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MISSING

The Canadian Engineer

VOL. X.—NO. 7. TORONTO AND MONTREAL, JULY, 1903. 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 Sts. 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.

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POWER DEVELOPMENT AT NIAGARA.

The Queen Victoria Niagara Falls Park, above Niagara Falls, is at present in a state of wild confusion with excavations, railway tracks, piles of stone, pony engines, and temporary buildings, indicating that important works are in progress. The three great power companies which have obtained concessions from the Ontario Government, have a large force of men employed on the works, which are to supply power not only to industries in the neighborhood, but through Western Ontario and to Toronto. These three companies, in the order of their obtaining concessions, are: the Canadian Niagara Power Co., the Ontario Power Co., and the Toronto and Niagara Power Co. The first is practically identical with that which has erected the plant on the New York side of the Falls, where 50,000 horse-power was developed and utilized, and where the capacity is now being doubled. This company is bound under its agreement with the Ontario Government to hold one-half whatever it may develop, for use in Canada. A full account of its projected works appeared in the Canadian Engineer for November, 1902. Since then considerable progress has been made. The tunnel is practically completed and the wheel-pit, in which provision is to be made for the installation of 11 units, is well advanced. Only a visit to the works can give an adequate idea of their massive character.

The Ontario Power Co.'s works are to be of an entirely different nature. Their power house will stand under the bank below the Horse Shoe Falls, a portion of the overhanging rock being cut away to prevent any danger of pieces of rock falling away. The water will be conveyed from the inlet by a steel pipe 6,000 feet long and 18 feet in diameter, which will be placed underground in a trench, which has been excavated for it under the hill. Provision is made for two additional pipes of like capacity, when required, as only one-third of the power is to be generated at the outset. The wheels and generators will be placed side by side in the power house on the same shaft. There will be six pairs of wheels, one being spare. Each unit will have a capacity of 10,000-h.p.

The Toronto and Niagara Power Co., whose wheel pit and power-house will be situated in what is now the bed of the river, and whose outlet will be through a tunnel discharging under the Horse Shoe Fall, has its coffer dam well under way, and has just called for bids for the wheelpit, which will be the largest in the world. It will be 480 feet long, 180 feet deep, and 27 feet wide. The power to drive the excavating machinery, concrete mixers, etc., will be supplied through a flume carried from the Ontario Co.'s coffer dam at the head of the rapids, and which has dried up the channels about the Dufferin Islands while the works are in progress.

The works under way for these three companies will involve an expenditure of over $17,000,000. The amount of power to be developed is as follows: Canadian Niagara Power Co., 100,000-h.p.; Ontario Power Co., 150,000-h.p.; Toronto and Niagara Power Co., 125,000-h.p. In addition, the Ontario Power Co. has the right to take from Chippewa Creek water to generate another 150,000-h.p.

A reference to the accompanying map will show the position of the works of the three companies.

Considerable fear has been expressed lest the diversion of so much water would affect the Falls. There does not seem to be much need of apprehension on this score. Measurements covering an average of 40 years show that the flow of the Niagara river at the outlet of Lake Erie, at mean level, is 222,400 cubic feet per second. Three hundred cubic feet may be added as received below Buffalo. Of this one-tenth passes over the American Fall and nine-tenths over the Canadian Fall. The three developments, and the power-house of the Electric Railway, when running at full capacity, will require 32,000 cubic feet of water per second, so that it does not appear that any very serious inroad will be made on the quantity passing over the falls.

As to the condition of the Park, the companies to whom the concessions have been granted are bound under their agreement with the Ontario Government to restore it to a state of order after their works are completed. The shore line will be considerably altered, and the flow of water diverted to some extent, but we are assured the beauty and grandeur of Niagara will not be detracted from.

The Engineers' Club of Toronto had an opportunity of inspecting the various works on invitation of Cecil B. Smith, resident engineer of the Canadian Niagara Power Co., the other companies joining in extending hospitality to the visitors. The Canadian Association of Civil Engineers is to visit them during the summer. The operations going on are of an extremely interesting character.

—The act passed at the late session of the Ontario Legislature, empowering municipalities to engage in the development of water-power and its electrical transmission, will have an important part in the industrial development of the province. It is the outcome of recent actions in connection with Niagara Falls power, and while giving municipalities extensive powers, free from the control of the Legislature,, contains provisions for safeguarding the rights of the people. The practicability of every scheme must be attested by the report of a commission composed of specialists in hydraulic and electrical engineering, as well as in business affairs. Safeguards are provided against attempting mechanical or commercial impossibilities. It seems to us that the measure is a long step in the right direction.

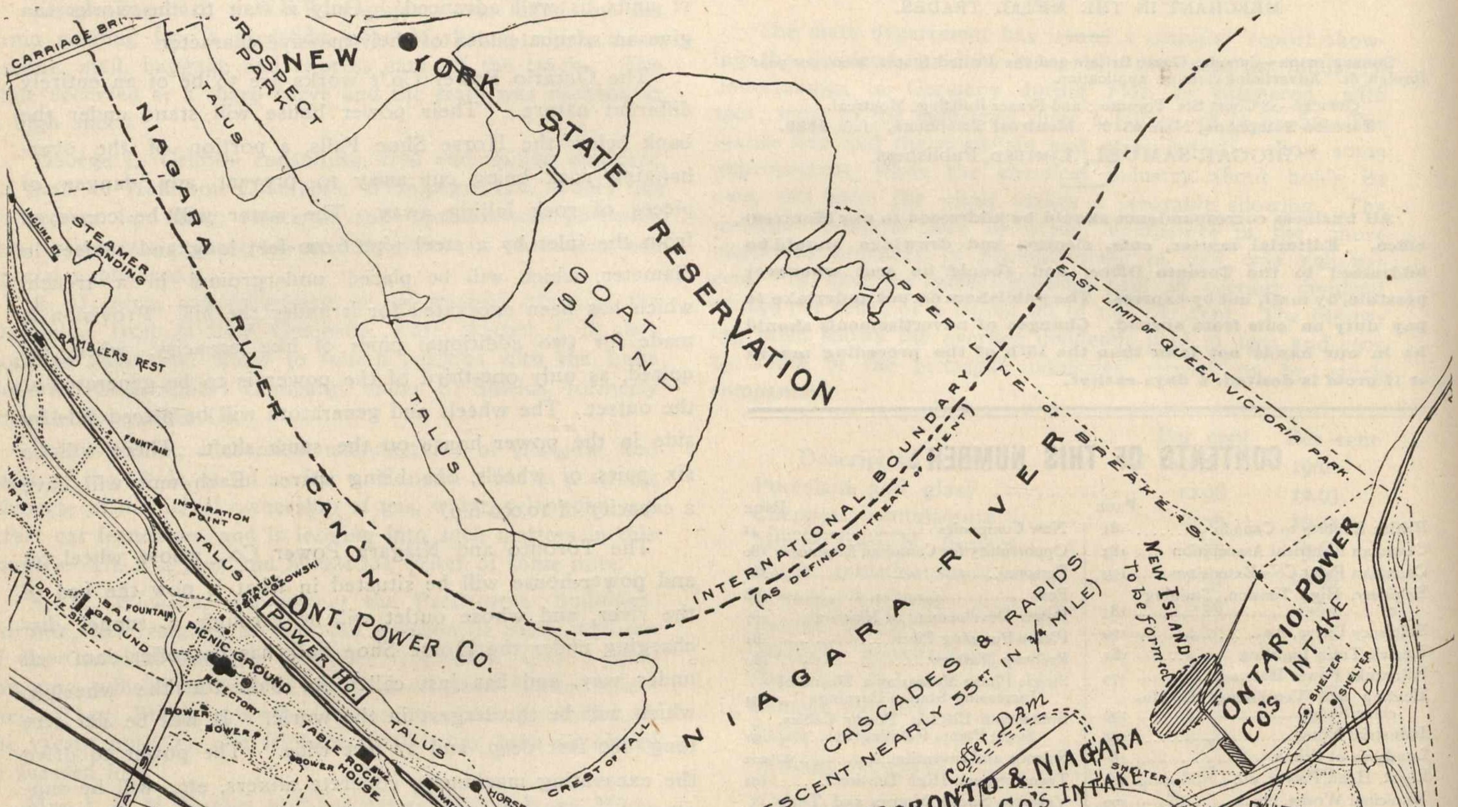
PEAT.

