afterwards built Pickering harbor, and conducted a large grain buying and shipping business there until he removed to the City of Peterborough. He was the managing director of the Peterborough Fuel and Cartage Co.

R. L. Newman, of New York, has taken a position as consulting engineer for the Victoria Machinery Depot, Victoria, B.C. Mr. Newman is a shipbuilder of wide experience, having at various times been with John Penn & Sons, Greenwich, Earl's Shipbuilding Co., Hull; Mandsley Sons & Field, London; Cramp Shipbuilding Co., N.J., and the American Shipbuilding Co., Cleveland. He has recently been general manager for the New York Shipbuilding Co., of Camden, N.J. Mr. Newman has worked on the designing and construction of ships for the navies of England, Italy, Spain, United States, Russia, Peru, Brazil, and other countries.

PEAT PAPER.

The February number of the Pulp and Paper Magazine of Canada, contained an article on experiments that have been made in this country and in Ireland recently in the manufacture of paper boards from peat. Since the experimental machine set up by Mr. Dobson at Beaverton, the erection of a factory having three machines with a capacity of 30 tons of "half-stuff" per day has been started at Cannington, near the south-east shore of Lake Simcoe, and is soon to be in operation, under the auspices of the same gentleman. The report of the Ontario Bureau of Mines for 1904, recently issued, speaks encouragingly of this industry, though in view of the collapse of the experimental factory in Ireland, and the failure, commercially speaking, of experiments in this field in the Eastern States, it must be admitted that there are difficulties yet to overcome. The remarkable capacity of sphagnum—from which plant the peat beds are formed—for absorbing and retaining moisture, is one of the problems to solve; but no doubt human ingenuity will be equal to the case. As a substitute for other fibres in the making of imitation leather, as well as for paper boards, there would appear to be a distinct field for peat, and the samples used by some Canadian shoe manufacturers for the filling of boot soles and heels are said to be a great improvement over other leather substitutes. This process is the invention of an Austrian, who died this year, but the works established at Admont, Austria, for exploiting the process, are reported to be a commercial success. The cost of making boards there is given as $9 a ton, but in Ontario the cost is calculated to be $12.50 or about half the price of strawboard and less than half that of board made from wood pulp. At the works at Cannington, it is proposed to make card board, leather board, fibre board, and other lines now made from straw and wood pulp. A sample made at Beaverton is on view at the office of the Pulp and Paper Magazine, and though it is made of a mixture of peat and wood pulp, it is much stronger than ordinary board, and experts say it will make an admirable board for bookbinders' use. Canada is as wealthy in the raw material of this product as she is in pulpwood, for millions of tons of peat are to be found in various provinces, more especially in Northern Ontario and Quebec.

REMOVING METAL SPLINTERS FROM THE EYE.

The ragged chips and splinters which are separated during the processes of turning and chipping off, often find their way into the eye, and are sometimes very difficult to remove. The use of magnets has been recommended, but even the strongest magnet is entirely inefficient, if the splinters be imbedded. We have found a fine, sharp knife the best instrument, but it requires skill and a steady hand. The best method in the hands of the inexperienced is that which a London surgeon thus describes in the Lancet: "In consequence of the difficulty I experienced in removing from a patient a portion of steel deeply bedded in the cornea, which did not yield to spud or needle, some other means of removal became necessary. Dry, soft, white silk waste suggested itself to me, and was wound around a thin piece of wood so as to completely envelop its end. This soft application was brushed once backwards and forwards horizontally over the part of the cornea where the foreign substance seemed fixed. To my astonishment it was at once entangled by the delicate but strong meshes of the silk, and was withdrawn with the greatest ease, caught by the same. A gentleman in turning steel at a lathe suddenly felt that a portion had entered his eye. He went at once to a surgeon, who, with the most skilful manipulation, failed to extract the same, saying it would soon work out of itself. The next morning the patient saw me, having suffered severely since the accident, and on the first application of the silk the steel was extracted."

GRAND TRUNK PACIFIC PROGRESS.

During the past month the Grand Trunk Pacific directors have completed their trip up the Pacific Coast. They made a general inspection of the coast from the Alaskan boundary to Bute Inlet. They went up the Portland Canal some distance, and also inspected Port Simpson and Tuck's Inlet, and ascended the Skeena river as far as Hazelton. Before coming to any conclusion as to a terminus, the directorate will await the results of surveys of the land approaches.

The construction of the main line will be pushed first and later southern feeder lines will be built. The Allan Steamship Co. will in all probability inaugurate a Pacific service with the completion of the G.T.P.

The Transcontinental Railway Commission has appointed M. J. Butler assistant chief engineer to Mr. Lumsden, and has plotted out the work of surveying the line from Moncton to Lake Abitibi. This section is divided into three districts with district engineers as follows: District A, from Moncton to the boundary between New Brunswick and Quebec, Guy C. Dunn, acting district engineer; District B, from the New Brunswick boundary to Clear Lake, Quebec, A. E. Doucet, district engineer; District C, from Clear Lake to Lake Abitibi, A. N. Molesworth, district engineer.

Twenty-seven surveying parties are being organized and will be placed on the three districts immediately. They will be located as follows: Between Moncton and Chipman, two parties; Chipman to Boiestown, one party; Chipman towards Fredericton and St. John river, one party; between Boiestown and Plaster Rock, two parties; Plaster Rock to Grand Falls, one party; Grand Falls to Edmundston, one party; Edmundston to Connor, one party; Connor to Lake Pohengamook, one party; between Lake Pohengamook, which is the boundary between New Brunswick and Quebec, and to or near Chaudiere, four parties, one at each end and two in the centre; Quebec, including both sides of the proposed bridge, one party; from there on to Clear Lake, four parties, covering about 32 miles each; from Clear Lake to the boundary between Ontario and Quebec, and south of Lake Abitibi, four parties; four parties on the route running north of Lake Abitibi, and between that and the point where the southern route converges. Alternative routes will be investigated between Grand Falls and Chipman, N.B., and also north and south of Lake Abitibi. Nine of the ten engineers to take charge of survey parties in the New Brunswick district have been selected, as follows: Charles Garden, C. Led Miles, G. R. Balloch, F. D. Maxwell, E. G. Evans, C. O. Foss, Horace Longley, N. P. Clark, Karl Weatherbe. It has been decided to secure the services of Dr. Murphy in connection with the river crossings in the province of New Brunswick.

Supplies for the survey parties in northern Quebec will be transported up the rivers. John Sunstrum will superintend this work on the Ottawa, and Allan P. McDonald on the Gatineau.

The Commission plans to have all exploratory surveys on the eastern division, that is, from Winnipeg to Moncton, completed by spring.

ON INSULATION.

It may be taken for granted that testing the insulation of an electrical machine after completion, without any previous satisfactory knowledge of the insulating materials used in its manufacture, is far from being the correct thing to do. If, then, we are to choose between the various insulating materials on the market (each of which may be good for a particular purpose), it becomes essential to institute some preliminary tests. As to what should be the nature of these tests, it would be profitable to first consider what the insulation has to do, and under what conditions. These points will determine the nature of the tests it will be profitable to make.

It will be beneficial here to note some of the conditions which have to be fulfilled by a good insulator, though it may not be absolutely necessary that one particular insulator should meet every possible condition. These conditions may be broadly divided into two classes, viz., those necessary for convenient and cheap manufacture, and those essential to the longevity or commercial efficiency of the machine.

Taking first "paints or varnishes," we find the following features desirable, if not absolutely essential: (1) They should be quick drying, and yet should not lead to great waste owing to the drying up of the solvent; (2) they should have considerable elasticity and strength; (3) have a high melting point, and should not lose their insulating properties or char with possible rises of temperature in practical use; (4) should not chemically affect the copper conductors; (5) must be waterproof and unaffected by oils, acids, and, as sometimes specified, salt water; (6) last, but not least, should be good insulators.

Secondly, with regard to insulating fibres, papers, and tapes, we know that some depend on the nature of the material for their insulating properties, whilst in others this is merely a medium for carrying an insulating "varnish or paint," and it is on this that the strength of the insulator, as such, depends. This latter class, which also includes a certain variety of tapes, should, as far as the insulating medium is concerned, with which they are impregnated fulfil the conditions enumerated above for paints and varnishes. Regarding fibres and papers in their "natural" state—i.e., not impregnated with an insulating medium—they might be approved of if they meet the following conditions: (1) They should be tough, yet pliable; (2) should not suffer excessively as insulators should they be creased; (3) they should, as far as it is possible to make them, be non-hygroscopic; (4) should be able to stand all temperatures experienced in practice without charring or reducing their insulating properties; (5) should have high insulation per mil of thickness, except where their mechanical strength is the principal consideration. It will be obvious from the varied nature of insulating materials, and also from the fact that no one material meets all conditions, that a choice has to be made of such as will best suit the varying conditions of service, both mechanically and electrically. With careful attention to this point considerable reduction in the cost of insulating materials may be effected in the manufacture of various electrical apparatus, though the cheapest insulation is not always the best.

Returning to the subject of varnishes and paints, let us look at the first of the properties required, viz., "quick drying." It will be obvious to anyone acquainted with shop methods the great saving in time and the increased output that can be obtained from a given drying stove, the more "quick drying" the insulating medium is. With this object in view resource has been made to shellac, copal and resin varnishes, using alcohol as a solvent. This would not be objectionable but for the fact that when the spirit (and also the water it carries) has been dried out, the resulting solid is too brittle. This solid under vibration or due to expansion and contraction, as the winding heats up and cools down, is in time reduced to a powder, and is then, of course, useless as an insulator. Should it be a revolving portion of a machine that is insulated with these varnishes, then centrifugal force will assist in the destruction of the insulation. Oil "varnishes" are not "quick drying" unless an objectionable amount of "dryer" is introduced. A considerable amount of waste occurs where the varnish has to be painted on coils such as are inconvenient to dip. Further, all tanks used in dipping coils should be provided with covers when not in use. Even whilst in use attention has to be paid to the consistency of the material owing to constant evaporation, and "thinners" have to be added, as when used too thick more insulation is added than is required, leading to needless expense.

2. The second property claimed is that of elasticity and strength. From this point of view all mixtures, as distinct from chemical compounds, should be avoided. They are objectionable because of separation through settling. Should this be overcome by frequent stirring it is only temporary, as separation can take place after application. These mixtures are often brittle when thoroughly dry, and this considerably impairs their use. The American asphaltums, or, as they are re-christened here, varnishes, are satisfactory at first as regards elasticity, but in time become brittle.

3. If high melting point is forthcoming, coils or armatures may be satisfactorily baked. Armatures, however, running at high peripheral speeds, especially turbine armatures, throw off the varnish in which they have been dipped at comparatively low temperatures, as the high centrifugal force assists in this work. This is, of course, a great disadvantage, covering as it does the field winding and poles with a discoloring varnish. It may be noted here what temperatures may be expected under working conditions. The writer knows of one or two electric lighting stations where the temperature is not infrequently about 100 deg. F., and with the usual 70 deg. F. rise of temperature stipulated in most specifications, we get 170 deg. F. as the final temperature. This, it should be noted, is only at points convenient of reaching, and consequently internal parts of the windings will be considerably higher. It is certain, therefore, that insulating materials should not melt or have their insulating properties deteriorated under a temperature of at least 212 deg. F. Even this will probably leave no margin. Insulating materials should be tested throughout the working limits of temperature, as some lose their previously high insulating properties when the temperature is raised to the working limit, whilst the insulation in some cases chars or carbonizes. This is a very important point, as many engineers insist that pressure tests on plants must be made immediately after a lengthy full-load run, and sometimes an additional run of two hours on 20 or 30 per cent. overload. The machine will, of course, be still warm and most likely warmer than at any time on load, as the cooling effect of the revolving parts has then ceased.

4. Affecting the copper winding chemically applies more particularly to varnishes, but as insulating materials are generally secret mixtures, it is not safe to say that all paints are free from this fault. If, however, care is taken to neutralize any acids, such as would attack copper and gives us the green deposit of copper sulphate, this fault is done away with. The moisture in the cotton covering of wires, not dried out before varnishing, assists in this chemical action which detroys the cotton covering, and thus leads to short-circuiting of the turns. It would be as well to mention here that cotton covering is much to be preferred to paper, which is readily cut on the edges of flat strip copper. Cotton covering should never be single, and if to be roughly handled should be braided.

5. The material should be impervious to moisture, unaffected by oils, acids, and salt water. It is, of course,

well known that water is an undesirable attendant of insulation, and therefore, there is no need to labor this point beyond mentioning the specially adverse conditions to which some outside work is subjected, as, for instance, traction motors of all descriptions, motors for small tools in shipyards, etc. Insulation should certainly not wash off within a reasonable time. Regarding oils, many machines are subjected to trouble from this cause; motors from faulty bearings, etc., and generators from this cause and, where placed between engine standards, from splashing of oil from the engine. Acids are detrimental to insulation, and more than one machine has had to be rewound owing to being subjected to the acid fumes from battery-rooms. Salt water has been added by engineers in cases of exposed stations near the coast, especially where the voltage generated is high, though in the case of low voltage it would only be a question of time if the insulation was not impervious to salt water.

6. The material should be a good insulator. This goes without saying, and if this is not forthcoming, the properties previously enumerated are of no account whatever. A thickness of insulation of .003 in. thickness should stand at least 2,000 volts alternating R.M.S. value. It is well to notice that fibrous materials dipped in insulating compound rarely add their full breakdown strength to that of the varnish, and it is as well to look upon the material as only a medium of applying the insulating varnish.

Turning now to fibrous materials (including papers and tapes), it will be obvious that where the paper, tape, etc., is used merely as a medium for carrying the insulating varnish, that the insulator should remain intact, that it should not crack on handling the tapes, etc.; consequently those insulators having the property of elasticity are invaluable for this use.

Considering the fibres in what we have called their "natural" state, the first property mentioned was pliability. This is essential from a manufacturing standpoint. A pliable material is much easier to work with than a stiff one, and results in a considerable saving of time. It is frequently found more convenient to use several layers of thin material for ease in handling. It is here that a good insulator scores over a poorer one, as fewer layers are then necessary.

In handling many fibre and paper insulators, it is almost impossible to avoid creasing the sheet, these materials being usually supplied in sheets or rolls. This brings us to the second point regarding this class of material. This creasing, whether accidental or intentional, should not materially weaken the strength of the material as an insulator. Further, creasing "fibre, presspahn, etc.", destroys the glazed surface, and this makes the material more hygroscopic, and is thus likely to reduce its insulating value. This class of insulator is naturally hygroscopic, and it is almost entirely on the glazed surface that dependence is made to keep out moisture. Care should be taken to inspect fibrous materials other than woven fabrics, as it sometimes happens that pinholes and very thin places are to be found, and at times small particles of metal, such as filing dust, are rolled into the material. Both of these faults are undesirable, the latter especially so.

4. That insulating materials should stand all temperatures likely to be experienced without charring will need no demonstration, but many of this class get brittle when subjected to even "reasonably" high temperatures, and then lose whatever merit they had as to strength, especially mechanical strength. In case of a short-circuit on a machine, the increase of temperature in the portion of the machine supplying current to the short is frequently very great; but it is certainly undesirable that this should necessitate the rewinding of a considerable portion of the machine.

(To be continued.)

A. C. vs. D. C. ARC SYSTEMS.

On page 317 will be found the concluding instalment of a paper with the above title read by W. L. McFarlane, at the recent convention of the Canadian Electrical Association. A spirited discussion followed the reading of this paper, a resume of which is given below.

At the close of his paper, Mr. McFarlane stated that the estimated costs of lights were merely nominal, and that $15 or $20 should be added to the figures given to get the real cost.

A. A. Dion: I was inclined to criticize this paper because some of the figures were misleading, and the saving effected by substituting A.C. for D.C. arc lamps was exaggerated. Happily, Mr. McFarlane's additional statement makes a difference. The superficial reader, however, would get the impression that arc lights could be produced at $23 a year. As to horse-power, $15 is too low; I do not know of power being sold for $15 per real horse-power.

R. G. Black: Suppose you had a D.C. system and wanted to change to a 60-cycle A.C. in order to get the saving spoken of, would you have to space the lamps farther apart or closer? Would you need to raise the lamp or lower it, to get the best results? Would you be able to use the same distributing circuits or would you have to use heavier insulation and trim the trees? Would it be necessary to bring the wires close together or could we run up one street and down another, as we now do? Also, in case you have to underground, would it be necessary that the two wires be placed in one cable, or could you run one wire as in the D.C. overhead system?

W. L. McFarlane: In Montreal, we changed the circuits from open D.C. to open A.C. lamps, and the only change we made was to lower the hangers. I think by putting the wires somewhat closer together, the power factor could be increased. It certainly has been increased by taking out the spirals in the flexible leads. A power factor of 75 allows of the circuits being run as they ordinarily are. By allowing 50 lamps on the circuit, the insulation is about the same. The trees are not as detrimental to the service as with the Brush arc machines, or the G. and H. With regard to the cost of power, of course that is for 3,000-K.W. in 500 arc lamps, and it is as low as I know any place to obtain power for. It is simply a figure; I might have used 10 per cent.

R. M. Saxby: Except for the saving for carbon trimming, I don't think the difference between the two currents is very great. I kept a diary for a year for the old arc lamps, and for the same time after we changed to D.C. enclosed lamps, and I found the difference very slight. Of course, the enclosed lamp is a far nicer lamp than the open arc, because of the absence of the dark shadow. Does Mr. McFarlane mean there is a saving of $6 in labor, or power?

Mr. McFarlane: A good deal of that is a saving in power. That includes everything. One has advantages in one respect, and the other in others. You can work out those costs, for any system you have you do not need to take the cost I put down.

President Wright: The point about the cost of power is rather unfortunate, as it is liable to lead to misunderstandings. The cost of power depends entirely on conditions.

Mr. Angus: We changed our system from D.C. open arc to A.C. closed arc, and had a great deal of trouble through induction on the city fire alarm and telephone systems. After doubling back the circuit on itself, we removed a great deal of this trouble. What is Mr. McFarlane's experience as to that particular effect?

Mr. McFarlane: It may be possible that in Montreal we have so many wires that it does not affect the telephone to the same extent. There was only one occasion where it was necessary to change for the telephone system. If we had a ground on our circuits, we heard from the telephone people, but apart from that, we were not compelled to parallel our lines on their account, with one exception, in an isolated suburb. The power factor of 75 is allowing for the old conditions. There may be conditions which would compel them to be run closely together. If so, perhaps 80 per cent. may be obtained.

J. G. Archibald: We did not change our system whatever. We found a little trouble with the circuits cutting out, but after we trimmed the trees there was no trouble. At the time about half the telephones were on the old ground return. They are now on metallic circuit and there is no trouble. The sidewalks are much better illuminated than they were; the light is better diffused under the trees. We are saving one man's wages in the cost of trimming lights.