By H. A. Krueger, Toronto.

The peat bogs of the Dominion of Canada contain an immense source of national wealth, and its practical use has begun, when its value is realized, as is shown in the report of the Bureau of Mines for Ontario. The consequences of last year's strike of the anthracite miners has directed attention to this natural product, as an escape from the fuel famine and brought it into notice, as a substitute for anthracite, with which peat briquettes do not compare unfavorably.

There are many other economic uses for peat outside that of fuel, which seem best understood in Germany. Its moisture-absorbing and retaining qualities are higher than any other known material. It also holds the ammonia and gives it off in moist soil. Ammonia, as we know, is the most valuable agent in fertilizing matter, but very volatile and oxidizing, as can be noticed in a horse stable. It is the best deodorizer and probably most practical disinfectant, itself being odorless and rendering docks and like locations so, and avoiding the very dangerous dock gas.

The application of fertilizer, mixed with peat, renders clay soil mellow, and advances absorption and retention of moisture in a high degree by capillary action. It has in sandy soils too much of a loosening effect without the addition of clay or calcareous matter, and is not advisable. It appears to stay to some extent the growth of fungi, as rust, mildew,



Map Showing Location of Power Developments at Niagara Falls.

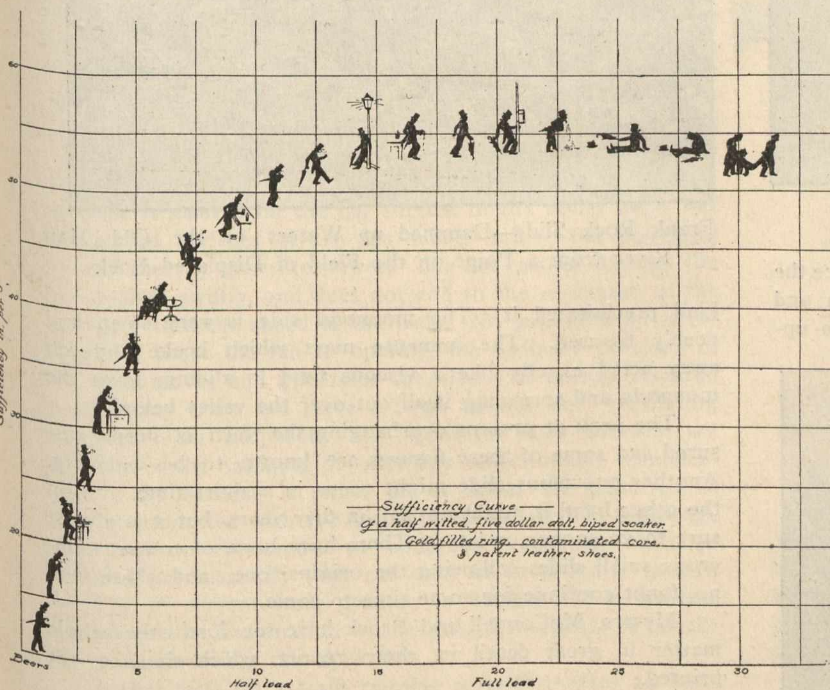
and potato disease, and has for that reason a very useful place in the greenhouse for propagating tropical and tender plants, and in various other ways, such as mulching. The long, fibrous parts, saturated with molasses, are sold for animal food and are said to obtain good results. It is also used for the base of insulating compounds.

The foregoing notes may not particularly interest technical men, but to the farmer, to whom the tilling of heavy clay soils so far has been an unsolved problem which has baffled the most expert, it is important. Before the manufacture of an article there must be a demand for it, and its usefulness and efficiency fully demonstrated, and ways and means of manufacture should not be copied from other countries but should grow out of local demand and be suited to such conditions.

The development of the peat fuel industry is in the more northern parts of much more national, social and vital importance as generally conceded. Thanks are due to the Bureau of Mines for Ontario for their efforts and labor in selecting the best adapted and tried appliances for manufacture of peat fuel, as well as for methods of heating and cooking, and the gleaned facts and data set forth and illustrated in the report are so plain as to be a reliable guide to manufacturer and consumer. The quality of Canadian peat, as shown in the report, is equal, if not superior, to the European material. The manufacturing process also seems to be on the whole on as good a basis as the European. The main difference is found in a greater tendency to the use of air-dried peat, prepared mostly by hand labor, and locally consumed or distributed by cheap water transportation in Europe. This form is more bulky, fragile and rough than lignite briquettes, which are much used in cities. Inventive ingenuity is untiring, and will undoubtedly succeed in furnishing an article that can compete in price and efficiency with coal in the near future.

AN EFFICIENCY CURVE.

The accompanying clever travesty of "an efficiency curve of a ½-h.p. 500 volt bi-polar motor, with cast steel ring, laminated core and cast iron shoes," was designed by Geo.



Bickell, a bright, young Canadian, now chief draftsman for a large electrical firm in the United States. The Canadian Engineer is permitted to publish it, but it is to be understood that this curve is not a part of the official records of the Canadian Electrical Association convention.

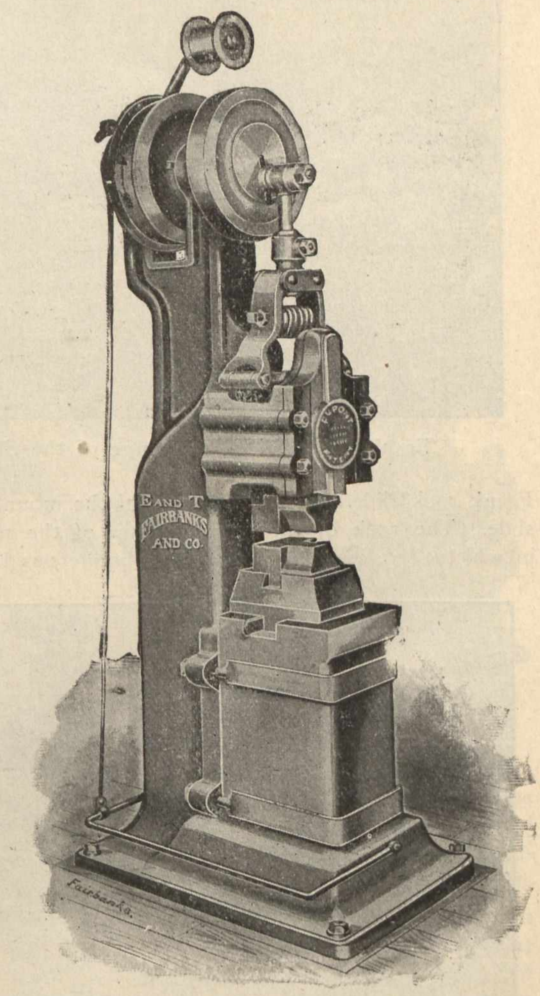
The S.S. "Carrigan Head" having gone aground in Lake St. Peter, by the buoys having become displaced, a recommendation has been made that a steam launch patrol the river three or four times a week to see that the buoys are in their proper place.

CANADA PAINT CO.'S EXTENSIONS.

The engineers of the Canada Paint Company, Limited, are now drawing up plans for their extension on Hunter St., Montreal. The gratifying increase of business which has come to this company necessitates larger premises. The company has purchased a tract of land on Hunter St., bounded by Chatham St. and Notre Dame Lane, which has the merit of being central and close to their present extensive plant upon William St. It may not be generally known that the Canada Paint Company, Limited, is by far the largest paint and varnish manufacturing company in the Dominon of Canada, and the only company in Canada who ship large quantities of painting material to the United States, in spite of the high tariff which our American friends have against us. Shipments are also made to Great Britain and to the Australian colonies. For some time it has been difficult for this enterprising Canadian company to take care of all the business which is offered, and now the directors feel warranted in doubling the color-making capacity and enlarging in all departments. The Canada Paint Company employ their own engineers, carpenters and machinists, and the new works, which will be erected by their permanent staff, will be the most complete yet devised on this continent.