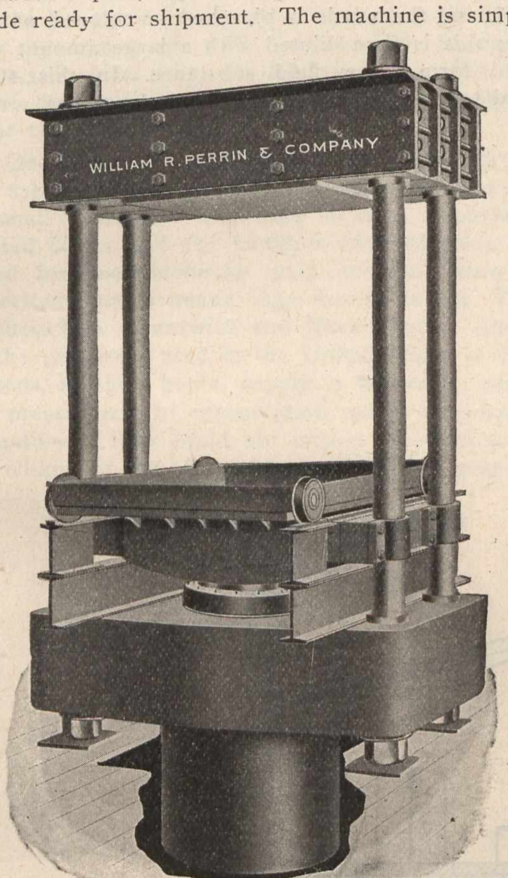
MECHANICAL WOOD PULP.*

By Stanislas Gagne, B.A.Sc.

(Continued from last issue.)

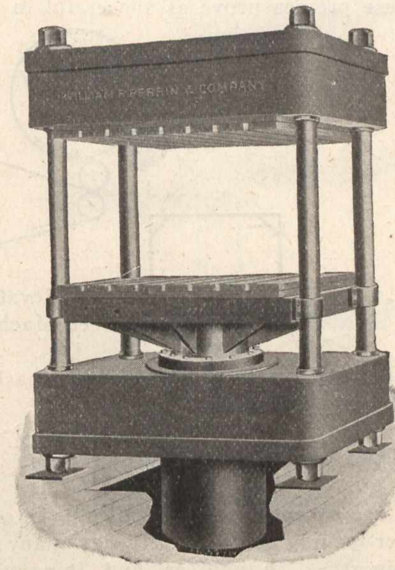
Wet and Dry Pulp.

We have seen that pulp when baled contains from 45 to 55 per cent. of water, 50 per cent. being somewhat a standard in most cases. When pulp has to be hauled only a short distance this percentage of water is not a very serious difficulty, as the freight charges are small, and the pulp can be more easily reduced to a solution again, but this is not the case when it has to be carried a long distance. Mills situated near seaports, such as those in Quebec and the Maritime Provinces, can still afford to export 50 per cent. of water with their pulp, but such a plan is ruinous to those situated more inland; hence, with longer railway transportation. This is the reason why some United States paper mills can import their wood sawn and barked instead of moving the pulp mills to the forests and railing their pulp to the paper mill. We have also seen that the percentage of water or pulp is a source of dispute, and that we must use heat to reduce it below 45 per cent. One of the largest mills in Canada has been turning out mechanically-dried pulp with a machine whose principle is illustrated by Fig. 38. The first part is the same as an ordinary wet machine with felt press rolls, etc., but the pulp, instead of collecting around one of the press rolls is taken up by another felt and carried to a roll and a large drum heated by steam, around which drum the sheet of pulp from the felt is made to pass, and is rolled up on a spindle at the other side ready for shipment. The machine is simple and



Heavy Duty Press, with working pressure of 450 tons, manufactured by Wm. R. Perrin & Co., Ltd., Toronto.

works economically, but the difficulty is to keep that single drum at such a temperature that it will dry the pulp without burning or scorching it. To prevent this tendency to scorching in a single drum, machines with several drying drums have been tried without very much success. In a word, we may say that heretofore most of the mechanical methods of drying pulp have not been a success, and that there is much room for improvement. The only method giving perfect results is by means of hot air, to which the pulp sheets are exposed, and this method is not employed in America. Many mills in Scandinavia have adopted it, and find profit by so doing. Its principle is this: Pulp sheets are hung on racks and made to pass through a chamber, at one end of which hot air is admitted, and after being exposed for some time to that hot air they come out dried. This is achieved by two processes, the tower and



Baling Press, manufactured by Wm. R. Perrin & Co., Ltd., Toronto.

the chamber processes. Fig. 39 represents the tower process. The pulp sheets are hung on racks, represented in Figs. 40 and 41, until the rack is full, when each end is connected to a long linked chain at A, from whence it goes up B, comes down C, and goes out at D dry. Air is heated at E, goes up C, down B to a fan F, and back to E, where it is reheated. The time required to dry sheets containing 50 per cent. of water is about five hours, depending on the temperature of the air and the degree of dryness required.

The chamber process is practically the same; the only difference lies in the fact that the chain carrying the racks moves horizontally instead of vertically. The only reason (which, indeed, is an important one) why these processes are not used on this continent is the great cost involved in their installation and operation. Not only is a large building of special construction required, but during the process every individual sheet of pulp must be handled several times. Generally, when the pulp is not very well wrapped there is not much advantage in drying it over about 90 per cent., because it will absorb enough water from the atmosphere to reach that percentage when exposed.

Hughes Process.

The Riviere du Loup Pulp Co., of Fraserville, Que., have substituted in their recently-built pulp mill a new process (called the Hughes Process) for preparing the pulp for shipment. In this process the pulp is ground and screened as in the ordinary way, but from the screen the pulp passes over a simple form of "slush machine," which extracts the greater part of the water, leaving the pulp of about the consistency of porridge. In this form it is pumped directly into the Hughes hydraulic pump machine, which consists of a compression chamber, divided into four spaces by drainer plates covered with wire cloth to which compression chamber a hydraulic cylinder is attached, on which any desired pressure can be exerted. The pulp is admitted to this compression chamber and the pressure is applied which extracts the water through the drainer plates, and the finished product is delivered in the form of sheets 20 in. by 26 in. by ¾ in. thick. The ordinary wet machine and hydraulic press are replaced by the Hughes press, with the result that a thick sheet of pulp, porous and spongy, is produced as compared with a matted or interlaced thin sheet obtained by the ordinary process. The percentage of water in both sheets should be approximately the same if the

*The above paper won the first prize given by the publishers of the Canadian Engineer for the best student's paper presented to the Canadian Society of Civil Engineers for 1903, the judges being members of the Society.

same pressure has been applied, but the former is appreciably more readily reduced to a liquid mass again in the beating machines of a paper mill. The new press, requiring as it does little more power than an ordinary hydraulic press, has this in its favor, that it dispenses with wet machines together with the power necessary to operate them, while the amount of floor space thus occupied is saved. If these presses prove as successful in their operation as is anticipated, their invention will mark a distinct advance in the pulp industry.

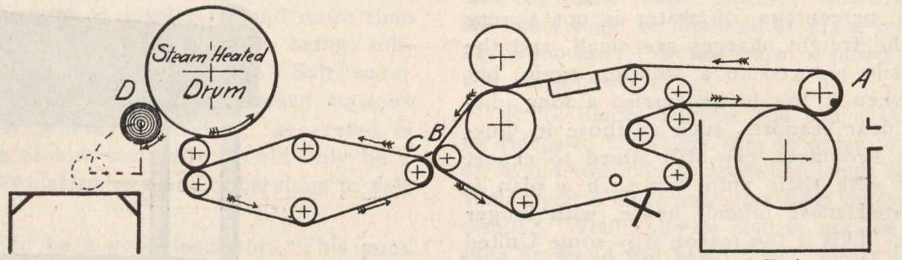


Fig. 38—Sectional Elevation of Dry Pulp Machine. From A to B is same as ordinary Wet Machine. From C to D is the Drying Part.

Uses of Mechanical Wood Pulp.

The chief use of mechanical wood pulp is, of course, to provide a paper-making material. It has many other uses, which yearly increase in number and importance, but at present it may be said to be all practically employed in the making of paper and cardboard. We have now examined these essential properties of pulp, the different sources from which it is derived, and the different processes by which it is obtained from wood; we have also seen the difference between a chemical and a mechanical pulp, and why this latter is naturally inferior in quality. This is why mechanical pulp alone does not produce a paper of good consistency; it is for this reason that it goes only as a percentage in the manufacture of paper. Some years ago it was thought that 50 per cent. of mechanical pulp was as much as could be allowed in the cheapest kind of paper, but on account of more improved methods of manufacturing both the paper and pulp as much as 85 per cent., and even 90 per cent. of it is used in some of the "news" paper. This is the recognized maximum, while the percentage below that may be anything down to zero, according to the quality of the paper produced. It is also largely used for cardboard and wrapping paper, where its percentage is again greatly varied. Outside of paper and cardboard, wood pulp is now employed in the manufacture of a great number of articles of common use, such as pails, tubs, trunks, cases, barrels, etc. Complete houses, and even car wheels have been made of it.

Manufacture of Paper.

To carry out our system of treating this subject, it is necessary to give a short description of the manufacture of paper. When the pulp is brought in bales to the paper mill it is first introduced, together with a proper percentage of other kinds of pulp, with water into a beating machine, where all the particles are separated from each other; from there it is sent to a tank or to a mixer, where the desired amount of loading or sizing material, such as kaolin or talc, is added, and the whole is bleached or colored, as the case may be; this is then diluted with a large amount of water so as to form a very fluid substance. In this state is it admitted to a Fourdrinier machine, where the water containing pulp is allowed to a certain depth on a travelling wire sheet, which retains the pulp and allows the water to pass through. This wire sheet then passes over suction boxes and delivers the pulp to three successive felts, on which it is pressed. From the last felt the sheet, now of a certain consistency, passes around a series of drying drums and cylinders, through a calender which gives the paper a required glaze, and finally the sheet is rolled or cut ready for use.

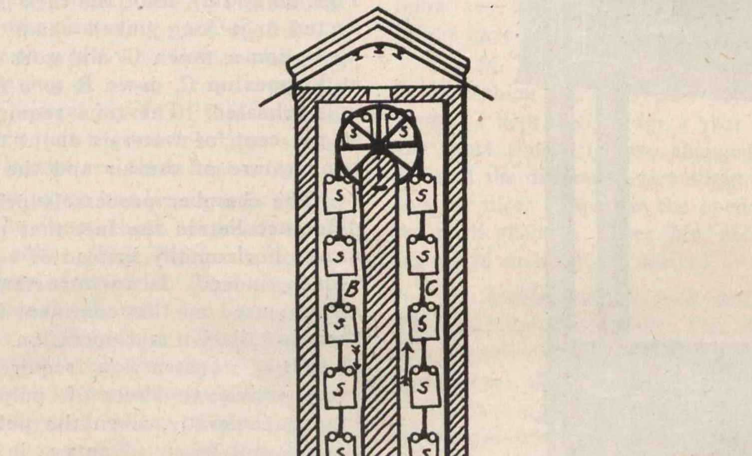


Fig. 39—Tower for Drying Pulp. S.—Pulp Sheets. P—Packing Press.

Cost and Value of Mechanical Pulp.

The cost of producing a ton of mechanical wood pulp in Canada, assuming the cost of wood to be about $4 per cord, is from $8 to $9, under ordinary circumstances. The great difficulty and what influences the most its value at the mill is its transportation to markets, in our cases, Great Britain and the United States principally. The price paid in Great Britain is sometimes as low as $12 to $15, and as high as $25 to $30 per ton, depending on general rules of supply and demand. In the United States, last year, the price varied from $13 to $25 per ton, dry, delivered. Their import duty is about $1.92 per ton. It is generally considered that mechanical wood pulp at $17 a ton in the United States or Great Britain, could be manufactured with profit in most parts of Eastern Canada.

Statistics and Remarks.

The statistical Year Book of Canada shows that during the calendar year, 1902, the wood pulp industry was carried on by 35 mills, 4 of which manufactured soda pulp, 9 sulphite pulp, and 25 mechanical, and 4 make both chemical and mechanical. These mills had an output of 240,989 tons; of this quantity 155,210 tons were mechanical pulp, 76,735 tons sulphite, and 9,044 tons soda; having a total value of $4,383,192. In 1881 the census returns show that there were in Canada five pulp mills, with a total output valued at $63,000. This shows that the growth of this industry in the last twenty years has been considerable. The Customs returns for the calendar year, 1902, show that during that year the export of pulp amounted to $2,511,666, leaving $1,871,518, or 43 per cent. for home use. Of this export, Great Britain took $976,172; United States, $1,518,319, and other countries $17,333.

Our export to Great Britain was about 8½ per cent. of her needs, and therefore all our mills could not supply their demand. Owing to the duty on pulp imported into the United States and the facilities afforded them in securing wood for manufacturing pulp in their own mills, the Americans are stripping our forests in the Provinces of Quebec, New Brunswick and Nova Scotia. About one-half of the pulpwood used in the United States is derived from Canada, as their home supply is becoming scarce, and at the present rate of consumption would be exhausted within a century if they could not import wood from here. It is a well-known fact that we have the largest pulpwood forests

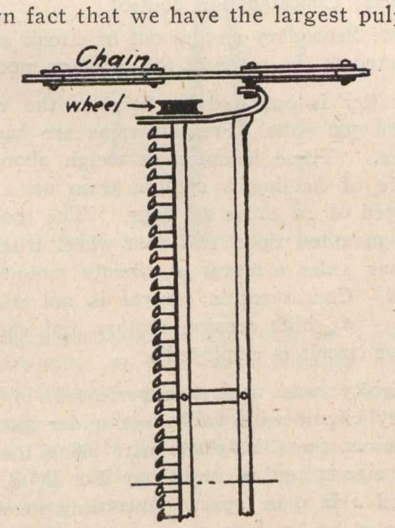


Fig. 40—Sheet Wagon or Frame.

in the world, and this added to our large amount of available water-power, makes a perfect combination as a source of wealth. According to J. C. Langelier, of Quebec, we could supply the world with 1,500,000 tons of pulp annually for 840 years with our present forests. Hitherto this wealth has been little taken care of as little legislation has been passed to prevent its waste and regulate forest operations; but the Canadian people are becoming alive to the advantages of reforestration and to the necessity of preserving their forests by strict regulations regarding the cutting of the wood. It is to be hoped that in the near future the science of forestry will be applied here with the same efficacy it has shown in some of the European countries.

We have seen that great pains are taken to dry pulp for shipment, and also that if paper and cardboard were made directly here, we could dispense with wet machines

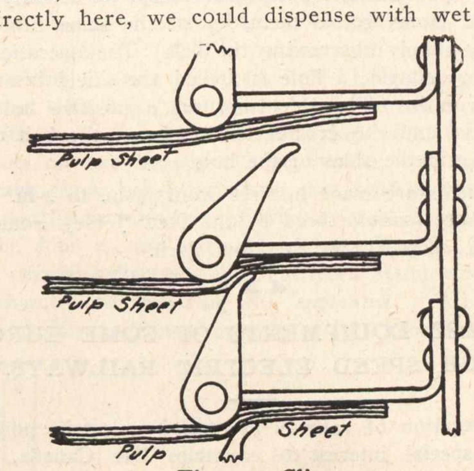


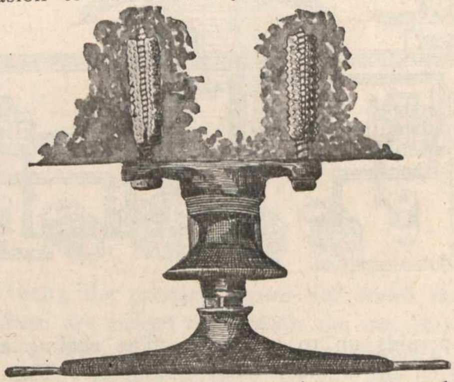
Fig. 41—Clips.

and presses. Both capital and labor will be saved by making paper and cardboard directly at our pulp mills; then Canada will surely become the greatest paper producing country in the world.

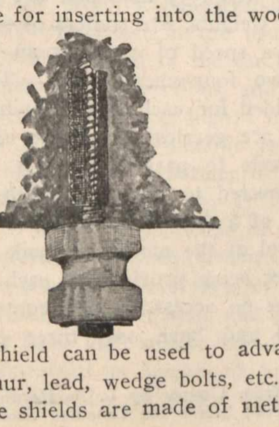
For a large amount of information contained in this paper the writer is indebted to the following: A paper on the Process of Manufacturing Mechanical Wood Pulp, read before the Engineering Society of the School of Practical Science, Toronto, in 1898-99, by W. A. Hare, "99," to catalogues and descriptions from the following firms: Jenckes Machine Co., Sherbrooke, Que.; the Waterous Engine Works Co., Brantford, Ont., and Carrier, Laine & Co., Levis, Que., and to different articles published in the Canadian Lumberman, and in the Pulp and Paper Magazine, both of Toronto.

DIAMOND EXPANSION SHIELD.

The Diamond Expansion Shield, shown herewith, will be of interest to telephone and telegraph companies, electric light and power companies, miners, railroad companies, and others having occasion to fasten trolley and feed wires to brick or



stone buildings, the roof or walls of mines or tunnels, and also for attaching electric wires to brick, stone, concrete, or other masonry. If desired, a pin with standard insulator threads can be cast on the bolt making it unnecessary to use wooden pins, or the bolt can be made for inserting into the wooden pin. The



Diamond Expansion Shield can be used to advantage in place of wooden plugs, sulphur, lead, wedge bolts, etc., which seldom give good results. The shields are made of metal, threaded on the inside to receive the screw, thicker at the outer end to expand as the screw is run in, and a roughened outer surface to grip the sides of the hole. When properly set, they will not work loose and cannot be pulled out except by actually working the material from around them, but at the same time may be removed by simply unscrewing the belt. The operation of the shield is very simple; a hole is drilled, the shield inserted, and the screw run in. The shield insures a positive hold in any solid material and the greater the strain on the belt the more the shields grip the sides of the hole.

The shields are made in sizes from ⅛-in. to 2-in. diameter screw, and are manufactured by the New Jersey Foundry and Machine Co., of 9 Murray St., New York.

POLYPHASE EQUIPMENTS OF SOME EUROPEAN HIGH SPEED ELECTRIC RAILWAYS.*

The operation of railway systems by electric power is a subject of special interest to countries like Canada, possessing such remarkable natural resources in the way of water power.

The application of alternating current induction motors to electric railroading has not made much headway in this country and in the United States, continuous current motors having almost absolute sway. In Europe, however, much work has been done, and at the suggestion of our president, I will endeavor to point out very briefly the characteristics of two high tension three-phase R.R. systems, viz.: The Valtellina R.R., in the north of Italy and the Berlin-Zossen Road in Germany.