THE FAIRBANKS POWER HAMMER.

The Fairbanks Company are presenting a new power hammer, adapted for work in carriage factories, car works, edge tool and general shops. The hammer, as it will be seen by the accompanying illustration, is operated by an adjustable crank, the crank-pin sliding in a groove in the crank-plate,



allowing the operator to lengthen or shorten the stroke at will. Motion is applied to the head or ram, by means of a circulating rod in a sleeve or collar supplied with a large set-screw, or, as in the large sizes, a clamp to hold the rod in position, and to this sleeve are hinged two side arms, these in turn being connected to the ram by metal links. By the use of a steel spiral spring, carefully adjusted between these arms, the force and weight of the blow are many times multiplied, but with an elasticity that removes all danger of breakages and at the same time the jar is so thoroughly cushioned that it is not noticeable in the machine when the blow is struck. The head strikes a quick, sharp blow at the rate of 250 to 500 blows per minute, according to the size of the machine, and instantly gets away from the work, thereby avoiding any chilling of the stock. The entire working parts of the hammer are at the top, in full view of the operator, every part is readily accessible, being easily operated by inexperienced men. Raising or lowering the hammer is accomplished by loosening the bolt, and when at the required place, tightening again. Another feature for the machine, is the small amount of power required to run it, and a saving of power means money saved. The entire machine is constructed with a view to durability, the best of material being used throughout. The Fairbanks Company are thoroughly reliable in every respect and can be depended upon. Their business is conducted on a line that is pleasing to each and every customer, and promptitude is a special feature of their business methods. We fully appreciate the difficulty the prospective buyer finds in endeavoring to ascertain the best make of power hammer, as he himself cannot know all the different kinds, and is therefore unable to decide for himself. Interested readers will get further information from the Fairbanks Company, Montreal.

THE LANDSLIDE AT FRANK.

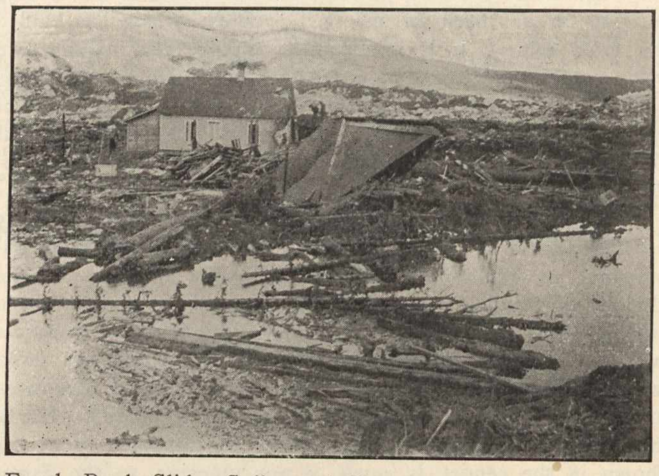
R. G. McConnell and R. W. Brock, of the Geological Survey, who examined Turtle Mountain, on behalf of the Government, have made their report as to the cause of the

Frank Rock Slide—A Fringe of the Slide.

Frank rock slide and the condition of the mountain since the slide. The rock of the main portion of the mountain and in which the slide occurred is a carboniferous limestone up-

Frank Rock Slide—The Obliterated Track.

turned, and dipping at quite a steep angle. The dip of the strata, however, was not parallel to the surface where the slide occurred, but on the contrary, was almost perpendicular to it. The interior workings of the mine were practically undisturbed. There was no explosion of any kind whatever. There does not even appear to have been any serious creeping or similar displacement in the mine, such as might have caused a sudden jar in the overlying rocks. In fact, the slide does not seem to have been the result of any sudden or rapid agency or motion of any kind, but rather due to slow and long continued action of water,



Frank Rock Slide—Splintered House on the Border of the Newly Formed Lake.

frost, etc., continually producing changes in the earth's surface. It is quite possible that small creepings in the mine during the past two years may have assisted or hastened the slide, but it is not thought that anything of this

Frank Rock Slide—Dammed up Waters of the Old Man River from a Point on the Field of Displaced Rock

kind precipitated it. The mountain side is very steep and deeply fissured. The immense mass which broke and fell away acted exactly like a viscous fluid in sliding down the mountain and spreading itself out over the valley below.

The peak at present overhanging the town is deeply fissured and some of these fissures are known to be widening. Another enormous slide might occur in a short time, and on the other hand it might not fall in fifty years, but it is almost sure to go sooner or later. There have been, of course, numerous small slides following the original one, and these will no doubt continue for some time to come.

Messrs. McConnell and Brock have set forth the whole matter in great detail in their report, which is not yet printed.

The accompanying engravings are from photographs made by Willis Chipman, C.E., of Toronto, who had the fortune to be in the vicinity at the time.

AN OPPORTUNITY FOR CANADIAN ENGINEERS.

The Austrian Ministry of Commerce is offering handsome prizes for complete plans of a lift lock to hoist vessels over an elevation of 35.9 M. on the route of the projected Danube-Oder Canal, in Moravia, securing an economical traffic with the least possible waste of water. The prizes are $20,000, $15,000 and $10,000. In addition, a premium of $40,000 will be given to the winning competitor in case his project should not be executed by himself, provided the works prove satisfactory. Details and conditions are contained in a circular issued by the Ministry of Commerce, copies of which may be had from the Austrian Consul-General, Montreal. Here is an opportunity for some of our Canadian engineers to win a handsome prize and distinction.

BRITISH EXPORTS TO CANADA.

The British Board of Trade returns show the following exports to Canada for May, as compared with those of last year:

	May, 1902.	May, 1903.
Iron—		
Bar, etc.	£ 5,866	....
Railroad	14,586	£95,025
Hoops, sheets, etc.	11,818	26,358
Galvanized sheets	8,439	33,964
Cast, wrought, etc., iron	10,927	....
Steel—		
Unwrought	39,591	....
Bars	....	19,281
Tinned plates	18,743	56,121
Sheets and plates	....	19,408
Lead	5,304	5,250
Tin, unwrought	3,604	3,279
Cutlery	5,598	7,788
Hardware	2,894	3,626

For the five months up to 31st May, there was also a substantial increase.

ELECTRIC TRAIN LIGHTING.

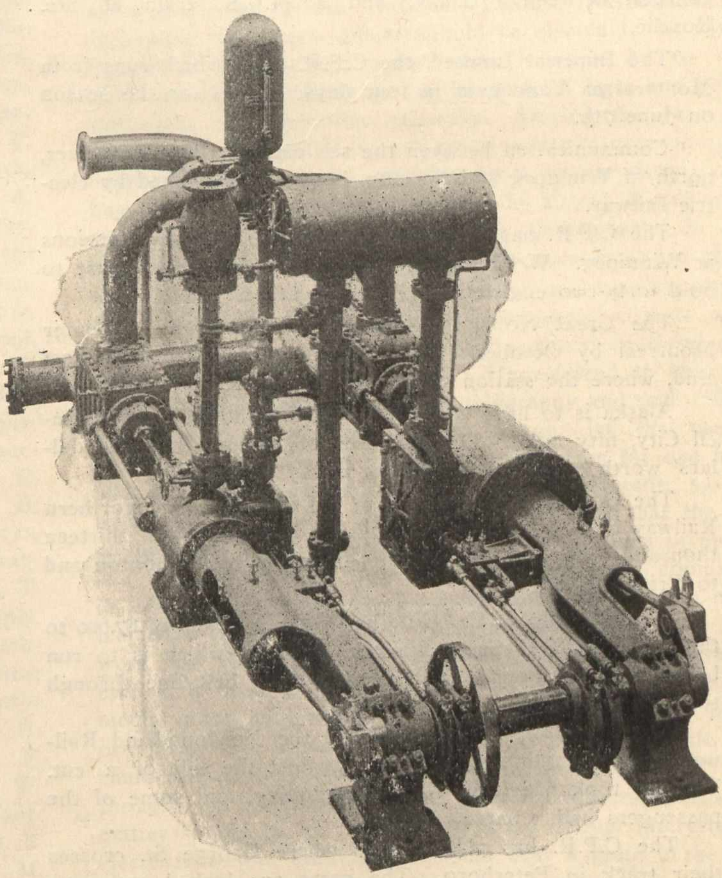
A novel idea in lighting trains by electricity, says the Railway and Engineering Review, is the Gullott system, which has been experimented with successfully on a small scale on an important road, and is now to be applied to an express train. As in the case of the axle light, the motion of the train is used to generate the electricity. Instead, however, of taking this power from the car axle, it is furnished by a rotary fan attached to the front end of the locomotive. The fan is close to the boiler head and presents a moving and cutting surface to the air pressure, causing the air to travel to the outer end of the fan's blades until discharged. No air pressure is massed on the flat surface of the boiler head, but the curved surfaces of the fan blades utilize the travelling air and thereby generate power. The fan cutting through the air revolves swiftly, and does not add to the resistance of the air nor retard the speed of the train. No gale of wind is required to cause the fan to operate, the ordinary pressure of the train moves and generates the electrical energy required to light any train and leave a large surplus for ventilating fans and other purposes. The apparatus does not obstruct the view of the engineer or offer any objectionable complications. The dynamo is either on or under the pilot and is directly connected with the fan by a special device. A storage battery is on the tender or underneath each car, and so equipped automatically with cut outs as to properly govern the flow of current from dynamo to battery. It is evident that the cost of illumination will be only the expense of installing and maintaining this apparatus.

Recent tests on a train running forty-five miles an hour resulted in the development of 4.5 K.W. per hour, which amount of energy is sufficient to charge the storage battery so that it will illuminate a train of five cars seven hours per night and leave the battery with nearly its maximum charge, due to the continuous operation of fan. On high speed trains greater power and efficiency are obtainable.

A new industrial centre, to be known as Clarke City, is to be established on the Labrador coast by the North Shore Railway and Navigation Co. A pulp mill and other works are to be built.

PICTOU PUMPING PLANT.

The town of Pictou, N.S., has recently completed a very efficient high duty pumping plant. The work was carried out under the supervision of Lee & Coffin, consulting hydraulic engineers, of Boston, Mass., and the machinery was made by the Smart-Turner Machine Company of Hamilton. The pumping plant consists of one cross-compound, condensing, high duty pumping engine, having a capacity of a little over a million United States gallons per day, against a vertical head of 225 feet; one auxiliary Underwriters' Fire Pump of 700 gallons' capacity. The pumps were so arranged that either or both could be operated at one time, drawing through a common suction pipe, which was connected with a number of artesian wells located in the neighborhood of the pump house. The general arrangement is shown by the accompanying cut. The engines are fitted with Meyer's adjustable cut-off, which can be so adjusted as to cut off steam at any portion of the stroke while the engines are in operation. The size of the engine is 14-in. high pressure cylinder, 25-in. low pressure cylinder, 22-in. stroke, water plungers, 8-in. diameter. On account of excessive high water, it was necessary that all pipes should be above the floor of the engine room. The exhaust from the low pressure cylinder was therefore carried overhead through the feed water heater, and down into the surface condenser, which condenser was placed in the suction pipe of the pump. The exhaust from the air and boiler feed pumps, as also that from the Underwriters' Fire Pump, when



in operation, was carried through a secondary heater. The feed water for the boilers is drawn from the wells, and pumped through the primary heater, then through the secondary heater, so as to increase its temperature to a maximum.

During the duty test of twelve hours' run, the engines were shown to develop a duty of 105,097,000 foot pounds. The steam pressure during this test was in the neighborhood of 105 pounds. The average head under which the pumps operated was 220.09 feet. In a letter on the operation of the pumps on regular service, the Mayor of Pictou says: "Our Smart-Turner pumps are as near perfection as can be made; at least we think so. . . We have about 400 water consumers now, and are burning between eight and nine tons of coal per month. We expect to supply from 500 to 600 consumers, and feel confident that we can do it on not more than ten tons per month. The Smart-Turner Company carried out their contract with us faithfully. No people could have acted more honorably. We cannot see to-day that ten cents' worth has been kept back that we should not have had; they did it all without any watching. Our experience with this firm leads us to believe them to be a first-class firm in every way, and we are more than satisfied with the pumps they supplied to us."

Railway Matters.

The Montreal Street Railway is running observation cars for tourists.

Thirty more convertible cars are to be built for the Toronto Railway Co.

An Alberta paper says the C.P.R. intends fencing the entire C. & E. line this summer.

The Manitoba Exploration Co. expect to start work on an electric railway from Winnipeg to Bird's Hill.

A tube in a Michigan Central locomotive, at Welland, burst, badly scalding the engineer and fireman.

The Grand Trunk Pacific has opened engineering offices in Winnipeg, from which operations in the West are directed.

Considerable damage was done to rolling stock by a collision between a G.T.R. and an I.C.R. train at Ste. Rosalie.

The Imperial Limited, the C.P.R. train which runs from Montreal to Vancouver in four days, started for the season on June 7th.

Communication between the settlements along Red river, north of Wininpeg and the city, is to be established by electric railway.

The C.P.R. has commenced work on its yard extensions at Winnipeg. Work has been begun on an engine house to hold forty-two engines.

The Great Northern Railway will be ready to enter Montreal by October. The terminus will be in the East End, where the station will be built at once.

Alaska is to have a railway, from Solomon City to Council City, fifty miles. One hundred and twenty thousand dollars' worth of material has gone up by steamer.

The Government proposes to aid the Canadian Northern Railway by a guarantee of bonds to the amount of thirteen thousand dollars a mile on the extension to Edmonton and to Prince Albert.

The township of Colborne has voted a bonus of $7,000 to the Ontario West Shore Electric Railway, which is to run between Owen Sound and Sarnia, with a belt line through the County of Huron.

A sleeping car left the rails on the Newfoundland Railway on June 13th, and fell over against the side of a cut. The car took fire from a lamp exploding, and some of the passengers had a narrow escape.

The C.P.R. has placed gates where George St. crosses their track in Peterboro. The gates are locked automatically, and are operated by a compressed air pump. When lowered and locked a gong is sounded to notify the public that the crossing is closed for traffic.

Two locomotive boilers and tenders from the Baldwin Locomotive Works, Philadelphia, and a shipload of one hundred and thirty-four car bodies and trucks, from Ontario, for the Reid-Newfoundland Railway Company, have gone forward. They were conveyed to the island from North Sydney by the steamer Bruce.

The two large G.T.R. iron bridges across the Don at Toronto, weighing several thousand tons each, were moved about 35 feet in opposite directions, without any interruption to traffic. The Grand Trunk will build two new bridges and lay four tracks. The old bridges will be used for shunting and freight trains, while the new ones will be exclusively for passenger trains.

The Toronto Suburban Railway has purchased two handsome new cars for the Weston and Lambton lines.

The Gatineau Valley Railway has been extended from Gracefield to a point half way up Blue Sea lake, and is expected to reach Maniwaki by October.

A. Heathcote, Winnipeg, has been surveying for an electric line from Winnipeg to Kildonan and Selkirk. The line is to be finished to Kildonan by November 15th.

A solid vestibuled train is to run daily over the Canadian Northern between Winnipeg and Lake Superior. A daily service is also to be put on the Morris-Brandon line.

The London, Ont., Street Railway Co. has been ordered to put a fender on its cars which will be approved of by the engineer of the Public Works Department of the province.

Traffic on the Midland Railway of Nova Scotia is increasing at such a rate that six daily trains will run between Windsor and Truro this summer. The company has ordered a new engine and a complete train of cars.

The shareholders of the Ottawa Valley Railway Co. have authorized the directors to purchase the Carillon and Grenville Railway, to extend the present line from St. Andrew's to Carillon, and to equip the whole line electrically.

A spread frog at a switch caused a train on the Bay of Quinte Railway to be ditched when conveying two batteries of artillery to camp at Deseronto. Seven flat cars and six horse cars left the track, smashing the guns and killing five horses. No one was injured.

An engine standing on the C.P.R. track at Smith's Falls ran away and smashed the turntable and injured the tender. The new steam crane was brought into use and did good work, picking up the disabled engine and placing it on a car to go to the repair shop.