The Valtellina three-phase 3,000 volt R.R. system has been equipped by Ganz & Co. of Budapest. The length of this road is slightly over 66 miles and the maximum grade 2 per cent. The power is derived from a waterfall on the Adda river, near the town Morbegno. The station consists of three 1,500-K.W., three-phase, 20,000 volt., 15 cycles generators, direct connected to three 2,000-h.p. Francis turbines working under 100 foot head. Three-phase current is sent on an overhead line to twelve sub-stations, where it is transformed to 3,000 volts and supplies twelve independent sections of the R.R. system. These sub-stations each contain one three core, three-phase air blast transformer, of 300-K.W. normal rating, but capable of working

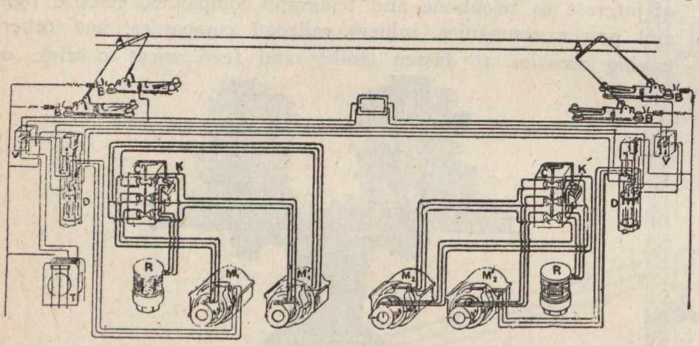


Fig. 1.

for short periods up to 900-K.W. The cooling apparatus, a fan, is driven by a small induction motor. The sub-stations are about six and one-quarter miles apart. Passenger and freight traffic are operated independently, passenger traffic by motor driven cars, freight trains by electric locomotives. The passenger cars weigh 53 tons and are capable of hauling, beside their own weights, five trailers of ten tons each on a 2 per cent. grade at a speed of 40 miles an hour. These cars are mounted on two four-wheel trucks. Two motors of 150-h.p. each are provided for each truck, giving four motors per car. These motors are gearless, the rotor axle is hollow and permits the car axle to pass through it. The rotor shaft or sleeves is connected to the car axle by a flexible coupling, a modified form of a drag link. Jar and vibration are thus prevented. Control of the motors is made from both ends of the car, a controller being provided to each platform, to which the passengers have no access. These controllers are mechanically inter-connected and have only three positions. Each motor car is fitted with two primary and two secondary motors. The primary motors have six poles and are rated to develop 150 B.H.P. at 300 revolutions per minute under 3,000 volts, 15 cycles. The diameter of the car wheels being 3.84 feet, the maximum speed of the car is close to forty miles an hour. The maximum torque these motors can develop is from four to five times their normal torque. There is practically no difference in weight and design between the primary and secondary motors, which are also rated at 150-h.p. under 300 volts and 15 cycles.

Fig. 1 gives a diagram of connections of one of these cars. In starting the two motors M_1 and M'_1 on a truck, are connected in concatenation or cascade. The stator winding of motors M_1 and M_2, the primary motors, are connected to the 3,000 volt line A through the high tension switch D. The rotor of these motors (ratio 10 to 1), thus giving 300 volts, are connected through the controller C to the stator windings of the secondary motors M'_1 M'_2. The rotor of these motors (ratio 1 to 1), are each connected to a three-phase liquid rheostat R, containing an alkaline solution, the resistance of this rheostat depending on the quantity of liquid which is forced and regulated into it by compressed air. When the liquid has reached a certain height an automatic arrangement short circuits the rotor windings. With the motors in concatenation the speed is approximately twenty miles an hour. It is well to mention here that before a start is made the controller is placed in position with the motors in concatenation before the primary switch D is made, throwing the 3,000 volt on the primary motors stator windings.

To obtain full speed, that is forty miles an hour, the primary switch D is opened, the controller is placed on third notch, cutting the low tension motors out of circuit and connecting the liquid rheostat to the rotor of the primary motors, the high tension switch is then closed, the primary motors are then alone in circuit. This method of control is very similar to the ordinary series-parallel control.

The 300 volt reversing switch consists of six copper plungers, which, when lowered, fit into an equal number of copper cylinders; by rotating the switch through sixty degrees the connections of the phases are changed, thus reversing the direction of rotation of the motors. This switch is operated from the end platforms by compressed air or if this fails, by hand.

The controller has only three points.

First point: Rotor of primary motors open circuited.

Second point: Concatenation control.

Third point: Secondary motors out of circuit and the liquid rheostat connected to the rotor of the primary motors.

This controller is operated by hand as the voltage on it does not exceed 300 volts. Freight trains are hauled by electric locomotives. These locomotives weigh about forty tons, and are capable of hauling a 250-ton train on a 2 per cent. grade at a speed of 20 miles an hour. The body of these locomotives is mounted upon two four-wheel trucks and upon each of the four axles a motor is directly mounted, no gearing being used. Concatenation control is not used in these, the four motors are high tension motors and rheostatic control in the rotor circuit is employed.

Great difficulty was at first experienced in working an overhead trolley circuit with two wires under 3,000 volt pressure between wires, the third-phase wire being the track. The trolley wire in size is equivalent to our No. O. B. & S.; these wires are placed 2 ft. 9 in. apart. According to circumstances, they are supported by brackets or span wire, flexible suspension being employed throughout. The insulators are of a special type, with long insulating bolts, and the wires are held by very short mechanical clips which pivot from the insulating bolt. The method of supporting the high tension feeders and the trolley wires, the type of insulators used, and the trolley insulators are shown in Figs. 2, 3 and 4.

The 3,000 volt current is taken from the trolley lines by a sort of bow trolley made up of two copper rollers 16 inches long and 3¼ inches diameter. These rollers which are mounted in the same axial line revolve upon steel ball bearings, and are separated by 5 inches of hard wood saturated in parafine under pressure. The current is transmitted by the rollers to highly

*Condensed from a paper by L. A. Herdt, assistant professor of McGill University, read before the Canadian Society of Civil Engineers.

insulated wires through carbon brushes held against the copper rollers. The current in this way is not allowed to pass through the steel bearings. The trolley wires are held 18 feet above the track. An arrangement inside the cab permits the lowering, by compressed air, of the trolley arms to disconnect the car from the overhead circuit. The high tension wires on the cars are all protected by grounded metallic tubing. I am indebted to "L'Industrie Electrique" for much of the above data and for the following: To start a motor car with five trailers, a total weight of ninety tons, seventy to ninety amperes are required; at 3,000 volts this is equivalent to 415 K.V.A. Power factor of primary and secondary motors at max., torque when concatenated, 70 per cent. When running full speed, the secondary motors being out of circuit, the current varies between fifty-two and fifty-six amperes. The power factor, 80 per cent. To start a train weighing 250 tons on a 1.1 per cent. grade, 150 amperes are required, viz.: 810 K.V.A. The maximum horizontal pull is 16,000 lbs. On 4.4 feet diameter driving wheels and twenty miles an hour the horsepower developed is close to 875-h.p. There are at present ten motor cars and two locomotives in daily service, consuming an average of 9,000-K.W. hour per day. The station equipment for this work is equal to 6,000-h.p. showing a rather small load factor.

The trials of high speed traction taking place at the present day in Germany over the Berlin-Zossen road, where speeds of 130 miles per hour have been obtained, have attracted the interest of railroad engineers all over the world. These trials and experiments have now extended over a period of two years. The first trials at high speeds were made with an electric locomotive, as it was deemed advisable to perform experiments with it rather than with a motor car. The line voltage is 10,000, three-phase, 45-50 periods per second. The underframe of the locomotive is of the double truck construction of a pair of motors, being provided for each bogey. The motors are designed to work at 10,000 volts. The wheels have a diameter of 4 ft. 4 in., and the motors are geared to the axles of the driving wheel with a gear ratio of 2. The speed at starting is regu-

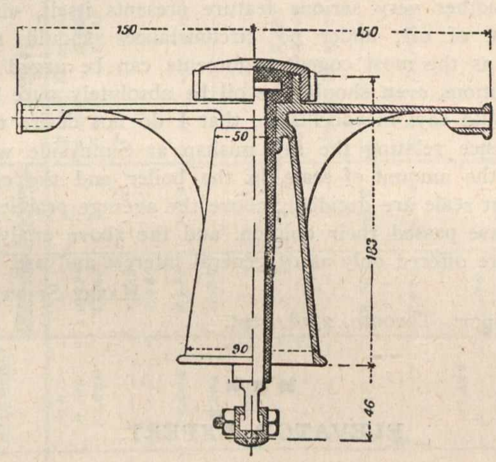
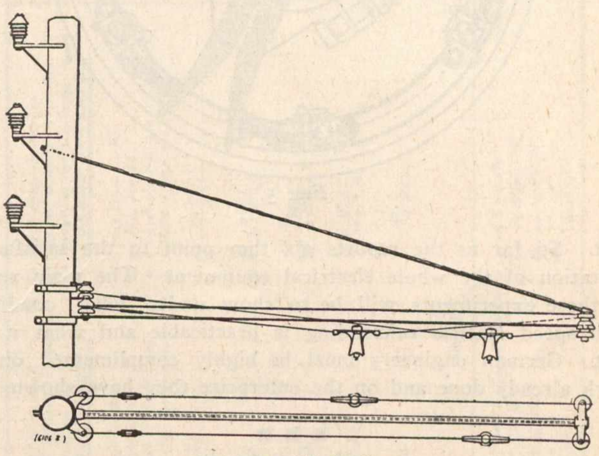


Fig. 2.

lated by varying a resistance in the rotor or secondary circuit. Speeds of ninety miles an hour were obtained with this locomotive. It was found, however, that it was not sufficient at these high speeds on account of the velocity of the teeth being exceptionally great to fill the gear box with oil or consistent grease, but that lubricants had to be forced by compressed air through nozzles directed above and below the toothed wheels.

The more recent tests have been made with a motor car, 3,000-h.p. maximum. The starting and regulating apparatus for an output of 3,000-h.p. could not be built on the lines of the ordinary car controllers, and many costly experiments were necessary to test new types of apparatus designed for this purpose. The motors are not geared, the rotor axle is hollow and permits the car axle to pass through it. The transmission from rotor axle to driving wheels is shown in Fig. 5. A ring in three parts is placed at each end of the hollow shaft, in which are fitted three double arms in the shape of sets of springs, the ends of which bear against sliding pieces fixed on the wheels. The sliding and elastic movement thus obtained allows the regular working and play of the hollow sleeve on the axle. I understand that a slight modification of this transmission has been made. The electrical equipment of each car is divided into two units, the control of these two separate circuits can be made from either end of the car, according to the direction of travel. Each contain: (a) Two motors with two sets of resistances and two starting devices. (b) One large, three-core transformer with high and low tension switches. (c) Air pumps with small transformers, safety cut out and air receiver. which rests on two six-wheel bogey trucks, the motors being two to each truck, one attached to the front and rear axle of each truck, the middle pair of wheels in each group running free. The four motors have a total of 1,100-h.p. normal and (d) One current collector. (e) A driver's stand with air pressure mechanism for working the apparatus. All apparatus, cables and safety appliances are placed in a room in the centre



Insulators and Trolley Lines

Fig. 3.

of the car. The motorman's platform contains no part under electric pressure, he controls the running of the car through mechanical connections with the apparatus in the central machine room. Some place had to be found for the transformers weighing twelve tons, reducing the 10,000 volts of the line at which voltage the current is supplied from the three overhead

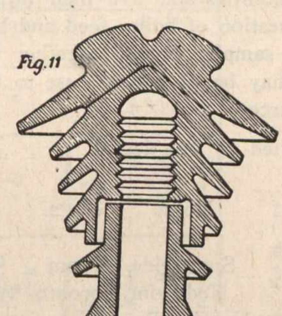


Fig. 4.

lines to 1,150 volts, the primary tension for which the motors are built. These are placed underneath the car body in the middle section. The cooling of these transformers is made through air currents passing through two air shafts, which run from the roof of the car to the transformers in such a manner that cool air is taken through one shaft, the hot air flowing out through the other. Concatenation control is not used, and to bring the motors up to the speed, starting resistances are inserted in the secondary current circuit in the usual way. On account of the space under the flooring of the car being already taken up by the transformers and connections, and to obtain as large a cooling surface as possible and as high a degree of efficiency for the weight as possible, the metallic resistances are carried against the sides of the car. A battery of 631 lbs. furnishes the current for lighting when the car is standing with the trolley off the lines. It is out of the scope of this paper to describe in detail the working of this equipment; it does not, however, materially differ from the description of the previous one cited. Each car is seventy-two feet long, and weighs ninety tons. The track on which these high speeds have been obtained is a nearly level line throughout its length of eighteen miles and the track is in every particular up to the highest standard of railway construction. "The Electrical World and Engineer," states that when going at the rate of 130 miles an hour the steadiness of the car did not make the impression of so great a speed being obtained, but that persons or objects standing near the track presented blurred images as the car dashed

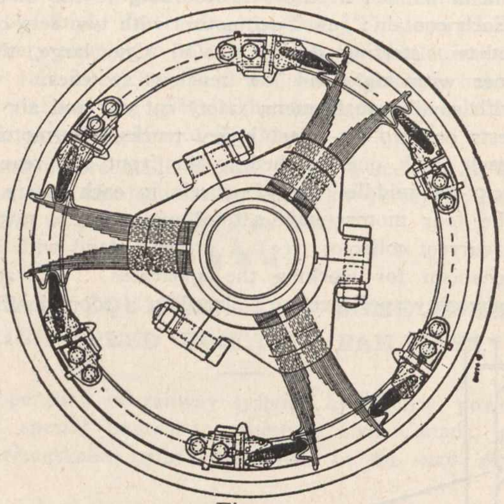


Fig. 5.

past. So far as the reports go, they point to the satisfactory operation of the whole electrical equipment. The main results of these experiments will be to show under what conditions high speed electric railroading is practicable and what it will cost. German engineers must be highly complimented on the work already done and on the enterprise they have shown.

❧ ❧ ❧

BOILER SCALE AND THE SUNNYSIDE CASE.

Editor, Canadian Engineer:

SIR,—There is one point of interest common to all boilers, viz., the extent and composition of the scale, and in this connection curiosity led me to take a sample of the scale of the boiler that burst at "Sunnyside," Toronto, on September 14th, resulting in two fatalities and five men injured. Being much interested in the question of boiler feed and boiler scale, I made an analysis of the sample, which (together with others, I add for comparison), may be of general use to those taking water from the same source:

All samples dried at 212 deg. F.

	No. 1. Sunnyside, Fed from Humber Bay.	No. 2. From Toronto Water.	No. 3. From Toronto Water Compound Used.	No. 4. Artesian Well Feed.
Oil	.40	....	....	9.03
Organic matter and water of combination	7.79	10.58	3.62	.44
Carbonate of lime	57.55	52.02	72.86	74.96
Sulphate of lime	4.87	9.29	.51	.20
Carbonate of magnesia	4.87	1.22	8.97	6.61
Magnesia	19.72	13.81	7.03	3.04
Oxide of iron and Alumina	2.94	3.12	3.42	1.65
Salt	2.94	3.12	.07	Trace
Silica	5.59	9.96	3.52	3.71
Undetermined	1.14	9.96	3.52	3.71
	100.00	100.00	100.00	100.00

No. 1, the Sunnyside boiler was fed from Humber Bay; Nos. 2 and 3 were boilers fed from Toronto city water; on No. 3 was used a so-called boiler purge; No. 4 is scale from a boiler fed from an artisian well; on this scale also was used a commercial "purge."

In order to make comparisons, I give my analysis of Toronto water, expressed, as is customary, in grains per gallon, and also as per cent. (The grain and gallon do not lend themselves as easily to per centage calculation as the Metric Weights and Measures). Toronto water contains 9.2 grains per gallon of solid residue, composed as follows:

	Gr. per Gal.	%
Organic matter and water of combination	1.40 =	14.97
Carbonate of lime	5.38 =	57.54
Oxide of iron and alumina	.06 =	.64
Sulphate of magnesia	1.41 =	15.19
Sodium chloride (salt)	.82 =	8.77
Silica	.28 =	2.99
	9.35	100.10
Error in excess	.15	.10
Total	9.20	100.00

In scale analysis Nos. 1 and 2, we have a deposition fairly comparable with the Toronto water from which they were deposited.

In No. 3 we have a scale deposited also from Toronto water, but which has been acted upon by one of the so-called "boiler compounds" of commerce, with the result that the per cent. of everything has been lowered except the carbonates of lime and magnesia, the very materials which it is most desirable to be rid of. This case is typical of a great number more, where the ignorant practice of doctoring before "diagnosing" is applied to the boiler and scale. The proper way is to analyze both scale and water, and after a full knowledge of their composition has been obtained, act upon the calculations of only experienced people in this particular line. After a special purge has been used, the scale should again be tested and also some of the water in the boiler to get a full grasp of the chemical actions taking place.

In analysis No. 4, we have a singular case where the proprietors sank an artesian well to secure better water. They also used a "purge?" resulting in a scale showing nearly 75 per cent. carbonate of lime, and 6.61 per cent. carbonate of magnesia. Another very serious feature presents itself, viz., over 9 per cent. of oil; under no circumstances should this be tolerated, as the most cogent arguments can be urged against such conditions even should the oil be absolutely pure mineral oil. I would say, in conclusion, that I do not desire to draw any inference relating the sad mishap at Sunnyside with the scale, as the amount of scale in the boiler and the composition of that scale are decidedly above the average practice. The experts have passed their opinion, and the above analysis and remarks are offered only as of general interest and use.

HARRY SPURRIER.

Davenport, Toronto, 23rd Sept.

❧ ❧ ❧

ELEVATOR EXPERT.

Editor, Canadian Engineer:—

Sir,—Will any of the readers of your paper be kind enough to supply me with the names of two or more of the most eminent of the mechanical experts in passenger elevators, either hydraulic, electrical or any other kind?

Carleton West, Ont. ENQUIRER.

❧ ❧ ❧

—One of the features of the B. F. Sturtevant Co.'s new office building, at Hyde Park, Mass., is the lunch room located in the basement of the building. Arrangements were first made with a caterer to furnish lunches, but the desire for home lunches became so prevalent that the company now hires the help and furnishes lunches at cost. The new drafting rooms of the B. F. Sturtevant Co., at Hyde Park, Mass., contain about 5,000 sq. feet of floor area. The chief draftman's office is in the centre of the room with two large vaults nearby in which are kept all the tracings, numbering in all about 30,000. The room is 13½ ft. high, well lighted and equipped with all conveniences for draftsmen. The Blue-Print Department is connected to the drafting room by shop telephone and dumb waiter.