G. A. Mountain, chief engineer of the Canada Atlantic Railway, has introduced a gasoline motor car on which he will make his trips of inspection. Motor cars will probably be employed before long for section men. A speed of 30 miles an hour can be attained.

The Cape Breton Railway is expected to be in operation between Hawkesbury and St. Peter's by July 15th. The River Inhabitants bridge, 400 feet long, is completed, and is the finest on the island. It is very strongly built, the water being deep and the current heavy.

A strong Nova Scotia syndicate, with B. F. Pearson at the head, have secured an option on the New Brunswick and Cape Tormentine Railway. Their intention is to improve the terminal facilities at Cape Tormentine and put on fast ferry boats between P. E. Island and the mainland.

The transcontinental train on the C.P.R. went through a bridge across Scovil Lake on June 9th, and the engineer and fireman lost their lives. The locomotive and a car of fish went into the lake. The accident was due to the bottom of the lake shifting, leaving the trestle without adequate support.

An investigation into an accident on April 29th at West Lorne, on the Detroit & Lake Erie Railway, by which a passenger and two railway hands were killed, lays the blame on the crew of the gravel train, which ran into the passenger train without taking precautions to ascertain its whereabouts.

The C.P.R. has received six of the fifty locomotives ordered from the Scottish locomotive works. They were built from designs furnished by the company's engineers. One now in service is a ten-wheeled engine, with 69-inch driving wheels. The weight on the driving wheel is 126,000 lbs. The locomotive has storing capacity for 5,000 gallons of water and ten tons of coal.

A big electric railway merger has been planned, to include the Niagara, St. Catharines & Toronto, the Hamilton, Grimsby & Beamsville, the Hamilton Street Railway, the Toronto Suburban and the Metropolitan line of Toronto. When the bill to incorporate the company was going through Parliament, it was discovered that it would give rights over the streets of Toronto which belong to the city, and prompt action was necessary to prevent such an unwarranted proposition.

CANADIAN ELECTRICAL ASSOCIATION.

The thirteenth annual convention of the Canadian Electrical Association was held at the King Edward Hotel, Toronto, on Wednesday, Thursday and Friday, 10th, 11th and 12th June, the president, B. F. Reesor, of Lindsay, in the chair.

The following registered attendance:

B. F. Reesor, Lindsay; A. A. Wright, M.P., Renfrew; K. B. Thornton, Montreal; C. H. Mortimer, J. J. Wright, Toronto; John Yule, Guelph; A. B. Smith, Toronto; P. G. Gossler, Montreal; Ormond Higman, Ottawa; Ed. A. Evans, Quebec; A. A. Dion, Ottawa; A. Sangster, Sherbrooke; H. D. Bayne, Montreal; Gordon Henderson, Hamilton; C. C. Starr, Halifax, N.S.; J. Frederick Thorne, Pittsburg, Pa.; J. M. Leamy, Buffalo; Alfred Collyer, Montreal; H. B. Kirkland, Chelsea, Mass.; J. R. Hooper, Toronto; G. M. White, Montreal; J. W. Campbell, H. O. Edwards, Toronto; Cecil Doutre, Montreal; E. I. Jenking, Toronto; W. H. Reynolds, Fred. Thomson, J. A. Burns, Montreal; H. A. Moore, Toronto; C. H. Abbott, St. John, N.B.; A. Esling, Toronto; James Johnston, Ottawa; L. D. W. Magie, Peterboro; J. E. Skidmore, Cobourg; W. H. Breithaupt, Berlin; Mrs. J. E. Skidmore, Cobourg; Mrs. W. H. Breithaupt, Berlin; Miss F. A. Reesor, Lindsay; Alfred Demers, St. Cesaire, Que.; A. E. Wilson, Toronto; J. G. Archibald, Woodstock; F. Jno. Bell, Montreal; J. W. Pitcher, Halifax, N.S.; Wm. McKay, Toronto; A. T. Hicks, Trenton; R. J. Russell, St. Louis, Mo.; V. B. Coleman, Port Hope; Wm. A. Bucke, Toronto; R. M. Saxby, Bowmanville; Frank G. Bolles, Cincinnati, O.; G. A. Paterson, Brandon, Man.; C. W. Henderson, Montreal; C. B. Wilkinson, Brockville; A. E. Brock, R. T. Macken, Toronto; Chas. L. Farren, Lakefield; J. M. Dobbie, Brockville; J. P. Thomson, Montreal; F. Simmons, Kingston; R. G. Black, A. W. Smith, Toronto; W. H. Wiggs, Quebec; Geo. A. Childs, Montreal; L. H. Reesor, St. Mary's; Wm. McCaffrey, C. W. Bongard, J. E. Bilger, J. J. Ashworth, George Angus, Toronto; J. W. Purcell, Walkerville; Jas. Bannan, Toronto; Mrs. J. W. Purcell, Walkerville; C. E. Fortier, J. Herbert Hall, Toronto; T. Beecroft, Barrie; Joseph Rogers, Toronto; William Wilds, W. Williams, Sarnia; F. Rose, W. A. Johnson, E. S. Edmonson, Oshawa; Jos. Knox, Stayner; J. G. Haworth, Toronto; Stephen T. Kelly, Barrie; J. A. Whyte, Toronto; Alex. H. Skene, Bracebridge; Geo. F. Haworth, Toronto; Chas. B. Hunt; R. E. Campbell, Toronto; H. O. Fisk, Peterboro; William B. Boyd, Sydney; Arthur Warren, New York City; W. A. Boys, Barrie; H. Jecks, Toronto; R. B. Hamilton, St. Catharines; Geo. C. Rough, Montreal; E. Irving, Toronto; A. T. Duncan, St. Catharines; E. A. Smith, Toronto; L. Denis, Quebec; F. C. Whatmough, Stratford; Alex. Reid, Strathroy; P. H. Hover, New York; Roderick J. Clarke, Toronto; A. P. Manning, New York City; J. K. Johnstone, Toronto; Dr. R. B. Owens, Montreal; J. H. Bennett, Barrie; F. H. Leonard, Jr., Montreal; W. Warren, Toronto; Chas. F. Scott, Pittsburg, Pa.; R. R. Wiley, St. Catharines; Geo. W. Watts, Toronto; J. K. McDonough, Irving Smith, Montreal; G. A. Kammerer, C. C. Mooring, R. A. Stinson, G. B. Nicholson, E. B. Price, Toronto; G. Moacoysire, D. M. Stewart, Montreal; W. M. Beall, Toronto; C. W. Watson, Orangeville; W. McLeish, Toronto; G. Groves, Parry Sound; James Kynoch, Toronto; Thos. Hilliard, Ottawa; B. G. McBurney, A. B. Lambe, W. D. Wilgar, Toronto; Clarence Thomson, Montreal; C. E. Reid, London; A. M. Wickens, Toronto; J. M. McLennan, Thos. Stewart, Lindsay; Chas. Henry Hims, A.I.E.E., J. D. Lachapelle, Montreal; Max Toltz; A. C. Read, Levis; E. G. Patterson, Peterboro; Geo. H. Olney, Montreal; J. M. Deagle, Cataract; G. U. G. Holman, Levis; G. E. Woodhouse, Alex. M. Smith, G. B. Henderson, R. J. Henderson, Fred. Lyonde, Toronto; J. E. Stephenson, Montreal; Robert T. Lozier, Cincinnati; Louis W. Pratt, Brantford; F. W. Martin, St. Catharines; P. S. Coate, W. G. Richards, Chatham; L. Sangity, Hamilton; R. J. Sanderson, Orillia; E. T. Sifton, London; L. J. Belnop, W. R. J. MacPherson, Peterboro; G. F. Maddon, H. G. Nicholls, J. C. Grant, Toronto; C. E. A. Carr, London; K. T. Aitken, Toronto.

In the absence of the Mayor, Ald. Starr welcomed the convention to the city, referring to the importance of the association and the deep interest of the subjects it was to discuss, such, for instance, as the question of long distance transmission. He would suggest that in addition to the paper to be read on the subject, another should be presented under the title of: "How the City of Toronto can get cheap power in competition with the companies that have already got the control of the power over at Niagara Falls." If any member could help the city out on such a problem as that, he was sure Toronto would vote not only to give him the freedom of the city, but would strain a point and give the freedom of the city to all the members.