DOUGLAS FIR. (Pseudotsuga Douglasii)

Ultimate Breaking Stresses in lbs. per Square Inch from Experiments by Various Authors.

Compiled for the Canadian Engineer by E. Mohun, C.E.

AUTHOR.	REMARKS.	TENSION. WITH GRAIN	CRUSHING		EXTREME SKIN STRESS.		MODULUS OF ELASTICITY.		SHEARING WITH GRAIN.		WEIGHT PER CUBIC FOOT.	BREAKING LOAD OF BEAM 1 IN. SQUARE 1 FT. SPAN LOADED AT CENTRE.	
			ENDWISE.	SIDEWISE.	LIMITS.	MEAN.	LIMITS.	MEAN.	LIMITS.	MEAN.		LIMITS.	MEAN.
(a) Prof. Bovey.	Specially selected	14,311			8,020 to 10,444	9,054	1,934,500 to 2,178,100	2,036,529	397 to 440	411	41.	495 to 580	503
	New Timber; First Quality	11,160	5,974		4,027 " 8,382	6,084	926,500 " 1,138,900	1,431,209	280 " 456	396	35	224 " 466	338
	Old Timber; Old Can. Pac. R^y. Stringers.	12,663	6,265		4,613 " 7,339	6,293	949,720 " 1,201,620	1,423,962	302 " 371	328	35	256 " 408	350
	Included in preceding 46 Pieces New Timber, straight grained and clear.	—	7,098										
	20 " Old " " " " "	—	7,070										
(b) Oregon & Cal^{ia} R^y	—	16,600	3,085	1000	—	8,658	—	—	—	—	—	—	481
(b) J. D. Isaacs.	Southern Pac. R^y.	15,900	6,000		—	—	—	1,272,000	—	600			
(b) Report of Am.	Chapter Am. Ins. Architects.	—	—	—	—	5,979	—	—	—	—	—	—	332
(b) Chas. Wing.	Ordinary N^o 1. Timber 10 Beams.	—	—	—	5,580 to 7,951	6,482	—	—	—	—	—	310 to 442	360
	10 Small Beams.	—	—	—	6,438 " 12,056	9,257	—	—	—	—	—	358 " 670	514
(b) Onward Bates	10 Beams	—	—	—	5,268 to 7,544	6,214	—	—	—	—	—	293 to 419	345
(b) A. L. Johnson.	—	—	4,400	500	—	6,600	—	1,380,000	—	—	—	—	367
(c) E. Mohun.	Specially selected, straight grained, free from knots and flaws, partly seasoned. All test pieces 1 inch square.	—	7,000	1,750	10,800 to 11,700	11,484	—	1,585,000	—	—	34	600 to 650	638
(d) Prof. Frank Soulé.	63 Pieces	14,388											
	59 "	—	5,556										
	Indentation 3 per cent 83 "	—	—	879									
	" 15 " " 83 "	—	—	1,215									
	21 "	—	—	—	—	9,334	—	1,862,947	—	—	36.99	—	518
	85 "	—	—	—	—	—	—	—	—	546			
E. A. Wilmot.	Old bridge stringer, damaged, 10"x12" x 37'6"	—	—	—	—	8,298	—	—	—	—	—	—	461
	MEAN	14,170	5,824	1,083		7,811		1,570,285		456	36.50		434

RECOMMENDED VALUES.

AUTHOR.		TENSION.	CRUSHING. ENDWISE	CRUSHING. SIDEWISE	SKIN STRESS	MODULUS OF ELASTICITY.	SHEARING WITH GRAIN	WEIGHT PER CUB. FT.	BREAKING LOAD OF BEAM 1x1x12"
(a) Prof. Bovey	Ultimate Stress.	—	6,000	—	6,000	1,430,000	400	—	333
	Factor of Safety	—	—	—	3	—	—	—	3
	Safe Working Stress.	—	—	—	2,000	—	—	34	111
(e) Am. Association of Superintendents of Bridges, &c.	Ultimate Stress	10,000	—	—	5,000	—	—	—	278
	Factor of Safety	10	5	4	6	2	4	—	6
	Safe Working Stress.	1,000	—	—	833	—	—	—	46
(b) A. L. Johnson.	Ultimate Stress	—	4,400	500	6,600	1,380,000	—	—	367
	Factor of Safety	1	5	3	—	2	4	—	5
	Safe Working Stress	—	880	167	—	690,000	—	—	73
(c) E. Mohun.	Ultimate Stress.	14,000	5,000	1200	6,000	1,400,000	400		333
	Factor of Safety	10	5	4	3	2	4		3
	Safe Working Stress.	1,400	1,000 (f)	300	2,000	700,000	100	37	111
(b) A. Brown. S. Pac. R^y	Ultimate Stress.	15,900	6,000	—	13,630	1,272,000	600	—	702

(a) Prof. Bovey. Trans. Can. Soc. C.E. Vol IX. 1895.
(b) A. L. Johnson, C.E. Bulletin 12 Div^n of Forestry, Dep.^t of Agic.^re U.S.A.
(c) E. Mohun, C.E. Indian and Colonial Exhibition, 1886; Trans. Can. Soc. C.E. Vol. II. 1888.
(d) Prof. Frank Soulé Trans. Am. Inst. M. E. 1899.
(e) Committee Report. Am. Ass^n of Railway Superintendents of Bridges and Buildings, 1895.
(f) When the length does not exceed fifteen times the least diameter.
(g) Deduced from C. S. Smith's formula.
(h) Deduced from Tredgold's formula.

BEAMS SUPPORTED AT BOTH ENDS.

FORMULÆ.

Let L = clear span in feet; l = clear span in inches.
" b = breadth of beam in inches; h = height of beam in inches.
" W = total load in lbs; θ = length of end bearings.

UNIFORMLY LOADED.

S = safe load in lbs.
F = skin stress.
E = modulus of elasticity.
Δ = deflection in inches

$$S = \frac{222.b.h^2}{L}$$

$$F = \frac{3W.l.}{4b.h^2}$$

$$E = \frac{5W.l^3}{32\Delta.b.h^3}$$

$$\Delta = \frac{5W.l^3}{32E.b.h^3}$$

$$b = \frac{W.L}{222h^2}$$

LOADED AT CENTRE.

s = safe load in lbs.
f = skin stress.
e = modulus of elasticity.
δ = deflection in inches

$$s = \frac{111b.h^2}{L}$$

$$f = \frac{3W.l.}{2b.h^2}$$

$$e = \frac{W.l^3}{4\delta.b.h^3}$$

$$\delta = \frac{W.l^3}{4e.b.h^3}$$

$$b = \frac{W.L}{111h^2}$$

$$\theta = \frac{W}{333b.}$$

(h) When the deflection = $\frac{1}{480}$ of the span, and $b = 0.6h$

Uniformly loaded:

$h = \sqrt{L}.\sqrt[4]{.0096W}$
$b = 0.6\sqrt{L}.\sqrt[4]{.0096W}$
$W = \frac{h^4}{.0096L^2}$

Loaded at centre:

$h = \sqrt{L}.\sqrt[4]{.0154W}$
$b = 0.6\sqrt{L}\sqrt[4]{.0154W}$
$W = \frac{h^4}{.0154L^2}$

REMARKS.

The foregoing safe working stresses are estimated for first quality timber, such as would be accepted by a competent inspector for bridge or trestle work.

The life of such a structure under favourable climatic conditions may be estimated at about twelve years.

Beams covering more than one span, or firmly fixed at both ends are stronger than beams merely supported at the ends by from 50 to 100 per cent.

(g) **PILLARS.**

Safe load per sq. in. in lbs $= \frac{1900}{1 + .004\frac{l^2}{b^2}}$

(h) **INCLINED BEAMS**

loaded at centre, where D = horizontal distance between supports.

$h = \sqrt[4]{W.L.D.x.0154}$. $W = \frac{h^4}{.0154L.D.}$

Note. If the proportion of $b:h$ is not $0.6:1$ but $x:1$, the coefficients .0096 and .0154 become $\frac{.00577}{x}$ and $\frac{.00924}{x}$ respectively.

THE NORTH BAY ACETYLENE PLANT.

Editor, Canadian Engineer:—

SIR,—Your interesting article on town lighting by acetylene in the September issue of the "Canadian Engineer," will no doubt do much to bring the new gas light to the attention of practical people throughout Canada. In your reference to the earnings of the acetylene plant in North Bay, there is a slight error as to the amount of profit. While the income of the plant for this year ending 30th June, 1905, will be in excess of $4,000, and the earnings of the electric plant will be in the neighborhood of $10,000, it would be wrong to claim that the profits from the $4,000 would be as great as the profits on the $10,000. What we do claim for acetylene is that the ratio of profit for the town plant of say 2,000 lights should be greater than the ratio of profit from an electric plant with 2,000 lights, especially when steam is used to generate the electricity.

It may interest you to know that the Gas Company have bought out the Electric Company in the town of North Bay, and a new charter has been applied for for the amalgamated companies. The name of the new company is: "The North Bay Light, Heat and Power Co." This is the first instance on record where an acetylene town lighting plant and an electric town lighting plant have been combined.

Yours truly,
A. F. LEGGATT,
President, North Bay Gas Co.

ELECTRICITY FROM WATER POWER.*

By A. A. Campbell Swinton, M.I.C.E., M.I.E.E.

It should be gratifying to our national pride to know that probably the very earliest example of the production of electricity by means of water-power on a practical scale, and its transmission to a distance, was the installation put up, for the purpose of lighting, at Cragside, Northumberland, by the late Lord Armstrong, in the year 1882. This plant, which was still in daily use in the year 1884 when the author saw it in operation, consisted of a Siemens continuous-current dynamo, which was driven by means of a belt off an 8-h.p. water turbine operating with a fall of 30 feet, the electricity, which was delivered at ninety volts pressure, being carried by bare overhead wires attached to porcelain insulators on poles to the house about a mile distant. It is an interesting fact that when the installation was first put to work it was designed to operate with only a single wire, connection being made to the hydraulic power pipes at the one end and to the ordinary household water pipes at the other, the earth being expected to form a sufficient return in the manner employed in telegraphy. This plan, which was adopted on the advice of the late Sir William Siemens, was found to be quite ineffective, as, owing to the low voltage employed and the exceedingly rocky nature of the ground no useful amount of electricity could be transmitted until the earth return was done away with and a second metallic conductor substituted.

Though this twenty-two-year-old English example of electricity developed by water-power and transmitted to a distance, was, as already mentioned, probably the first such installation in existence in the world, the great development of such installations has, up to recently, taken place almost exclusively abroad. No doubt up and down this country, a very considerable number of small electric plants operated by water-power, have been put up for private house lighting and such like purposes, and there are even towns such as, for instance, Salisbury and Keswick, where water-power has for long been employed to assist steam power for electrical production for public and private lighting, the water-power being in these instances found of great value for the purpose, more especially of maintaining the supply during the periods of minimum load. A few hundred horse-power will, however, probably cover the whole of the plants of this character at present running in Great Britain, which is an altogether insignificant amount compared with the much larger corresponding figures for the continent of Europe, America and other countries.

To obtain accurate statistics as to the amount of water horse-power at present employed for electrical production throughout the whole world is a very difficult matter, as in many countries no figures are available, while in others, such as are obtainable are not up-to-date.

The following table, giving an aggregate horse-power of nearly 1½ million comprises all the hydraulic electricity works of which the author has been able to obtain particulars. He has, however, no doubt that there must be many others in existence to which he has not been able to find any reference, while again, in the case of a number of the installations which have been included, the horse-power now employed is greater than that in use at the time that the statistics were made out.

Water-power Electricity Installations.

	Horse-power.
United States of America	527,467
Canada	228,225
Mexico	1,470
Venezuela	1,200
Brazil	800
Japan	3,450
Switzerland	133,302
France	161,343
Germany	81,077
Austria	16,000
Sweden	71,000
Russia	10,000
Italy	210,000
India	7,050
South Africa	2,100
Great Britain	11,906
Total horse-power	1,483,390

It therefore seems reasonable to suppose that the total amount of water-power actually used for electrical production throughout the world at the present time must exceed 2,000,000-h.-p., which is about double the total steam power at present devoted in Great Britain and Ireland to the same purpose.

It is interesting to calculate what would be the amount of coal required to produce this large amount of horse-power were it generated by steam engines in the ordinary way; in other words, what is the saving of coal that the adoption of this amount of hydraulic power entails. Many of the hydraulic plants, particularly those which are used for chemical processes, operate at full power continuously night and day, but others work for shorter hours. Assuming, however, that the whole 2,000,000-h.-p. is in use for 12 hours per diem, in other words, is employed on the average with what engineers call a 50-per-cent. load factor, and assuming, as is reasonable, that were the energy produced by means of coal, at least 3 lbs. of this fuel would be required on the average per horse-power hour, we get 5.86 tons of coal per horse-power year, or 11,720,000 tons of coal saved annually on account of the 2,000,000 h.-p. utilized. Though this may appear a large figure, it amounts to less than 2 per cent. on the total output of coal in the world, which, on the average of the last five years, was 632,000,000 tons per annum. Assuming, however, an average cost of coal of 10s. per ton, this 11,720,000 tons represents £5,860,000 yearly, an amount which it would take over £100,000,000 of capital earning 5 per cent. per annum to provide.

Apart from mere magnitude, many of the more recent examples of hydro-electric engineering abroad, especially in America, are interesting, by reason of the enormous distances over which the electric energy is being economically transmitted, and the very high electric pressures that in numerous cases are being successfully employed.

The longest distance over which transmission has so far been commercially effected, is probably the 232 miles of line

*A paper read before the British Association.

belonging to the California Gas and Electric Corporation, which stretches from the De Sabla Power House via Cordelia to the Town of Sausalite, which is situated on the opposite side of the Golden Gate Straits from the city of San Francisco. What this transmission means will be realized when it is stated that the distance covered is about equal to that which separates Cambridge from Newcastle-on-Tyne. The same Californian company also owns the Colegate and Oakland transmission line which runs 142 miles from the Colegate power house, where 14,000-h.-p. is developed from a head of water of 702 feet.

Another very long line is that which reaches from the Electra power house, via Stockton and Mission San José to San Francisco, a distance of 147 miles, over which 10,000 h.-p. is being delivered regularly. This line belongs to the Standard Electric Company, who have 217 miles of power line with a capacity of 27,000-h.-p. in operation. The voltages employed, as is to be expected having regard to the distances covered, are very high, ranging from 55,000 to 67,000 volts, 60,000 volts being apparently the standard figure for many recent installations of which the following are some examples:—

Plants Recently Installed by the Stanley Electric Manufacturing Company, Pittsfield, Massachusetts.

Name.	H.-P. capacity.	Voltage.	Transmission distance, Miles.	Head of water Ft.
Quanajuato Power & Electric Company, Mexico	8,000	60,000	101	300
Washington Water Power Company, Spokane	12,000	60,000	110	68
Kern River Power Company, Los Angeles, California	16,000	67,500	110	...
Pierce Company	26,000	55,000	40	...
Mexican Light and Power Company, Mexico	......	60,000	110	1,500
Winnipeg General Power Company	10,000	60,000	60	40
Canadian Niagara Power Company	......	60,000	93	...
Electric Development Company, of Ontario	......	60,000	93	...

For these particulars the author is indebted to Mr. C. C. Chesney, the chief engineer of the Stanley Electric Manufacturing Company, who have recently installed these and numerous other similar plants.

Mention should also be made of the 50,000-h.-p., and the 125,000-h.-p. plants for the Canadian Niagara Power Company and the Electric Development Company of Ontario, contracted for by the Canadian General Electric Company, both of which will employ pressure range up to 60,000 volts, while, to pass to another quarter of the globe, the Cauvery Falls electric-power scheme in India has now been at work for over two years, and transmits 5,000 h.-p. to the Mysore gold mines, a distance of 92 miles, using a pressure of 35,000 volts.

Turning now to the British Isles, the only large scale plant for the production of electricity by water-power at present in operation in this country is the well-known installation of the British Aluminium Company at Foyers. This installation, which was originally designed by the late Mr. Birch, and carried out by Mr. Vaux Graham, has been at work ever since the year 1896, and the whole of the power is employed for electro-chemical purposes on the spot. A small percentage of the power is utilized for the production of calcium carbide, but the bulk is and in the near future the whole of the power will be used for making aluminium. At present, the gross horse-power of the plant is 7,000-h.-p., but plant for a further 2,000-h.-p. is at the present moment being installed, and will be working in about a month's time.

The water is derived from the River Foyers, which has a catchment area of upwards of 100 square miles. Storage is effected by means of two lakes which have been joined together by the raising of dams and embankments, the result being a continuous lake of about 5½ miles long by about ½ mile in width. The storage thus obtained is sufficient to run the entire plant continuously day and night for about fifty days.

From the River Foyers, the water is first passed through a tunnel 8½ feet in diameter, cut through the solid rock, to the penstock chamber from which the water is delivered by separate cast-iron pipes to the turbines, which are installed on the shore of Loch Ness, and into which the water is finally discharged, the available head of water being 350 feet.

The British Aluminium Company have obtained Parliamentary powers for a further large power installation on Loch Leven. It is their intention to commence immediately the development of this scheme, which is capable of giving 17,000-h.-p. The reservoir is artificial, and will contain about 150 days' storage of the full power, the head of water at the turbines being 964 feet. It is anticipated that the whole of this power will also be taken up in the manufacture of aluminium on the spot, no distant transmission being, at present at any rate, contemplated.

Another interesting water-power scheme of considerable dimensions is at the present moment being developed in Wales by the North Wales Electric Power Company, who have obtained Parliamentary powers for this purpose.

Their first installation is at present being erected under the superintendence of Messrs. Harper Bros., the company's engineers, and derives its power from Lake Llydaw on Snowdon. This lake, into which runs the water from Lake Glaslyn, is about 1 1-5 mile in length, and about ¼ to ½ mile in width. Its area is 5,500,000 square feet, and it derives its water from a catchment area of about 1¾ square mile, including the summit of Snowdon. Being in the track of the Atlantic depressions, this area has one of the heaviest rainfalls in Europe, amounting on the average to 180 ins. per annum. In 1903 it reached the phenomenal figure of 250 ins.

The prevailing winds are from the sea, and the atmospheric moisture is driven up the sloping side of the mountain, and on being condensed at the summit is discharged in the form of rain or snow on the eastern side over Lakes Glaslyn and Llydaw.

The fall of the year gives the wettest months, and it happens that the quantity running from the lakes in spring is averaged by the snow melting on the sheltered eastern side.

By means of a dam about 100 feet in length, the level of the lake is to be raised 20 feet. The water will be drawn from the lake by means of a tunnel 600 feet in length at a point 30 feet below the present level, or 50 feet below the level when the dams are completed, with the result that there will be sufficient storage for meeting a 90-days' drought. The total fall utilized will be about 1,150 feet, and the total horse-power available—on the basis of nine-hours' working day—is calculated at 8,200.