Ald. Ward added a few words of welcome, and A. A. Dion, of Ottawa, replied, thanking acting Mayor Starr and Ald. Ward for their hearty welcome. The Association was glad to meet in this beautiful and interesting city, and the members knew that their stay here would be quite as profitable and pleasant as they wished it to be.

The president then delivered his annual address, in which he bespoke for the papers to be read a free and thorough discussion, so that the salient points in each might be brought out or criticized. In this way the members present would get the benefit of the knowledge imparted to the fullest degree. This year a feature new to this Association had been inaugurated, namely, the establishing of a question drawer, from which much benefit should accrue; and following along the lines of the National Electric Association, he suggested that a new officer should be elected to be named "Question Box Editor," whose duty it would be to look after questions pertinent to the interests of light and power companies and electricity generally. During the year just passed, the question of long distance power transmission had engrossed the minds of capitalists to a greater degree, perhaps, than at any previous period in the history of this country. Rapid strides had been made in development in this direction and at the present time some very extensive plants were contemplated and under construction, notably around the Niagara Peninsula, and when completed Canada could boast of having some of the largest and best equipped electrical installations in the world. He referred to the progress in connection with wireless telegraphy and said: "Truly electricity has passed its 'infancy' stage; let the use of electricity be suspended for one day, yes, even for one hour, and our whole commercial, if not our domestic system, would be paralyzed." He referred to the fact that the tide of municipal ownership was in full flow. Millions of money had been invested in Canada by individuals and companies in lighting and power development, sanctioned, and in many instances induced by the very municipal corporations that were now clamoring or looking with longing and covetous eyes at a business that had been carried from an experimental stage until it had become to all appearances a factor of considerable importance in every day commercial life. He characterized it as a case of "municipalities gone mad." He thought the experiences of the past in connection with this matter should be an incentive to every person interested in electricity to join the Association and bear a quota of the burden in connection with combating this movement. He acknowledged with thanks the cordial invitation extended by the National Electric Light Association to the officers of the Association to attend their annual convention which had been held a few weeks ago in the City of Chicago, and he was pleased to say several had availed themselves of this pleasure.

The report of the secretary-treasurer, C. H. Mortimer, showed the present membership to be 344, being an increase of 38 during the year. There was a balance of cash on hand of $404.17, which is exclusive of a donation of $500 by the Canadian General Electric Co., which is not available for the general purposes of the Association, it being given for prizes for papers of superior merit. The president and vice-presidents compose the committee on papers, with power to add to their number. The importance of the question box was urged. This feature is a great success in the National Electric Light Association; upwards of 250 questions appearing this year on their circular. The organization of local branches or clubs in the larger cities was suggested, who should hold monthly meetings during the winter of a social character, at which short papers might be read and discussed. These papers could be printed and distributed. Regret was expressed at the long-continued illness of J. J. Wright, of the Toronto Electric Light Co., an ex-president.

The secretary read a letter from the Mayor of St. Louis and the Business Men's League, inviting the C.E.A. to hold the next convention in St. Louis, during the Louisiana Purchase Exposition, as it was the intention to hold an international electrical convention at that time.

Prof. Owens said the authorities of the St. Louis Exposition were organizing an International Electrical Congress to be held in the first week of September in 1904; the American Institute of Electrical Engineers, the National Electric Light Association of the United States, and other societies would participate, and the management was anxious that the Canadian Electrical Association would also participate.

O. Higman, of Ottawa, in moving a vote of thanks for the invitation, said he had the privilege of being sent to the International Congress in Chicago in 1893 by the Canadian Government, and could speak as to the good that the electrical world derived from the deliberations of that congress. The absolute units, as we have them to-day, were adopted at that congress and legislation followed all over the world making them legal, so that we find to-day the nomenclature and the value of these units the same in all countries.

John Yule, of Guelph, presented the report of the Committee on Legislation. The committee had met and agreed upon a plan of campaign for defence of the Conmee Amendments, which were threatened by a bill introduced in the Legislature by Mr. Downey, M.P.P., for their total repeal, and the committee were pleased to report that they had been successful in opposing this bill. The committee asked for better financial support from those who were reaping the benefit of the work done, as by the efforts of this committee millions of dollars had been saved to the companies interested.

Mr. Higman said the Arc Light Rating Committee had no report to make. Owing to the transition stage in which arc lighting is at present, it would not be desirable to bring in a report recommending a standard for arc lighting. We moved from the old open arc light to the enclosed and the alternating, and now we have the Nernst lamp, as a distributing element, and it would be quite impossible to lay down hard and fast lines as to what shall constitute an arc light. The National Electric Light Association of the United States had made investigations with greater means than this Association had at its disposal, and we could assimilate the information it had gathered. His department at Ottawa had recommended that contracts should be made in terms of energy delivered at the lamp instead of candle power, and this was now becoming the custom.

C. B. Hunt said the contract in London got over the difficulty of candle power entirely. His company has to produce a lamp of a certain voltage and have the current at a certain amperage to produce 450 watts or over at the lamp. This is accepted by him as a 2,000 candle power lamp and is also the standard adopted by the National Electric Light Association.

Mr. Hunt reported that the Executive had appointed Mr. Dion and himself to take charge of the Question Box. The National Electric Light Association of the United States this year had a great many questions, nearly three hundred, put in during the year. The secretary sends out papers about every month with the questions that have been submitted and each member is asked to answer, if he can. The questions and answers made a book almost half an inch thick. Next year the Executive Committee might find it possible to publish these questions and answers in a similar way.

"Is it advisable to 'ground' secondaries at the transformer or in the building supplied?" Will some gentleman now answer that? There was some difference of opinion at Chicago, some saying it was better not to ground them at all and others contending that it was.

H. O. Fisk, of Peterboro, said they were grounding all secondary work of late, especially the three-wire; ground the neutral and ground at the transformer, and so far they had not grounded anything in the building. It has worked very satisfactorily.

Mr. Dion asked what means were taken for grounding on the streets?

Mr. Fisk: Simply put a copper plate down in the ground about seven inches deep, about twelve inches square, nailed to the bottom of the pole, and a copper wire soldered to that.

The President thought good moist ground would be sufficient one way or the other.

Mr. Higman thought the most effective way was to ground it at the transformer. The plan adopted by Mr. Fisk was not an advisable one. Electrical action would soon wear out the connection, and there would be no ground. The only effective way was to string an iron wire of good size, and make the ground in the transformer in that way. The grounding of the secondary was quite a common practice in the Old Country.

Mr. Hunt understood the National Board of Underwriters objected to this grounding at the transformers. There had been trouble through having grounds there; and also to grounding inside of buildings where there are water and gas pipes. There have been more fires caused on that account, where the ground is crossed with water and gas pipes in the building.

Mr. Dion thought the question was as to whether we should ground the secondaries at the transformer or in the building. There seemed no choice in the matter because the National Board won't allow grounding, except outside the building.

The next question was: "Should meters be tested in places, or should they be returned to the station for that purpose."

One answer from the Sherbrooke Power, Light & Heat Company, was: "In some cases in places; in others, taken to the station."

The other from Mr. Higman was: "Government regulations require that meters should be presented to the inspector for inspection. To test in situ is extremely inconvenient, and sometimes impossible. An extra fee of fifty cents is charged for meters so tested."

Mr. Fisk said his company brought in all meters for inspection. It was almost impossible to do anything to a meter on the premises, if found incorrect.

Mr. Higman said where the correctness of a meter was disputed the meter could be handed over to the inspector in the presence of the customer.

Mr. Purcell had in mind one meter which when tested in the shop ran all right, yet when put up, the meter had crept up 24 kilowatt hours in one month. There was vibration in the building in which it was put up. There was no vibration in the building in which it was tested. There are some instances in which you have to make tests on the premises. The Edison people of Detroit insist on all meters being tested on the third floor of their power house where there is a great deal of vibration. Originally they used to receive their Thomson meters from the General Electric Company that were tested on an air bag, so as to eliminate all vibration there might be. When the meters were received and put up for test they found that they were possibly anywhere from ten to twenty per cent. fast. They specified that these meters must not be tested on the air bag; they must be fastened to the wall or shaft, or anything convenient, so as to be liable to the vibration in the building—every day conditions—and that they do now; they test all their meters on the third floor of their power house, where there is vibration from the machinery, which is below, and they get every-day conditions, and as a result, they have very few objections.