The first installation consists of two steel pipe lines and four 1,000-kw. sets, each consisting of a double tangential water-wheel coupled to a three-phase alternator giving 11,000 volts at 40 periods per second.

The company will develop the full horse-power of Lake Llydaw before proceeding further, but they have also acquired a further water power at Llyn Eigiao in the Conway Valley, where a fall of 800 feet is obtainable, and where it is calculated there will be nearly twice as much horse-power available as there is at Llyn Llydaw.

One of the first objects of the North Wales Electric Power Company, as soon as their installation is completed, will be to supply energy for the working of certain light railways which they control in the district. It is, however, in addition, intended to supply electric energy throughout a large area comprising the whole of the counties of Carnarvon, Merioneth, and Anglesea, and also a portion of the county of Denbigh.

Three-phase currents are to be used and the transmission lines will be of bare copper wires .324 inches in diameter, carried on insulators triangularly placed on wooden poles. A large proportion of the transmission lines will be carried along the track of the above-mentioned light railways. Lines are to be laid to the principal slate-quarry districts of Nantele, Llanberis, Penrhyn, and Festiniog, where a considerable demand for power exists. The distances from the power station to these places ranges from six to twelve miles.

The latest water-power electric scheme in the United Kingdom is that of the Scotch Water Power Syndicate, who have, by agreement, obtained from Lord Breadalbane and the Trustees of the Colquhoun Estate of Luss, important water-power concessions. These agreements have been negotiated by Mr. E. Ristori, who, it may be mentioned, was one of the original founders of the Falls of Foyers installation, while the engineering and electrical details have been worked out by Mr. William Vaux Graham and the author.

The first power that it is proposed to develop is one connected with Loch Sloy, which is situated some five miles north of Tarbet on the side of Ben Vorlich between Loch Long and Loch Lomond.

Loch Sloy, which is situated some 757 feet above Loch Lomond, which, in turn, is some 26 feet above the sea-level, is fed from a catchment area of about 3,801 acres, which includes one side of Ben Vorlich, which, with its 3,092 feet, is one of the highest mountains in Scotland. The district has the very heavy rainfall of some 74 ins. per annum, of which it is calculated that 60 ins. will be collectible.

A dam will be constructed at the eastern end of the loch, which will raise the height of the latter by some 60 feet. This will impound some 240,000,000 cubic feet of water, capable, with a calculated net fall of 700 feet to Loch Lomond, of maintaining some 6,000-e.h.p. on a 25-per cent. load factor for the maximum possible periods of drought which are calculated at 100 days.

From the loch the water will be taken in the first instance along an open conduit 3,650 yards in length which will follow the contour line round Ben Vorlich till a point is reached almost immediately above the position where the power-house will be constructed on the shore of Loch Lomond at a spot called Inveruglas. From the end of this conduit to the power-house the water will be conveyed in steel pipes, the length of the pipe-line being about 600 yards, and the height of the fall 700 feet.

From the power-house an overhead transmission line is to be constructed in duplicate for the purpose of conveying the electrical energy to the industrial areas of the Vale of Leven and the Clyde, which comprise the towns of Dumbarton, Helensburgh, Renton and Alexandria, and includes shipbuilding yards, engineering and dye works, calico printing works, and factories of various descriptions, many of whom have already intimated their desire to be supplied. The transmission line, for which private wayleaves have been obtained throughout, will be overhead on poles, starting from the generating station at Inveruglas and continuing across country for a distance of 22 miles to a sub-station which will be situated at Renton about mid-way between Dumbarton and the foot of Loch Lomond, in the centre of the Vale of Leven industrial area. At this sub-station the voltage will be reduced from 40,000 volts which it is proposed to employ for the long overhead transmission to some 6,000 to 10,000 volts, it being the intention that the distribution from the sub-station to the various works shall be underground.

The following are the efficiencies which it is calculated will be obtained:—

	Full Load Efficiency %
Open conduit, pipe lines, turbines	75
Three-phase generators	94
Step-up transformers	97
High-tension transmission line	93
Step-down transformers	96
Underground distribution (say 6,000 volts average)	95
Total efficiency	58.6

This is on the assumption of the energy being delivered to customers at 6,000 volts. If, as is probable in most instances, it will be delivered at lower voltages, there will be a further transformation, the efficiency of which will be 95 per cent. in the case of transformation in pressure only, and 86 per cent. in the transformation to continuous current, making a total overall efficiencies: 55.6 per cent. for three-phase current delivered, and 50.3 per cent. for continuous current delivered.

So soon as a market has been found for the total power procurable from Loch Sloy it is intended to utilize a further water power, for which the rights have also been obtained, at Ardlui, about two miles further up Loch Lomond. This power is also fed by a small loch with an available fall of 800 feet, the horse-power obtainable being about half that available at Loch Sloy. The Scotch Water Power Syndicate have, in addition, obtained the rights to still further water powers on the Breadalbane Estate that exist further north, and these will be utilized as soon as the demand for power justifies the capital expense.

It is because of these additional powers (which will considerably extend the length of the transmission) that it is proposed from the start to employ so high a pressure as 40,000 volts.

It is estimated that the total cost of the Loch Sloy scheme, including the transmission line and the distribution to the various factories, will not exceed £200,000 which, on a basis of 5,000-h.-p. delivered, works out at about £40 per horse-power, everything included. Seeing that many of the existing electric generating stations worked by steam have cost almost this amount for land, buildings, and generating plant, this does not appear to be an excessive figure, and it may be pointed out as an interesting fact that the 20 miles of overhead transmission line only accounts for some £24,000, or about 12 per cent. of the total expenditure. This, coupled with the fact that the calculated loss on the transmission line at full load will only amount to about 7 per cent., and the step-up and step-down losses to another 6 per cent., making 13 per cent. in all, all give some idea of the extent to which the length of the transmission line is but a comparatively unimportant factor in schemes of this description. It may be pointed out further that the above-mentioned line loss of 7 per cent. is upon the basis of only one of the two duplicate transmission lines being in use. When both are employed the line loss will be reduced to 3½ per cent., and the total transmission loss at full load will be only a little over 10 per cent.

The main transmission will be on the three-phase system over two sets of three copper conductors each, about 3-10 in. in diameter, the possibility of conveying as much as 5,000-h.-p. over a distance as great as 22 miles, with only 3½ per cent. loss by means of such comparatively small wires, being, of course, due to the high pressure employed. Indeed, using pressure as high as 40,000 volts, when it is a matter of transmitting comparatively small amounts of power, as for instance the 600-h.-p. or thereabouts, that under the present scheme it is expected will be required for the supply of the town of Halensburgh, the interesting point arises that the minimum size of conductor allowable is limited not by electrical conditions, but by considerations of mechanical strength.

On the main transmission line the conductors will be carried at a minimum height of 40 feet from the ground, while at all crossings over roads they will be enclosed in a wire cage to meet the Board of Trade requirements for insuring public safety.

The application of water power in the United Kingdom can, of course, never attain the dimensions that it has already reached in America and elsewhere, still, the above brief account of what is at present being done in Scotland and in Wales, shows that there are possibilities even in this old country, of which till recently but few were aware.

As regards the economies of electrical generation by water-power, no general rule can, of course, be enunciated, and every case must be dealt with on its merits according to local circumstances. This, notwithstanding it is possible to give an indication of what is generally involved, having regard more especially to the fact that with water-power as a rule interest on capital plays a much greater part in determining the cost than do labor or upkeep.

Avoiding on the one hand small powers where the costs are likely to be abnormally high, and on the other very large powers such as we do not possess in this country, it may be taken generally that interest on capital, depreciation, upkeep and working expenses in this country will amount to about 12 per cent. on the capital expenditure.

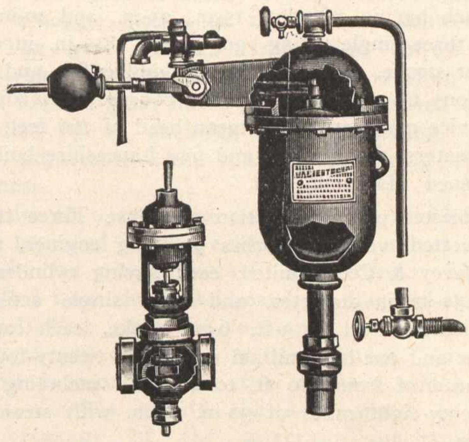
On this basis it is easy to see that to be economically sound, the capital involved must not exceed 8½ times the annual price which can be got for the whole of the energy. For instance, if 5,000-h.-p. is available for sale, and £6 can be got for each horse-power on the average per annum, the capital involved must not exceed £52 per horse-power, or £260,000 in all.

To conclude, it has been said that the greatest benefactor to the human race is he who makes two blades of grass to sprout where only one grew before. On this principle the utilization of natural water-power is obviously to the public advantage. When mechanical or electrical energy is generated by the burning of coal, it is a matter of the consumption not of interest, but of capital. On the other hand, every water horse-power that is put to use is something added, mundanely speaking, for all time, to the permanent resources of mankind.

THE VIGILANT FEED WATER REGULATOR.

Boiler owners seldom realize the enormous amount of energy stored in a boiler charged with the average steam pressure, unless they have seen the havoc from a boiler explosion. At the present time with the large factor of safety with which they are designed, and the careful yearly inspections most boilers are submitted to, it may safely be said that the predominating cause of explosions of this type nowadays is low water. It is not to be understood by this that the water is always permitted to become so low as to allow burning the crown sheets. But the water is permitted such a varied range in the boiler by letting it run pretty low, then filling it to the limit of safety, that the material is subjected to the widest possible variations in expansion and contraction. This action going on from day to day finally terminates in a rupture of greater or less degree; hence the value of maintaining a fixed water line.

To ensure a fixed water level in boilers the Chaplin-Fulton Manufacturing Co., Pittsburg, Pa., have placed upon the market the Vigilant Feed Water Regulator. This appliance not only maintains a fixed water line, but does it automatically. The principle on which the apparatus is based is the difference in weight between a body suspended in steam and suspended in water, which is, of course, equal to the weight of the water it displaces. The regulator consists of three parts. The first is a special bent brass nipple and gate valve, which is screwed into the water column at the point you wish to carry your water level. From that a three-eighths inch pipe connection is made to the top of the hooded chamber. The second part of the apparatus is a hooded chamber as shown. This is placed as close to the column as possible, with the bottom of the chamber eight inches to ten inches above the point at which you desire to carry the water level. A 1¼ in. connection is made from the bottom of the chamber to the boiler or to the bottom connection to the water column. On the top of the hood is a small pet cock for blowing out any accumulation of air. Inside the chamber is suspended a weight which is hung from the end of a lever, whose fulcrum is a shaft, one end of which extends through a stuffing box, while the other rests on a step inside. To the projecting end of this shaft is keyed another lever, which carries an adjustable counterweight, and at the fulcrum has a shoe with an adjustable set screw for lifting the stem of the actuating valve. This valve is attached to the top of the hood, and a steam connection made to the gauge pipe or other point where dry steam may be obtained. The valve has an upper and lower seat so arranged that when against the upper seat the steam connection is shut and the bottom one is open to the atmosphere. When seated on the bottom seat the connection to the air is shut and the steam pressure is admitted to the controlling valve. The controlling valve is the third part of the regulator, and is placed in the feed line to the boiler. In construction it is similar to a check valve, and the entering water tends to lift the valve. A stem extends from the valve through a stuffing box to a hood, which has



Vigilant Feed Water Regulator.

a mushroom top on which rests a diaphragm. The cap above the diaphragm forms a reservoir for water, which prevents the hot steam reaching the rubber diaphragm and burning it. Under the mushroom is a spring which tends to open the valve when there is no pressure on the diaphragm. When the water level is below the opening of the special nipple the regulator chamber will be full of steam, and the water in the pipe to the chamber will be the same height as in the column. The weight in the chamber is then heavier than the counter-weight, and the latter will be in the top position and the actuating valve held against its top seat, and the exhaust will be open to the air. There can then be no pressure on the diaphragm, and the controlling valve will be wide open and the boiler taking water. When the boiler fills up to the opening of the special nipple the steam will be cut off from entering the chamber, and the steam which was in it condenses and makes a vacuum so that the water from the boiler instantly fills it to the top. The inside weight then weighs less than it did when it hung in steam by the weight of the water which it displaces. The counterweight is now heavy enough to over-balance the inside weight and goes down, while the inside weight goes up. As the inside lever goes up the actuating valve goes down, opening the steam connection and shutting the exhaust. This admits the steam pressure to the diaphragm chamber and forces the controlling valve down, so that the feed-water is shut off at once. No more water can enter the boiler until the water level falls to the opening of the special nipple, when steam is admitted to the top of the chamber, the water in it falls to the old level, all the operations are reversed and the controlling valve opens again. These operations are repeated as the water gets above or below the desired point, and the variation does not exceed one-half inch. The agents in Canada for this feed water regulator are the Fairbanks Co., Montreal, Toronto, and Winnipeg.

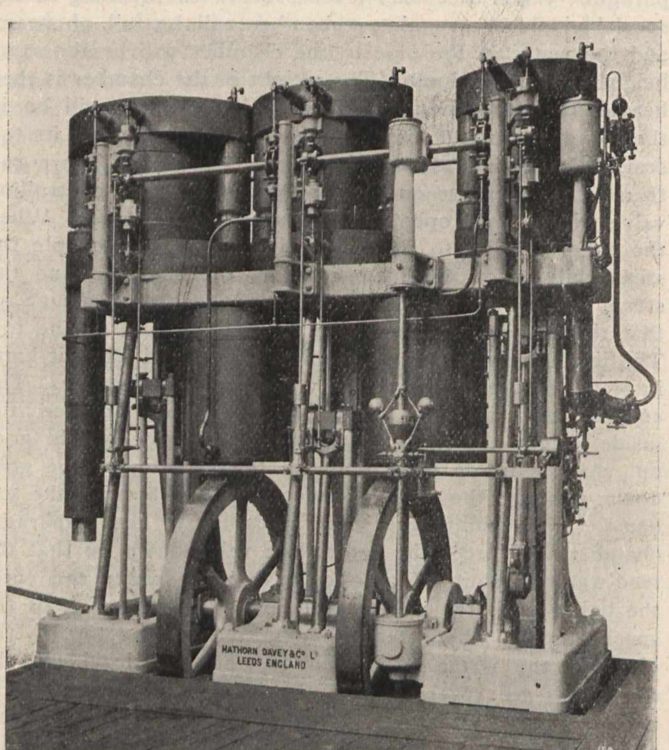
ODESSA WATERWORKS.

When the Odessa municipality purchased the waterworks from a private company, they retained the services of J. J. Platts, the late manager, as consulting engineer, together with his officials, and appointed Mr. Dmitrieff as chairman of the Waterworks Council.

Mr. Dmitrieff at once initiated, under the advice of the consulting engineer, a large scheme for extension of modern lines, which has been successfully carried out. The old plant, which was put down some years ago and has been added to from time to time, draws its water from the river Dniester, where it is filtered and pumped to Odessa through about twenty-eight miles of 30-in. main; it is then re-pumped into the service mains to supply the higher parts of the town. The new extension is to supplement the old plant with the most modern and economical machinery, and consists of a town pumping station with covered reservoirs, situated in Chumka, a suburb of Odessa; a river pumping station with settling tanks and filter beds, situated at Beleivka on the river Dniester, with a new 30-in. main from Dniester to Odessa. The Chumka pumping station contains: Four triple expansion, inverted, vertical, Corliss pumping engines, made by Hathorn, Davey & Co., Limited, Leeds, England, each having cylinders 15-in., 25-in., and 40-in. in diameter, and three single acting ram pumps 18½-in. in diameter, all by 3 feet stroke, each capable of pumping five and one-half million gallons in 24 hours from the covered reservoirs direct into the service main, against a mean head of 160 feet, together with feed heaters, economizers and five Lancashire boilers, was officially opened May 20th, 1901.

The Dniester pumping station contains: Three triple expansion, inverted, vertical, Corliss pumping engines, made by Hathorn, Davey & Co., Limited, each having cylinders 20-in., 36-in., and 54-in. in diameter, and three single acting rams 17-in. in diameter, all by 3-ft. 6-in. stroke, each capable of pumping five and one-half million gallons in twenty-four hours, against a head of from 380 ft. to 460 ft., including friction through twenty-eight miles of 30-in. main, with steam at 180 lbs.' pressure.

Filter Engines.—Two triple expansion, inverted, vertical, Corliss pumping engines, made by the same firm, each having cylinders 12-in., 20-in., and 31-in. in diameter, and three single acting rams 32-in. in diameter, all by 2-ft. 6-in. stroke, each capable of pumping twelve million gallons in twenty-four hours, against a head of 35 ft., including friction, with steam at 180



lbs.' pressure. There are five feed heaters, two Green's economizers, eight Babcock water tube boilers, fitted with superheaters. The steam and feed pipes are on the ring system, and the whole plant is so arranged that any unit can be stopped without interfering with the working of the rest of the plant. Russian coal is used, which costs 24s. per ton, delivered at the pumping station.

With respect to the comparative duty of the old and new pumping plants, the following figures, which are a fair average of every-day working, have been furnished us by the engineering manager, Theodore Platts:

Week ending June 20th, 1903.

Duty in foot pounds per pood (36 lbs. of coal.)

Old engines	16,880,700
New engines	34,271,000

This is equivalent to a duty of 52,517,733 foot pounds and 106,620,888 foot pounds, respectively, by the English standard of measurement.

Head pumped against old engines	323.17 feet.
Head pumped against new engines	314.74 feet.

The difference in the heads pumped against by the old and new engines is accounted for by having a clean main in the case of the latter, but this difference is taken into account in the duty, the measure of work done being in foot pounds.

All the engines were guaranteed by the makers to use not more than 16 lbs. of steam per pump horse-power per hour, and all of them have now been officially tested and are well within the specified guarantee.

Hathorn, Davey & Co. are represented in Canada by Peacock Bros., engineers, Canada Life Building, Montreal.

THE ST. LOUIS EXPOSITION SERVICE PLANT.