Question No. 3 was: "What systems are mostly used and commendable to check up lamp manufacturers' guarantees as to life, efficiency, and c.p.?"

Mr. Higman suggested a good photometer set with standardized incandescent lamps; a low reading watt meter, and a volt meter. That, Mr. Hunt thought, covered the whole thing, because it is not very extreme, and it is very efficient.

Mr. Dion said the question might be taken in another way: What is the best system of testing incandescent lamps? In other words what means do you take to ascertain whether your lamps are correct or not? Apart altogether from the instruments which you use there may be different ways of getting at that. For instance, it is not practical to test every lamp, but a certain percentage may be tested. The system used in Ottawa, which is probably the same as that used by a great many other companies, is this: they took five per cent. of all the lamps purchased; for instance, in a package of 300 lamps, they take fifteen lamps at random and put them through a photometer test, and also connect them with a watt meter immediately after. The candle-power and wattage are noted, and they plot that on a printed form with a target in the centre, and they insist that at least sixty per cent., three out of five of the lamps tested shall fall within target, and if they do not get this result the whole package is returned to the factory. Those are the terms of the contract, and we try to follow them up. Then apart from that, lamps are selected from time to time, and put on a board for life test.

The company's standards are supplied by the lamp testing bureau of the United States; they have two grades, a cheap standard and a closer standard which is more expensive; they cost about $2.50 a piece.

The next question was: "What has been the experience in operating single phase motors on lighting circuits, and to what size of motors is such operation practically limited?"

A. B. Lambe said he did not recall anything larger than about five horsepower, generally smaller, in this country.

R. J. Russell said size of motor which can be operated in lighting circuits depends to a great extent on local conditions. In Newark, N.J., they are using as high as 31 horsepower on a multiphase system. There are other systems where they have less than 100 kilowatts, and they have 30 horsepower; in other cities they are only allowing as high as 5 horsepower. The reason given by central station managers, it seems, is that they will put on any size of motor which can be placed on a circuit, and the load being thrown on and off will not give them a greater fluctuation than they can stand for proper service to their customers.

At the afternoon session, C. F. Scott, chief electrician of the Westinghouse Co., Pittsburg, Pa., read for the author, a paper by Paul Lincoln, Pittsburg, Pa., on "The High Tension Engineer."

The paper is as follows:

THE TRAINING OF THE HIGH TENSION ENGINEER.

There are two schools in which the electrical engineer may receive his training, but only one in which he must receive a course before he can be called a high tension engineer. Those things which are learned in the schools equipped with professors and laboratories and mathematical text books must be supplemented by the things which can be learned only in the school of experience. These two schools are quite different in method. The college instructs in theory, and in those methods of doing things which have become standard by universal adoption. The college teaches positive knowledge. In the school of experience, on the other hand, one is more apt to learn how not to do it, and by the elimination of the unsuccessful, arrive at the goal of success. The knowledge gained by experience is more often negative. Put to the fresh college graduate the problem of the amount of distance to be left between the conductors of a high tension transmission line. His answer will involve most likely the jumping distance of the voltage to be used, the length of span, the sag, and perhaps a liberal factor of safety. It is experience only that will show that his premises are wrong and that the equation to determine spacing of high tension wires depends very little on the voltage to be carried and almost entirely on such things as the average length and ohmic resistance of cats, the spread of wing of owls and cranes and eagles, and the average length of scrap bailing wire, together with the strength of the average small boy's throwing arm. The college graduate enters practical work invariably feeling that the greatest danger of his work lies in his liability of receiving a shock from the high tension conductors. Not until he has had experience with accidents of an electrical nature does he learn that it is the danger of being burned that he has to fear more than the danger of shock. My own experience, and I think it will be checked by the large majority of those in a position to know, has been that the number of electrical accidents in which the victim has been injured by burning is incomparably greater than the number from shock. The graduate has learned how to make accurate measurements of power. He finds after he has been up against it that it is easier to measure power accurately than it is to persuade the customer that his power is being accurately measured. The man fresh from the college laboratory enters his practical duties with the idea that rubber is one of the best insulators that exists. It is not until he has seen rubber insulation break down in the most unaccountable manner that he finds that rubber as a high tension insulator is extremely treacherous. The deterioration of rubber insulation is probably due to chemical reactions on the rubber induced by the brush discharges, which are in turn caused by the high voltage of the conductor. The newly made graduate usually has a high opinion of efficiency and can calculate the economy of a transmission to an excessively small fraction. When he becomes responsible for the operation of a transmission line, however, it does not take him long to find out that efficiency is a vanishing quantity when compared to continuity of operation, and that economy is not to be considered as being in the same class as good service. The technical graduate, in short, may have knowledge a-plenty, but his wisdom is to come. It is furthest from my thoughts to cast any slur upon the technical graduate. I look back upon my own course in electrical engineering and feel that it is the most valuable asset I ever possessed. The technical course is the best of foundations, but it is only a foundation. The end of the college course is rightly called Commencement. The great advantage of the technical education is that it gives the man proper equipment for overcoming the difficulties with which his experience is bound to bring him into contact. It gives him, as nothing else will, the power of initiative—that most valuable quality that a high tension engineer can possess. There is nothing like the college education to equip a man for making every accident a lesson in how not to do it, and every failure a stepping stone to success. Take, for instance, the recent accident to the Niagara plant, in which a fire destroyed the cables on the bridge connecting the power-house with the transformer house. The lesson to be drawn from this accident—so plain that he who runs may read—is that where many cables are run together extreme precaution should be taken to protect against danger of fire. Before the occurrence of this fire there was little suspicion that the insulation of cables when lead covered or protected by fire-proof braid—as was the case at Niagara—is sufficient to maintain so fierce a blaze without the aid of some other combustible beside the insulation. One accident of this kind should suffice, not only for the Niagara Falls people, but also for any others who have occasion to run many cables together. The art of long distance electric transmission as it exists to-day is the result of the accumulated experience of all those who have had to do with transmission work. And the process of accumulation is still going on. Those men who are to-day designing and operating transmission plants are the moulders of the art. Their expedients for improving service or reliability, or for cheapening cost are noted, and when successful have their influence on future installations. The experiences of to-day are incorporated into the text books of to-morrow. But, although the result of experience may be taught to the college student—allowing always for a considerable angle of lag—the college curriculum can never become the substitute for the school of experience. The high tension engineer no less than the man in any other department of human endeavor may find in failure the way to better things. It was Roosevelt, the strenuous, who gave expression to the sentiment that absence of failure accompanied only lack of effort. "The uses of adversity are sweet," and the engineer may well heed the words that Shakespeare puts into the mouth of the Duke, who, exiled to the forest of Arden, finds "tongues in trees, books in running brooks, sermons in stones and good in everything."

Mr. Scott said by way of comment on the paper, that the manufacturing companies had developed experts; they had sent these experts out over the country; they had built new lines of apparatus, carried on laboratories, and investigated to try to determine what is most suited to meet your conditions. The primary business of these companies was to manufacture apparatus, but they have had to come and take the place of the consulting engineer and the text book; they have had to develop the engineering itself and to tell you what you need and how to operate it as well as selling you the apparatus. Members of such an association as this could also add to the stock of knowledge.

As President of the American Institute of Electrical Engineers, he was happy to be present and to see such a substantial gathering of electrical men on this side of the border. The American Institute has been broadening in its work, not only in connection with transmission, but in other lines; it has felt it should be in touch with more men, and particularly with the younger men who are growing up in the profession. It has presented to young engineers and to older ones the advantages to them of becoming members of the Institute, and also in that way the responsibility which they ought to feel in supporting an institution of the character, and with the endeavor which the American Institute has. Formerly the American Institute has had its monthly meetings in New York, which have been attended by a local audience. There have been one or two places where local meetings have been held this year, and great extension has been made by the formation of local branches. They have been formed in the principal cities; in Boston, Washington, Philadelphia, St. Louis, Cincinnati, Pittsburg; the one in Chicago, which had existed before, has taken on new life; in Denver, and in other places.