The contract for the main service plant for the Louisiana Purchase Exposition was awarded to the Westinghouse Electric and Manufacturing Company shortly after the plans for the Exposition had assumed final form. It called for the designing, installation and equipment of a complete central station to supply electric power for general use throughout the Fair—for the night illumination of the 1,240 acres and countless buildings of the Forest City, for pumping the water for lagoons and court basins, cascades and fountains, for operating exhibits and concessions in various parts of the grounds. The entire steam and electric station was designed and installed by Westinghouse, Church, Kerr & Company, and constitutes a plant of 14,000 horse-power capacity, representative of thoroughly modern practice at minimum cost, such as may be seen in only a few large cities. The four 3,500 horse-power Westinghouse-Corliss vertical cross-compound reciprocating engines at the west end of Machinery Hall, the smaller engines driving exciters in Machinery Hall, the engines driving pumps, stokers, and cooling tower fans in the service plant section of the Steam, Gas and Fuels Building, or Boiler House, just west of Machinery Hall, and the mechanical stokers in the latter building were manufactured by the Westinghouse Machine Company. The auxiliary electric apparatus and switchboard equipment was supplied by the Westinghouse Electric and Manufacturing Company.

The plant has been in continuous operation since April 15th, maintaining its own load, and from time to time carrying extra loads which exhibit plants have been unable to sustain. The station records show the exacting character of service rendered and the number of hours run.

The progress achieved in the manufacture of electric generating units of great capacity has been a very important feature of mechanical and electrical engineering since the time of the World's Columbian Exposition. The great central station at Chicago in 1893 was of about the same total capacity as the present plant, but the twelve generators, although then the largest polyphase alternating current machines ever constructed, were each of only 750 kilowatts, or 1,000 horse-power capacity, while to-day the four 3,500 horse-power units of the Louisiana Purchase Exposition service plant, although three times as large as the largest at Chicago, are regarded as of only medium size. The Westinghouse Electric and Manufacturing Company now has under construction generators for the Ontario Power Company of 10,000 kilowatts, or about 13,500 horse-power capacity, and steam turbines are being built in sizes up to 10,000 horse-power. It is interesting to note that the floor space occupied by the Westinghouse-Corliss engines and their direct-connected generators in the present Exposition service plant, 15 by 35 feet each, is proportionately only about one-ninth of that required at Chicago for six of the twelve 1,000 horse-power generating units there which were belt-driven, each of the latter, with only one-third the capacity of the present units, covering a space 27 by 65 feet.

The Exposition service plant, although it furnishes the main source of power for the world's greatest Fair, and carries all of the commercial operating and lighting load on the grounds and Pike, as well as a large part of the decorative night illumination of the main exhibit buildings, is of interest to engineers not so much for its size as for its completeness.

The Switchboard.

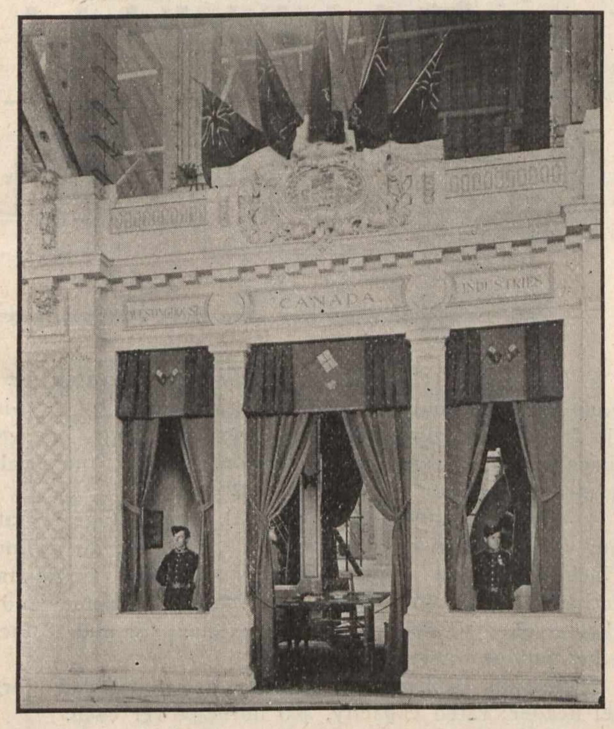
Electric current from the Exposition service plant and from exhibit power plants in Machinery Hall is transmitted over the network of underground cables at a potential of 6,600 volts, transformers being used only at distributing points. All Exposition power is controlled from the twenty-nine-panel marble switchboard on the upper gallery over the west end of the main aisle. The electrically operated oil switches are behind the operating panels, the busses and instruments on the lower gallery, busses being in duplicate, and housed in a structure of masonry with intermediate barriers. All main generator and feeder switches are installed in independent fire-proof vaults, and are electrically operated from the main panel, indicators showing whether a switch is open or closed. Remote control of high tension current is exclusively employed, the switchboard being supplied with high tension, oil-immersed, automatic circuit-breakers, and with ammeters and voltmeters for each space.

Starting the Cascades.

The three 2,000 horse-power Westinghouse induction motors which operate the cascades pumps, estimated to have a capacity of 90,000 gallons of water a minute, are started very gradually at the advertised hours throughout the day and evening, the current being slowly raised to normal, the starting rheostats under Festival Hall, because of the exceptionally large size of the motors, having very many steps. Integrating and indicating wattmeters at the ends of the cables in Machinery Hall record the motor load when the cascades are in operation.

Generating Units.

The four main units are alike in capacity and general design. The engines are of the vertical "cross-compound" type, built vertical to economize floor space, and compound



Canadian Booth in Westinghouse Street of Nations, Palace of Machinery.

in order to secure greater economy of steam, and operate at a speed of eighty-five revolutions a minute. As the generator and flywheel are mounted between cylinders, a connecting "receiver" is necessary, which is built of riveted boiler steel plate, and conducts the exhaust steam from the high pressure cylinder to the inlet of the low pressure cylinder. Bed plates, one on each side, support in order the journals, engine frames, cross-head guides, and cylinders. The shaft, which is nearly three feet in diameter at the centre, is forged hollow from open hearth steel, fluid-compressed to ensure perfect homogeneity of metal. On account of the long span the bearings are self-aligning, having spherical instead of cylindrical seats, resembling the ball and socket arrangement, this permitting slight flexure of the shaft, due to the load concentrated at the centre. Both the bearing shells and the cross-head guides are arranged for water cooling.

Rocking valves of the Corliss type are located directly in the cylinder heads, which connect with "side pipes" paralleling the cylinder walls, a trip release gear on the inlet and a toggle motion on the exhaust controlling these valves. The gear permits a maximum cut-off of three-quarter stroke, enabling each engine to sustain for short periods a load of 5,000 horse-power. The speed of the unit is controlled by an enclosed type self-oiling centrifugal governor, adjustable while running for spring tension and sensitiveness.

In order to operate the generators in multiple, a small motor is provided at the engine, which moves an adjustable weight on the governor mechanism. This motor is controlled from the switchboard, so that the engine speed may be adjusted until the incoming generator has been synchronized and connected to the system. An automatic speed limit is provided on the engines, which instantly closes the throttle should the safe speed be exceeded through breakage of the governor mechanism. This mechanism may be operated also by the engineer from the main floor by means of an electric switch.

The generators, which are rated at 2,000 kilowatts at the usual temperature rise, are of the engine type, revolving field construction, with laminated armatures and fields, the armatures strap wound in partially closed slots, and the fields wound with copper strap on edge. In order to obtain access to the winding the entire generator frame may be moved out of position parallel to the shaft. Three 80 kilowatt, 125-volt Westinghouse engine type units furnish exciting current for the generator fields.

Condensing System.

All main and exciter engines, as well as auxiliaries in Machinery Hall, operate condensing, two complete central condensing equipments being installed, each of 7,000 horse-power capacity, and serving one-half of the plant. They are of the Worthington elevated jet or "barometric" type, provided with entrainers and rotative "dry air" pumps for removing air from the condenser cones. Both horizontal and vertical types of pumps are in operation, one of the three being held in reserve. In case of loss of vacuum an automatic relief valve allows the exhaust steam from the engine to escape through the roof. A motor-driven valve, operated from the floor below by a switch, controls the steam inlet to each condenser. Circulating water is supplied to the condensers by a centrifugal pump of the Worthington turbine pattern, direct driven by compound engine. The hot water discharged into the condenser hot wells is not thrown away, but is cooled for further use in four specially designed cooling towers adjacent to the boiler-room. A second turbine circulating pump elevates the hot water into the towers, and, in falling, the temperature is reduced by evaporation, which process is further aided by forced draft from the fans located at the base of each tower and driven from the boiler-room by a Westinghouse compound engine. A third turbine pump unit is held in reserve, and may be employed on either condensers or cooling towers. Motor driven valves operated by a switch from the floor control the outlet of each pump.

Steam System.

Two complete systems of steam mains, twelve inches in diameter, convey steam to the main engines. The mains are carried beneath the floor in pipe galleries, anchored firmly to prevent creeping, and supported upon rollers to accommodate expansion and contraction. Entrained water collecting in the boiler-room piping is drained out and automatically returned to the boilers by a steam loop and gravity return, which may be seen in continuous operation in the boiler-room.

A similar system of piping for the boiler-room and pumping auxiliaries is connected to the boilers between the drums and main valves, so that steam is always available at the boiler-house auxiliaries. These operate non-condensing, exhausting into two open-feed water heaters, which reclaim the greater part of the heat from the exhaust. In the engine-room all auxiliaries operate, condensing upon the main condensing system.

Boilers.

Steam is furnished by sixteen 400 horse-power Babcock & Wilcox water-tube boilers of the forged header type, set two boilers in a battery. The tubes and drums are carried by steel frames independent of the brick setting. Two ten-inch loop steam mains, each connecting four batteries of boilers, deliver steam to the two twelve-inch mains which carry the steam to the main units in Machinery Hall.

Mechanical Draft.

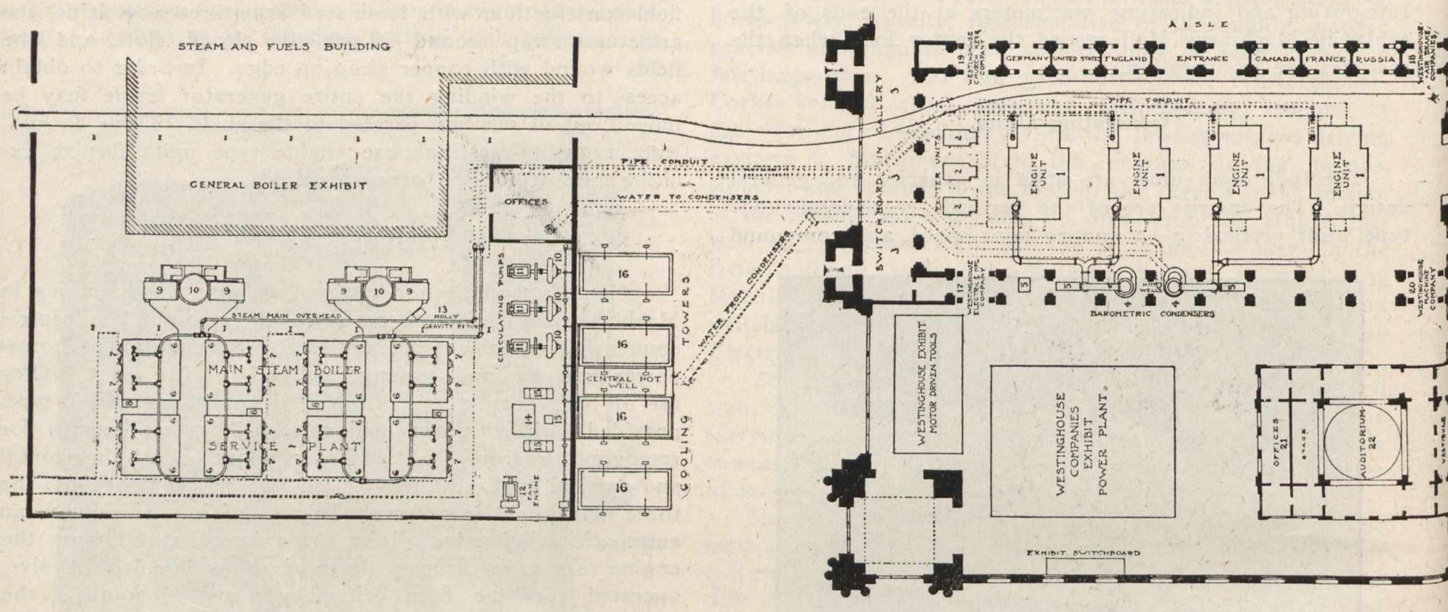
Each group of four batteries of boilers is served by an independent induced mechanical draft equipment. Each equipment is provided with two fans, each capable of operating the boilers at their full capacity. A damper, by means of which either bar may be cut in or out of service, is so arranged that, if desired, both fans may be run simultaneously.

Key to Numbers on Chart.

1. Main Generating Units—Four engines: Diameter of high pressure cylinder, 38 inches. Diameter of low pressure cylinder, 76 inches. Stroke, 54 inches. Shaft, 31 inches diameter and 25 feet in length; fluid compressed open hearth steel; weight, 50,600 pounds. Fly-wheel, 23 feet diameter; weight, 170,000 pounds. Speed, 85 revolutions per minute. Boiler pressure, 150 pounds. Vacuum, 26 inches. Cranks, counter-balanced disc, 90 degrees angularity. Fly-wheel effect, 13,110,000 pounds. Weight engine, without fly-wheel, 576,000 pounds. Weight engine, with fly-wheel, 746,000 pounds. Four generators: 2,000 kilowatt, revolving field, engine type, three-phase; voltage, 6,600. Frequency, 25 cycles per second. Overload capacity, 50 per cent. for one hour. Total weight, complete, 196,000 pounds. Units: Length, 35 feet 1 inch. Width of engine bed, 15 feet. Height of engine, 32 feet 4 inches. Total weight of unit, 942,000 pounds.

2. Exciter Units—Three 80 kilowatt, 6-pole, 125-volt generators, direct connected to three 12 inch and 20 inches and 12 inches Westinghouse compound engines, 300 revolutions per minute, operating condensing.

3. Switchboard—Twenty-nine panels; electrically operated oil switches; remote control.



Mechanical Stokers.

The firing of the boiler plant is accomplished by mechanical stokers, each group of four stokers in line being driven by a small engine, through suitable gearing. The stoker embodies the principle of the narrow rocking grate, stepped at such an angle as to facilitate a uniform descent of fuel from the coking arch at the top to the dumping gate at the bottom; the coking arch, which embodies the principle of the reverberatory furnace, being highly instrumental in securing perfect combustion of the volatile distillates contained in bituminous coal. On the Exhibition grounds the production of smoke is discountenanced, and careful observations of the smoke from the stoker chimneys are made at intervals during the day's run for purposes of comparative record.

Travelling Crane.

In the design of the service plant no important feature of a modern central station was omitted. The electric travelling crane over the main engine units in Machinery Hall is of forty tons carrying capacity, and bridges a span of eighty feet. It is equipped with three motors—one, of 20 horse-power capacity, to drive the bridge, being located at about the centre of the girder, and two, one of 20 horse-power capacity for hoisting and one of five horse-power for moving the trolley, being secured to the trolley itself. The motors are controlled from the crane cab, and current at 110 volts is supplied from the exciters for the main engine units.

4. Barometric Condensers—Forty-inch elevated jet or barometric type, supplied with injection water by a 30-inch main from circulating pumps; overflow from hot wells returned to circulating pumps by wood conduit; main valves operated from floor by electric motors.

5. Dry-air Pumps—One vertical, single-stage, rotative type; steam cylinder, 8 inches and 12 inches; air cylinder, 16 inches and 12 inches. Two horizontal, single-stage, rotative type; steam cylinder, 10 inches diameter and 18 inches stroke; air cylinder, 22 inches diameter and 18 inches stroke; pumps operate condensing.

6. Sixteen Boilers—Water tube type, inclined forged steel header; rated capacity, 400 horse-power each.

7. Mechanical Stokers—Two stokers to each battery; receive coal from overhead hoppers, supplied by general conveying system; ashes removed through basement to elevator.

8. Four Stoker Engines—Westinghouse enclosed, self-lubricating, each engine driving stokers on two adjacent batteries of boilers.

9. Mechanical Draft Plant—Two complete plants. Four fans, in pairs, three-quarter housed, over-hung type, operating on the inductive principle, the fan wheel being mounted on the engine shaft.

10. Centrifugal Circulating Pumps—Three direct driven, turbine type, 24 inch discharge; capacity of each, 17,000 gallons per minute under a 50 foot total head.

11. Circulating Pump Engines—Three single-acting, compound type, 18 inches and 30 inches and 16 inches; governor arranged to vary speed according to pump output.

12. Fan engine for cooling towers.

13. Steam loop and Holly gravity return system.

14. Feed Water Heaters—Receive exhaust steam from all boiler-room auxiliaries.

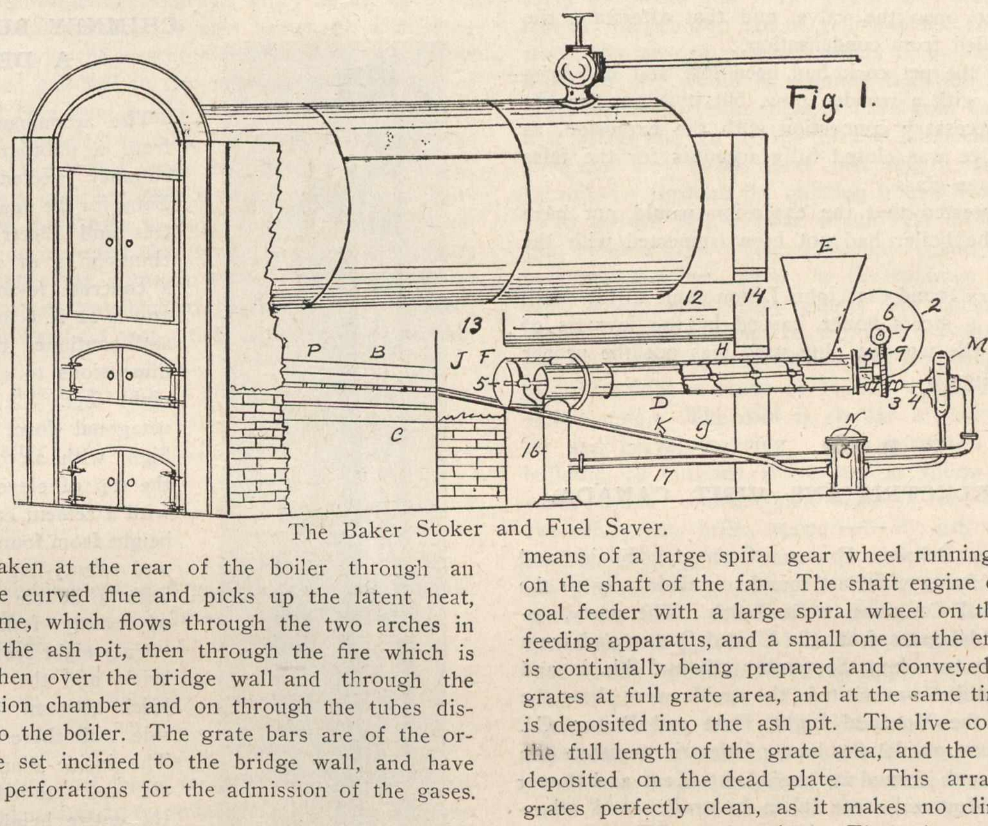
15. Boiler Feed Pumps—Steam cylinder, 14 inches by 18 inches; water cylinder, 10 inches by 18 inches. Two horizontal, compound, duplex, outside packed plunger type; steam cylinders, 9 and 16 inches in diameter by 15 inches stroke; water plungers, 7½ inches diameter by 15 inches stroke.

16. Forced Draught Cooling Towers—Effective area of each tower, 460 square feet, each equipped with four 120-inch disc fans; "make-up" water, replacing the amount evaporated, is supplied from city mains.

17 to 22. Information bureaus, general offices, and Biograph Auditorium.

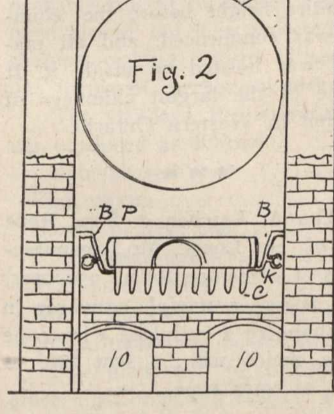
IMPROVEMENTS IN FURNACE FEEDING.

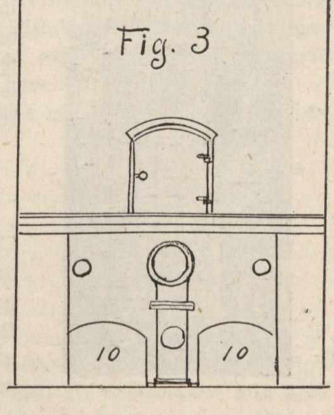
Robert Baker, of Hamilton, Ont., has obtained patents in Canada, Great Britain and the United States for a stoking and fuel-saving device which appears to combine two important advances in furnace feeding and in completeness of combustion of fuel. So far as we have heard, this is the first machine of the kind which works with natural draft, and it is the first which combines with a stoking apparatus a gas generating plant and retort for saving the by-products of coal. The invention is described as follows:



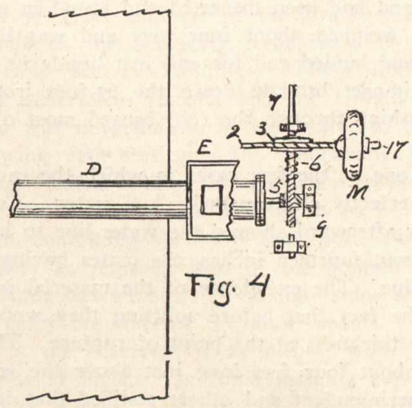
The Baker Stoker and Fuel Saver.

The draft is taken at the rear of the boiler through an opening beneath the curved flue and picks up the latent heat, increasing the volume, which flows through the two arches in the bridge wall to the ash pit, then through the fire which is upon the grates; then over the bridge wall and through the flue to the combustion chamber and on through the tubes distributing the heat to the boiler. The grate bars are of the ordinary type and are set inclined to the bridge wall, and have inclined sides with perforations for the admission of the gases.





The ash pit is provided with a receiver for water of the full area of the pit and is fed automatically at a constant level. The coal is fed into a hopper by means of a bunker and conveyed from thence by a spiral feed device to the generating chamber in the bridge wall, where it is prepared as live coal for the grates. The gases are conveyed rearwards by means of a fan, and in their course deposit their impurities in liquid form—as is done in the manufacture of illuminating gases—into a receiver; thence forward to the back of the inclined



sides, depositing the gases in opposite directions through the perforations to the fire, where they are consumed.

The engine that drives this appliance has double cylinders, and is set on quarter-crank motion. The draining of the cylinders is trapped with an expansion trap to relieve the condensation. The fan is geared from the shaft of the engine by means of a large spiral gear wheel running into a smaller one on the shaft of the fan. The shaft engine extends to the spiral coal feeder with a large spiral wheel on the shaft of the coal feeding apparatus, and a small one on the engine shaft. The coal is continually being prepared and conveyed forward on to the grates at full grate area, and at the same time the carbonic acid is deposited into the ash pit. The live coals are conveyed to the full length of the grate area, and the ashes therefrom are deposited on the dead plate. This arrangement keeps the grates perfectly clean, as it makes no clinkers, all impurities having now been deposited. The ashes can be cleared from the front when necessary without disturbing the fire. The fire and ash pit doors are kept closed until the deposits are required to be removed, therefore no cold air can be admitted to the boiler.

This machine is controlled by a damper regulator. When a given pressure is obtained, the dampers readily close, the engine is shut down, and the bye-pass is opened for the gases to flow to the grates by gravitation. When the pressure falls, the dampers readily open and the bye-pass closes and the engine is set in motion. This being a completely automatic machine, no attendance is required through the night, nor any banking of fires. Simply set the dampers to the pressure required to be carried through the night. When the engineer comes in for duty in the morning he sees that the water is all right in the boiler, then he goes to his damper regulator and sets it at the desired pressure to be carried through the day. He then may oil his engine and attend to any other necessary duties. He will then find the steam up and all ready for starting up without any further attention.

BOILER EXPLOSION AT TORONTO.

On September 14th, a boiler exploded in the Toronto Bolt and Forging Co.'s rolling mill at Sunnyside. Two men have lost their lives and five are more or less injured. The boiler was built about two years ago by the Canadian Heine Safety Boiler Co., and had been inspected and found in good condition in July. It weighed about four tons and was lifted from its foundation and landed end for end just beside its original location. The impact brought down the 65-foot iron smokestack, and this crashing through the roof caused most of the property damage.

This is one of the few cases in which the cause of the explosion is perfectly clear, namely, low water. An examination of the boiler afterward showed the water-line to have been at a height of about fourteen inches, the plates having been red-hot above this line. The excellence of the material in the plates is shown by the fact that before splitting they were stretched to a knife-edge thickness at the point of rupture. The tear in the plates was about four feet long just above the water-line.

The superintendent and others testified that just before the explosion the gauge-glass showed water to a good height, but investigation showed that the gauge glass was disconnected from the boiler, the valve at the lower end being found tightly closed. How it came that this valve should be closed will never be known, as Engineer Dixon, the man in full charge of the water feed, has died of his injuries. The most probable explanation seems to be that he had blown out the gauge glass and had forgotten to open the valve, and that afterward the glass had partially filled from condensation.

A brass plug in the pet cock had been lost and had been temporarily replaced with a wooden plug, but it is not thought that this had any necessary connection with the explosion, as the fact that the valve was closed fully accounts for the false indication of the gauge glass.

It has been suggested that the explosion would not have been so violent if the boiler had not been connected with the other boilers.

The coroner's jury found that John Dixon came to his death by the explosion of a steam boiler, caused by the lowness of water and also that the wooden plug used was not the proper thing for a water gauge.

EUROPEAN ELECTRICIANS VISIT CANADA.

Electricians from Britain, France, Germany, Spain and Italy paid Canada a flying visit last month on their way to the International Electrical Congress in St. Louis. The party, accompanied by a few delegates from the United States, and from South America, spent two days, September 7th and 8th, in and around Montreal. Lachine was visited; the rapids were shot; the main sub-station of the Montreal Light, Heat and Power Co. was investigated, where amidst the hum of electric monsters the visitors enjoyed a lunch served by the Light, Heat and Power Co. Trips around Montreal were taken by trolley and otherwise, and the first day was closed with a garden party given by the Forest and Stream Club at Dorval. The second day was occupied with a trip to Shawinigan Falls, where the party was entertained by the Shawinigan Water and Power Co. In the evening the delegation left by special train for Niagara Falls, whence, after a short visit, they departed for St. Louis.

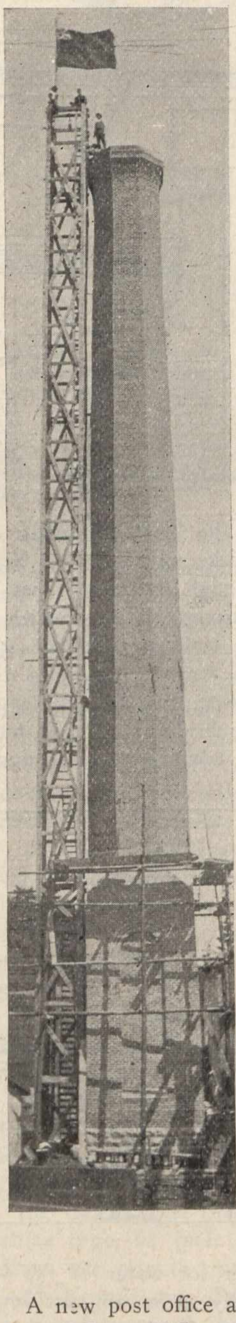
Following are the names of the visiting members of the Institute of Electrical Engineers of Great Britain: R. Kaye Gray, president; Col. R. E. Crompton, C.B., past president; Prof. John Perry, past president; C. H. Merz, member of council; R. Hammond, honorary treasurer; G. C. Lloyd, secretary, and A. F. T. Atchison, Francis G Baily, G. Balfour, R. S. Ball. W. A. Barnes, D. Bates, Fred. Beanland, G. Conrad Blair, John T. Connolly, Prof. J. D. Cormack, C. B. Crawshaw, J. R. Dick, W. Duddell, R. S. Erskine, W. P. J. Fawcus, Theo. Feilden, J. A. Foster, W. Geipel, W. A. Harris, Charles C. Hawkins, M. Hayashi, Thomas Hesketh, F. Hope-Jones, M. Jennison, F. C. Kidman, L. Lehurann, Emil H. Liebert, F. M. Long, Benjamin Longbottom, R. B. Matthews, R. S. McLeod, John L. Marr, W. B. Marr, G. F. Metzger, F. O. Mills, D. K. Morris, John T. Morris, R. W. Paul, Robert B. Perring, Godfrey Pope, A. P. Pyne, G. H. C. Risch, E. N. Sawtelle, A. P. Scott, E. M. Sconer, M. W. Scott, H. B. Simons, P. S. Sheardown, C. D. Taite, Max E. J. Tilney, J. H. Tonge, R. Tree, chief clerk; George Wilkinson, R. Ffolliott Wiliss, E. B. Wollan, and H. G. Whiting.

R. Kaye Gray, president of the Institution, spoke for the British delegates at the reception tendered. He expressed himself as deeply interested in all he had seen, and was pleased to find Canada a country vast in project and achievement. He reports England very much alive in matters electrical; he admits that there may be development on this side surpassing that in the Old Land, but ideas worked out on this continent often originated across the water. There is a feeling in England that English suggestions may be left with others to develop, and then results be reaped by the English people. Britain is ready to adopt ideas from anywhere, but she always gives ideas in return.

Jorge Newbury, general director of electrical works in Buenos Ayres, Argentina, was one of the party. He states that the electrical development of that city amounts now to about 30,000-h.p.

Several Italians were among the visitors, including Professor Ascoli, one of the Government delegates. Italian, Spanish, French and other tongues were heard in the party, but no lingual difficulty was experienced, as all spoke and understood the harsher and less musical English.

CHIMNEY BUILDING FROM A DERRICK.



The accompanying engraving is from a photograph of the brick chimney erected by R. Corrick & Sons, for the new plant of the Sarnia Gas and Electric Light Co. The chimney is of red brick, built on a concrete foundation 9 by 17 ft., and is 12 ft. 6 in. square at the base and continues the same form and dimensions to a height of twenty-eight feet. Above that it is of octagonal form ninety-seven feet high, with an outside diameter at the top of eleven feet and finished with a cement cap, making the total height from foundation, one hundred and twenty-five feet. It is provided with a double wall to the height of seventy four feet ten inches, twenty-eight feet of which is of fire brick, and the balance of ordinary brick between which and the outside wall there is ample air space. The inside diameter is practically six and one-half feet throughout the entire height. The derrick, as seen in the photograph, was built its entire height before the chimney was commenced, and all material was hoisted up inside it. It is one of the largest chimneys of its kind in Western Ontario.

—The A. Leschen & Sons Rope Co., of St. Louis, Mo., manufacturers of wire rope for all purposes, have issued a useful souvenir in the shape of a celluloid wire rope gauge, which will be sent free to users of wire rope.

A new post office and customs building is being erected at Sydney Mines, N.S., at a cost of about $18,000. James Reid has the contract.

NEW COAL AREAS ON THE C. P. R.

At Bienfait, about ten miles east of Estevan, on the Souris branch of the Canadian Pacific Railway, mines are being opened which will be capable of turning out, when fully developed, 1,000 tons of lignite coal per day. As at this point the coal lies within 70 feet of the surface and quite flat, and with a dip of about 1 degree to the south, an incline or slope is being used in place of a shaft. The thickness of the seam at this point is 15 feet, but only the bottom 7 feet will be mined. This class of fuel, which is somewhat better than that found in Dakota, is used almost entirely by the farmers throughout the wheat districts of the North-West Territories and Manitoba. It is also used by the largest milling companies, being cheaper than either the high-priced coal from the East or the coals from Alberta and British Columbia.

Two seams of semi-anthracite coal are also being developed at a point six miles east of Banff, Alberta. The two seams average, respectively, seven and eight feet, dipping 45 degrees to the west. The seams have been explored for a distance of seven or eight miles north, and the measures as a whole comprise some six workable seams in a distance of 2,000 feet at right angles to the dip. Some of the upper seams are semi-bituminous. The two lower semi-anthracite seams, on which all of the present development work is now being performed, are found in the hard, cretaceous sand stone. The upper measures are in softer shales and sand stones, which is supposed to be the explanation for the upper seams being semi-bituminous instead of semi-anthracite. A gravel entry 22 ft. by 9 ft., consisting of three compartments, is now being run a distance of 1,600 ft. to connect with the present underground workings. At a distance of one and one-half to two miles from the mouth of the entry, there will be a total height of about 2,000 feet of coal. It is, therefore, not intended to sink for some years. As the practice throughout Western Canada has been to use wood, lignite or bituminous coal for both domestic and steam purposes, it will require some time to develop a very large market in the West, but it is expected that within two or three years the product will supply the domestic trade from Winnipeg to Vancouver. It is also quite possible that this fuel will be marketed to advantage in the Pacific Coast cities, where a large market will be available.

The analysis of the clean coal is about as follows:

Fixed carbon	84 per cent.
Volatile matter	9 " "
Moisture	1 " "
Ash	6 " "
	100 " "

The clean semi-bituminous coal analyzes about as follows:

Fixed carbon	78 per cent.
Volatile matter	14 " "
Moisture	1 " "
Ash	7 " "
	100 " "

The semi-anthracite coal burns more freely than the Pennsylvania product, and is a little more brittle. The semi-bituminous is excellent steam coal. The ash in regular shipments will probably run 12 to 14 per cent. At present, the coal is being hand picked, but it is expected to install some of the latest mechanical picking devices as soon as experiments with the various forms of mechanical pickers have been completed.

The standard Pennsylvania sizes of anthracite are now being produced as follows:

Lump, passes over	3¼" round holes
Egg, passes over	2¼" " "
Stove, passes over	1½" " "
Nut, passes over,	7/8" " "
Pea, passes over	9/16" " "
No. 1, buckwheat, passes over	5/16" " "
No. 2 buckwheat passes over	3/16" " "

The plant will be equipped with four 150-h.p. Robb Engineering Company's boilers, a 15 drill air compressor, and also a high pressure compressor for compressed air haulage. Thirty or forty miners' cottages are being built this summer, and a large number will be completed next summer. Several boarding houses are also under way. A complete fire, water and drainage system will soon be installed. All these mines are owned and operated by the Canadian Pacific Railway.

COMPARATIVE COST OF WOOD AND STEEL FRAME FACTORY BUILDINGS.

H. G. Tyrrell, chief engineer of the Brackett Bridge Co., Cincinnati, sends us the following comparison of the cost of wood and steel in factory buildings. There are differences in the cost of material in Canada and the United States, but the comparison will, nevertheless, be instructive to our readers:

The following estimates give the comparative costs of a factory building, framed in slow burning wood construction, and steel fireproof construction. The building is 60 by 100 ft., and six stories high, containing six floors and roof. The floors are designed to carry an imposed load of 100 pounds per square foot. The building has windows in all four sides and the walls in both cases carry the ends of the floor beams. The thickness of walls in the basement is 24 inches, while in the first four stories it is 17 inches. In the remaining two stories the wall is 13 inches thick. The estimates given below, are for the structural part of the building only, including walls, columns, floors, roof, excavation, doors and windows, foundations, but do not include any partitions, stairs, elevator, plumbing, heating, lighting or wiring.

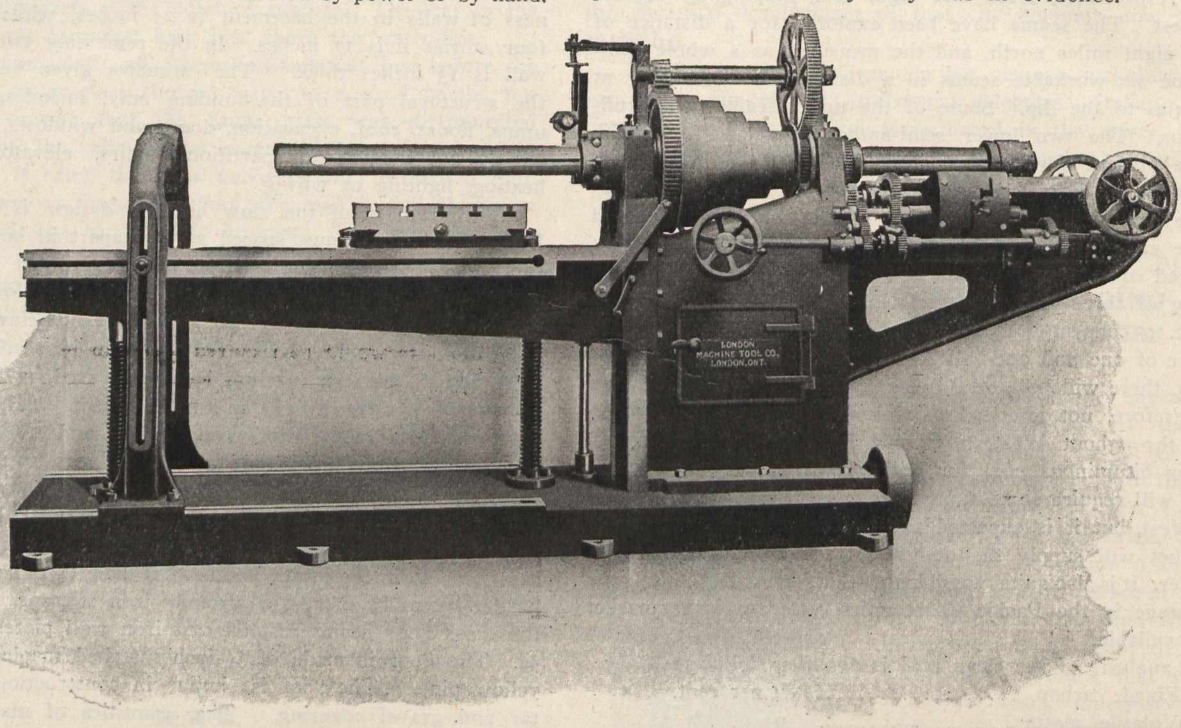
The framing of the slow burning design is as follows: Eight tiers of columns, spaced 20 feet apart in both directions, carry the floors and roof. From the roof down through four stories, the columns are of yellow pine. In the lowest of these stories the size of column used is 14 by 14. Below this, where a greater size would be required than can be secured economically, round cast iron columns have been used, 11 by 1¼ in the first story, and 12 by 1½ in the basement. All the columns have cast iron bases, three feet square and 16 inches high. Lengthwise through the building in the floors, run two lines of 12 by 20-inch yellow pine, which rest on the brackets of cast iron column caps. The cross floor beams are 8 by 16 yellow pine spaced 5 feet apart. At the columns they rest on column caps, and at intermediate points they hang from the 12 by 20 header beams by means of wrought iron stirrups. In the walls the cross floor beams rest on cast iron wall plates, 9 by 20 by ¾. The floor is made of ⅞-inch matched maple, laid on 1¾ yellow pine. The roof is similar in construction and has a tar and gravel covering. The quantities of material in the building, as outlined above, are as follows: Excavation, 1,800 yards; cellar, cement floor, 6,000 sq. ft.; foundation, concrete, 150 cub. yards; brick, 39,000 cub. ft.; 238 windows, 4 by 7 ft.; roofing, 6,000 sq. ft.; yellow pine timber, 116,000 ft. B.M.; yellow pine flooring, 73,000 ft., B.M.; ⅞-in. matched flooring, 46,000 ft., B.M.; iron work, 46 tons. The estimated cost of this design is $35,000, which is equivalent to 6.1 cents per cub. foot of the building, or 83 cents per square foot of the entire area of all the floors. The interior framing of floors and columns, including wall plates, columns, caps and bases and stirrup irons, is 27 cents per square foot of floor area.

In the fireproof design, the arrangement of beams and columns is similar to that for the slow burning design. Riveted steel columns are used from cellar to roof, and the floors are framed with steel beams. The flooring between the beams is reinforced concrete. In this case the quantities are as follows: Excavation, 1,800 cub. yards; cellar floor, 6,000 sq. ft.; foundadation, concrete, 150 cub. yards; brick, 39,000 cub. ft.; 238 windows, 4 by 7 ft.; roofing, 6,000 sq. ft.; steel columns, 105 tons; steel beams and wall plates, 252 tons; concrete, floor and roof, 42,000 sq. ft. The cost of the building in this case is $57,000, which corresponds to 10.2 cents per cubic foot of building, or $1.36 per square foot of the total floor area. Floors and columns cost 75 cents per square foot of floor area. Hence the comparative estimates are as follows:

	Cost per Cub. Ft. of Building.	Cost per Sq. Ft. Floor Area	Cost of Floors and Cols., Sq. Ft.	Total Cost.
Slow burning construction	6.2c.	83c.	27c.	$35,000
Fireproof steel construction	10.2c.	136c.	75c.	$75,000

NEW TYPE OF HORIZONTAL BORING MILL.

We herewith present a new type of horizontal boring mill, which has lately been put on the market. The capacity of the machine, as shown in the illustration, will bore up to five feet in diameter and six feet in length. The head is large and massive, having five speeds for four-inch belt, the largest diameter of cone being 23 inches, and being powerfully back geared gives ample power for the heaviest work, and permits of high speed steels being used to the best advantage. The boring bar is four inches in diameter, and has a feed of 36 inches, without shifting the driving pins. The feeds are reversible, are eight in number, ranging in geometrical progression from 1-128 inches per revolution of spindle to 5-16 inches. This provides a variation suitable for any class of work. The feeds can be thrown in and out while the machine is in operation from either side of the machine. Hand-feed and quick return is also provided. The table has movement, both crosswise and in a longitudinal direction. The knee is raised and lowered by power or by hand, as desired, the raising and lowering being accomplished by means of a worm and worm wheel placed underneath knee. A facing up to 26 inches' diameter. The total weight of the machine is 18,000 lbs. It is manufactured by the London Machine Tool Co., London, Ont., who will be pleased to furnish upon application any further information.



AN ANTHRACITE MOUNTAIN IN ALBERTA.

A mountain of hard coal in Alberta has recently been purchased by P. Burns & Co. for $32,000. From the Wetaskiwin Post we glean the following description of the location:

The property is in the Misty range, 36 miles west of Okotoks, Alta., and comprises 16,000 acres. It was discovered by an explorer, Julius Rickart, an old-time prospector. Mr. Patrick, D.L.S., and a party of surveyors spent several weeks in the district and made a thorough inspection of the coal seams as exposed in many tunnels made by the miners in the pass.

The situation of this phenomenal coal bed is most picturesque. Upon either side there tower huge, precipitous mountains thousands of feet high, and nestling in a valley is this mountain of coal, which is twelve miles long and three miles wide. Its formation differs vastly from that of the surrounding mountains, as it is covered with vegetation, while the others are bare limestone. For some time past miners have been engaged making tunnels into the mountain, and succeeded in exposing twenty-six veins of coal, which varied from four feet up to forty feet. Samples of this coal have been sent to assayers in Denver, Vancouver and other cities, and in every case remarkable reports were made. The assays run from 87 to 92 per cent. carbon. The following is the report received of the assay of the four-foot vein: Water, none; volatile matter, four per cent.; fixed carbon, 92 per cent.; sulphur, none; ashes, 4 per cent. The physical description is briefly given in the report: Color of ashes, white; weight per cubic yard, 2,680 pounds; specific gravity, 1.54. What particularly attracts attention is the total absence of rock, and of smoke in burning. The coal ignites easily, and from experience in burning it the assayers feel satisfied that it excels the well-known Pennsylvania variety.

The advantage of working this mine is a great consideration, as practically no machinery is needed for taking water out of the mine. Mr. Burns is highly elated with his purchase, and is of the opinion that it will develop into the largest mining camp in the Dominion. The whole of the country west is one huge bed of coal, but up to the present the soft variety only was in evidence.

—One of the principal difficulties in the economy of steam boiler operation in certain sections is incrustation. Its destructive effects have been the subject of such a wide amount of comment and warning that steam users might be presumed to be constantly on their guard to prevent it, but as a matter of fact, except in localities where the evil is so pronounced as to imperatively demand the adoption of preventive means, this subject is too commonly neglected. Unfortunately, the evils arising from this cause are often insidious, and do not make themselves manifest until substantial injury has occurred by the overheating and weakening of the boiler shell, or by effecting the crystallization, granulation, burning and fracture of the material, while wasting fuel. The extent of this waste is hardly appreciated until it is known that a 1-16-in. of scale in the boilers means an increase in the fuel bill of about 13 per cent. A standard remedy for the removal of scale, already deposited in boilers, as well as preventing its re-formation without injury to the boiler, is Keystone Tri-Sodium Phosphate. The most careful analysis by eminent chemists has shown that it is incapable of injuring the iron of the boiler. Where boilers are already coated with scale, its use gradually converts the stony incrustations of the carbonates of lime and magnesia, and even anhydrous sulphate of lime, into pulverent and flocculent phosphates. It also separates the foreign matter held in solution by the water as a light flocculent precipitate, which will not bake into a crystalline scale, but is easily removed by blowing off, thus preventing the formation of incrustation, and furthermore, it neutralizes acids contained in the water, thus rendering them innocuous. A sufficient quantity for testing this chemical will be sent to any Canadian manufacturer on mentioning the Canadian Engineer. Address: The Keystone Chemical Manufacturing Co., Camden, N.J.

A. C. vs. D. C. ARC SYSTEMS.

A Paper read by W. L. McFarlane before the Canadian Electrical Association.

(Concluded from August Issue).

Arc Lamps.

Having examined into the different arrangements of station apparatus, we now come to the lamps themselves, in the consideration of which we must pay due regard to the requirements or opinions of the customer or others depending on or using the light. Generally speaking, the systems available are the constant potential or multiple, used mainly for interior lighting, and the constant current or series, using both direct and alternating current, for street lighting. Multiple lamps are supplied for use on both alternating and direct current, but with few exceptions direct current for the operation of multiple lamps is not available in Canada; therefore, multiple A. C. lamps are all that need be considered here. These are of both the open and enclosed type, but the open lamp has not met with as much favor as the latter on account of the short life of the carbons, the poor quality of the light as compared with the D. C. lamp, its unreliability, and the noise made by the arc and lamp mechanism. The multiple enclosed lamp is much superior in this respect, the power factor also being better.

Multiple lamps are used mainly to supply customers' premises where the high voltage series arc system is objectionable, or the flat-rate charged for it does not meet with approval, as the multiple lamp can be charged for by meter, and supplied from the low potential lighting system. These lamps, being under control of the customer, permits of his using them at any time of the day or night. This is of great advantage during dull weather, or when the lamps are used in dark buildings or in basements. Then, in the case of long days or early closing, the customer is not compelled to pay for light which he does not need, as is the case when the series lamp is in use, and customers located beyond the reach of the series of commercial circuits are now as well supplied with light as those located nearer the station. The preference shown for the constant potential lamp for interior lighting is illustrated in the case of a plant which I have in mind, in which the commercial series constant current arc lamps connected are at present almost nil, where a few years ago they numbered almost 400; this in spite of the fact that the output of the plant in all other respects has increased enormously.

Constant current series lamps, either direct or alternating, give the best commercial satisfaction when they are of the differential rather than the shunt type. The direct current lamps are either open or enclosed. Open lamps cost about 15 per cent. less than the enclosed, and, owing to the E. M. F. of the former being about 50 volts as compared to 72 volts in the latter, there is a corresponding saving in the cost of the circuit insulation, etc. The enclosed direct current lamp is much more reliable than the open lamp, the maintenance of the lamps and the outages being reduced about 50 per cent. The most noticeable saving when enclosed lamps are used is in the operation, the cost of carbons and trimming being reduced nearly two-thirds. For mechanical reasons we cannot expect a saving in line copper to correspond with the difference in current required by the two styles of lamps, as No. 6 wire will probably be required in any case; there will, however, be a slight saving in the copper losses.

The enclosed A. C. series lamp, as far as reliability of service is concerned, compares favorably with the enclosed D. C. lamp; the cost of the lamp and the maintenance is slightly more, however, as there seems to be a greater tendency for the insulation of the A. C. lamp to become punctured. This I attribute to surging, resonance, or other high voltage conditions which occur on the circuit at times of grounds, short or open circuits, and believe that this trouble is reduced to a minimum by the use of suitable spark gaps connected across each lamp, as well as occasionally across the line. With the use of high voltage circuits comes the necessity of installing an absolute cut-out for each lamp as a protection against accidents to inspectors. Table No. 4 gives the approximate annual line costs of the three different types of series arc lamps. The costs, as stated above, are nearly equal for the two types of enclosed lamps, but the open lamp costs are nearly double that of the enclosed lamps.

Showing Comparative Approximate Annual Line Costs for Different Arc Lamps.

Items of Cost: Account	Sub-Account	Open D.C. Lamps $	Enclosed D.C. Lamps $	Enclosed A.C. Lamps $
Construction..	Reconstruction of Circuits	....	2550	2550
	Lamps	10000	11500	12500
	Total	10000	14050	15050
Maintenance..	Interest and Depreciation	1500	2107	2257
	Lamps	1000	500	750
Operation.....	Carbons	3285	700	800
	Trimming	3120	1040	1040
	Inspection	520	520	520
	Inner Globes	....	300	350
	Outer Globes	75	125	125
	Total	7000	2685	2835
Grand Total		9500	5292	5842

Illuminating Qualities.

The maximum candle power of the open arc is higher than that of the enclosed arc, but the light is not so steady owing to the more frequent feeding of the carbons, their poorer quality, and the action of the wind on the arc. Owing to the shortness of the open arc, and to the fact that most of the light comes from the crater of the upper carbon, this light is in a downward direction, being greatest at an angle of about 45 degrees, while a large area under the lamp is poorly lighted and affected by shadows. In the enclosed arc, the wandering of the arc is the main cause of what variation there is in the light, but by the use of an opal inner globe these variations are greatly reduced. The increased length of the enclosed arc allows the light to diffuse in a more horizontal direction, the result being much less light in the immediate vicinity of the lamp, but a slightly increased amount midway between lamps. A comparison of the light given by the two enclosed arcs, namely, the direct current and the alternating current lamps will show that the former gives slightly more light at all points than the alternating lamp, although the alternating lamp gives more light than the open direct current lamp midway between lamps. It is claimed that "the difference in the light (at, say, 150 feet from the lamp) between the D. C. and the A. C. enclosed lamps is nearly, if not quite, compensated for on account of the more subdued light in the vicinity of the A. C. lamp increasing the relative effect of the light at a distance by reduced contrast." Whether this is so or not, the fact remains that the light given by the alternating lamp is apparently less than that given by the open D. C. lamp, and the apparent reduction in illuminating power is a very difficult point to explain satisfactorily to the municipal authorities or the public in general. It is only fair to say though that where an old style open direct current arc system has been replaced by a modern alternating enclosed system it is rare to find any serious opposition, especially so if the new system is properly handled and maintained. The possibility of such trouble need not, I think, deter anyone from installing modern equip-

3rd. The efficiency, power factor, horse-power, and apparent horse-power for the different types of apparatus. Also an assumed cost of power under different conditions.

From this table we should be able without much trouble to determine the approximate annual cost of a 500 arc lamp plant under almost any conditions. For example, let us take a 60 cycle water-power plant with steam reserve, using direct connected sets and enclosed lamps. From the table we find:

The station costs..................................	$ 6,453 00
The line costs..	5,292 00
The efficiency of direct connected sets is 81 per cent. and the actual power required 397 h.p., this at an assumed figure of $15 per h.p. for 60 cycle water-power would equal $5,955; but $15 is for 24 hours service, so it might be fairer to charge the arc plant with but one-half of this, or $7.50 per h.p., at which the cost of our power would equal..........................	2,977 50
The total cost would, therefore, be...........	$14,722 50
Or a cost per arc lamp of about.............	29 44

Table No. 5.

Summary of Annual Costs.

STATION COSTS—INTEREST, DEPRECIATION, MAINTENANCE AND OPERATION.

Style of Station Arc Apparatus in use.	Water Power. 60 Cycles. Motors and Shafting. $	Direct Connected Sets. $	Constant Current Transformers. $	Water Power. 25 Cycles. Motors and Shafting. $	Direct Connected Sets. $	Constant Current Transformers. $	Steam Power. 60 Cycles. Motors and Shafting. $	Direct Connected Sets. $	Constant Current Transformers. $	Steam Power. Engine. Engine and Shafting. $	Engine and Motors Connected to Shafting. $	Water Power and Steam Reserve. 60 Cycles. Motors connected to Shafting. $	Direct Connected Sets. $	Constant Current Transformers. $	Engine and Motors Connected to Shafting. $	Water Power and Steam Reserve. 25 Cycles. Motors Connected to Shafting. $	Direct Connected Sets. $	Constant Current Transformers $
Small Arc Dynamos....	7067	....	....	7067	....	....	7067	....	....	7818	9084	7067	....	....	9084	7067	....	....
Large Arc Dynamos....	....	6453	.. .	....	6453	....	....	6543	....	7258	8660	....	6453	....	8660	....	6453	....
Constant Current Transformers.....	....	....	1415	....	....	1415	....	....	1415	....	....	....	....	1415	....	....	....	1415

LINE COSTS—INTEREST, DEPRECIATION, MAINTENANCE AND OPERATION.

Open D.C. Lamps Total Cost	Open D.C. Lamps Cost per Lamp	Enclosed D.C. Lamps Total Cost	Enclosed D.C. Lamps Cost per Lamp	Enclosed A.C. Lamps Total Cost	Enclosed A.C. Lamps Cost per Lamp
$9500	$19	$5292	$10.6	$5842	$11.7

EFFICIENCY AND POWER FACTOR.

	Direct Connected Sets	Motors and Shafting Small Dyn.	Motors and Shafting Large Dyn.	Engine and Shafting Small Dyn.	Engine and Shafting Large Dyn.	Constant Current Transformers
Efficiency..	81%	53.8%	76.8%	52.7%	75.25%	93%
Power Factor	.92	.92	.92	100	100	.75
H.P. required for 500 Lamps	397	598	420	614	427	347
Approximate H.P required for 500 Lamps	432	650	456	614	427	462

ment of this type if other conditions indicate that it is advisable to do so.

Summary of Costs.

As the factor which will determine the apparatus or system that shall be adopted, when the remodelling of an arc plant is under consideration, will most likely be the cost, it was thought that the placing of these costs in a convenient form might be useful, and this has been attempted in Table No. 5, as above:

Assumed Cost of Power.

60 Cycle Steam Power delivered on the Bus Bar—$50 for 24 hours service.

Steam Power delivered at engine—$35 for 24 hours service.

60 Cycle Water Power delivered on the Bus Bar—$15 for 24 hours service.

25 Cycle Water Power delivered at 60 cycles on the B.B.—$25 for 24 hours service.

25 Cycle Water Power delivered at 25 cycles on the B.B.—$15 for 24 hours service.

1st. We have the station costs for small arc dynamos, large arc dynamos, and constant current transformers under different operating conditions.

2nd. The line costs for open and enclosed D. C. and enclosed A. C. lamps.

We might now compare this cost with the cost of constant current transformers on 25 cycle water-power. For this system we find from our table that:

The station costs..................................	$ 1,415 00
The line costs..	5,842 00
We also find that our efficiency is 93 per cent., and that the actual power required will be about 347 h.p. Our cost for power in this case will not be the same, as A. C. arc lamps will not operate on 25 cycles, so we will have to take the cost of power after it has been changed to 60 cycles; this we find is $25 per h.p.; 347 h.p. × $12.50 (half as in the other example) would be..................................	4,337 50
The total cost for this system being.........	$11,594 50
Or a cost per arc lamp of.....................	23 02

A saving in cost by the use of the A. C. system of $6.42 per lamp. When the cost of power is known to vary from those assumed in this table the change can readily be made. In most cases the cost of power would likely have to be figured on the basis of apparent horse-power rather than actual horse-power; both are found in the table.

(For discussion of this paper see page 298.)