Meetings have also been started in a large number of colleges; college professors meeting with their students, or an engineering society of students constitutes itself into an institute meeting; and at these local branches, the papers presented in New York, together with the discussion of the papers held in New York, are presented as material, so that the local branches have better material than the New York meeting itself, having the discussion in addition to the papers. This has taken well among the college boys, and a number of professors have said that the results were far better than they had anticipated. Within the last week a report came from Toronto of the formation here of a local branch of the institute for the purpose of taking up institute papers, and strengthening the institute in this region.

In these later days we are beginning to appreciate more fully the value of co-operation; it is coming among engineers, and was brought about very largely through the electrical engineer. The hydraulic engineer had a quiet sort of time until the electrical engineer got after him. Now he has to work ten times as hard. The steam engine men gave any old kind of an engine and it did the business for a while, but when the engine had to run a dynamo, there were new speed requirements. The mechanical shop engineer did not have to know very much except to run a shop and figure out the size of the pulley, but when the electrical engineer got into the machine shop it revolutionized the whole thing. The tools now are not strong enough. The superintendent of their factory at Pittsburg made the remark with reference to new tools, that fifty per cent. more had to be paid in order that they might run faster and do more work, under the electric drive. The electrical engineer binds together other engineers instead of working independently. He instanced the Pennsylvania tunnel in New York where civil and mechanical and hydraulic and mining engineers were interested along with the electrical engineer. The young man they were developing needs to be all kinds of an engineer; he needs to know how to develop, to match up and fit in all kinds of engineering work.

"Engineers need to get together," were the words of Andrew Carnegie, a man who had done one of the most magnificent things towards co-operation and towards engineering work in its broadest sense, by giving $1,000,000 towards a great engineering building in New York, for National Engineering Societies. These big societies are being recognized; a man of that kind has recognized them; and these other societies, which take a particular line of work, they can recognize they have a part in the general onward advance.

Prof. Owens said that both Mr. Lincoln and Mr. Scott had outlined the relations which should and in the main do exist between the college and practical work. The large manufacturing companies now understand that a college does all that it can be expected to do when, in the short time it has to give to the student, it gives him some knowledge of the fundamental principles of engineering which underlie all his future work. The tendency in engineering education now was to instruct in the principles. No university that he knew of could operate a manufacturing establishment, and give to the students a knowledge of manufacturing details. It was significant, however, that the majority of the larger electric manufacturing companies select their young men almost entirely from college graduates, saying at the same time to me that they do not expect that every man who comes from the college will make an engineer, but that it is the best material from which to draw their men.

Mr. Black, speaking as an operator of transmission plants, was struck with one of the remarks in the paper which said that when things were designed and everything worked out so that you would naturally expect it to work perfectly, it didn't always work out that way. That was the experience of almost everybody who had to do with operating of electrical machinery. You may take every safeguard you like and think you have everything perfect; you may have the opinion of half a dozen men on it, and when you come to put the thing in actual operation you find it works out differently from what you expect. Some thing or some person along the line will fail. He was pleased to notice what Mr. Scott said about electrical engineers getting together and trying to work together for the benefit of engineers at large. It was very gratifying to younger engineers to find men like Mr. Scott, who had such experience, that they were willing to give others the advantage of their experience.

Operating men should compare notes as to their troubles. He was always under the impression that the Niagara plant ran off very smoothly until he lived for a few weeks with Mr. Imbley, the Westinghouse electrical engineer, who was stationed at Niagara Falls for three years, when he found they had about as much trouble as the rest. The Royal Electric people tried to lead the Lachine people to believe they had no trouble, that Lachine had all the trouble, and the Lachine people tried to lead us to believe they hadn't any, but when we can compare notes without being held down by our companies, we find that each one has had their troubles, and if the troubles of either company had been explained to the other in many cases it might have been obviated. At Chambly, they had done a lot of work which has not been done in many other places. For instance, they have put 25,000 volts into the water for testing 25,000 volt lines and transformers; they have had considerable experience in putting 12,000 volts into the water; they have had experience with throwing transformers on and off the line, and they have had trouble at various times. For instance, in closing the line on 12,000 volt transformers, on several occasions the transformers have gone out of business when the voltage was coming up; they have had trouble over a short circuit; within a short period after a short circuit they have had generators burn out; they have also had some experience in bringing people to after electrical shocks.

Mr. Lozier suggested that for an electrical engineer it would be of advantage if he could take a shop or practical course, a short experience the first year before he goes to college, so that he would have a familiarity with the things which he would afterwards learn in the text-books.

Mr. Dion, commenting on the educational aspects of the question said, all seemed to agree that the colleges do not produce engineers, but only prepare material to make engineers. Nevertheless, it is a practice of colleges to grant degrees, and to give a man the title of "Electrical Engineer," and this had led to some little misunderstanding with the employing public, who, perhaps, do not understand the practice of the universities in that respect.

In moving a vote of thanks for Mr. Lincoln's paper, he complimented Mr. Scott on his instructive commentary. The great progress the Institute of Electrical Engineers had made during the past year was largely due to the efforts of Mr. Scott, as its president.

THURSDAY, 11TH.

On assembling, the President named as the Select Committee to strike the standing committees, A. A. Dion, Ottawa; John Yule, Guelph; and W. Williams, Sarnia. He then called upon R. T. Lozier, of Cincinnati, to read his paper on "Variable Speed Motors and Their Relation to the New Shop Methods," referred to elsewhere.

In reply to questions, Mr. Lozier said the direct current motor now used on tool practice is quite a different kind of a bird to the motors of the past. The depreciation of these motors is very low. In the first place, the motor does not run at its full capacity all the time, and in the second place, it has practically no sparking. The depreciation will not exceed six per cent. Now against this depreciation we have: What can the motor do ? We will say a tool equipment for a shop costs $50,000, and we will take six per cent. of that as the depreciation on that, and we will say that $50,000 equipment is sufficient for an establishment turning out $1,000,000 worth of stuff. That is a pretty big equipment for that output but we will take it on that basis. Take six per cent. on that, it gives $3,000 as our depreciation account. We will double it; we will say it is $6,000, or multiply it by four, and say it is $12,000; in other words we are working on depreciation of 24 per cent., and our motors will only last for about four years; we will say $24,000 is our depreciation. With the individual directly applied motor we can increase the output of that shop about ten per cent. We have now got $1,000,000 output; we are going to take ten per cent. out of it with the same fixed charges and the same pay-roll; we have got to use a little more material; we have got $100,000 to the good; we will take out for material 20 per cent.; we have got $80,000 against $24,000. Now, you can use a pretty dear kind of a motor on a proposition of that kind.

Mr. Gossler thought it well established that the general system of distribution was that of the alternating current, and anything that will tend to simplify the system and permit of the use of alternating current motors will be a great step in the utilization of motors directly connected to individual machines.

Mr. Hims said if we could have an alternating variable speed motor, undoubtedly we would have the ideal factor in shop development, but unfortunately we are not able to vary the speed of an alternating motor, except within certain limits. The alternating motor is far simpler than the direct current motor, we grant, but the direct motor appears in the machine shop to be far more flexible with the maximum output. If you put a man at a machine on the piece work system, and you want to get all out of the machine and man that you can, it would appear that the direct current motor was best adapted for that work, even allowing a large depreciation, but it seems to me with the increased output, and the figures Mr. Lozier gives, all the economy of the alternating current motor and distribution system would be more than counterbalanced by the increased output obtained from the direct current motor. There seems to be a large diversity of opinion as to whether it is best to equip with the direct current motor and apply individual motors to almost every tool of 5-h.p. or over, or put in the alternating current and group your tools.

Mr. Leonard said the conditions in Canada were peculiar because all our plants are operating on the alternating current system, and it is difficult to obtain the direct current for variable speed purposes unless some means of conversion—a motor generator set, or something of that sort, is utilized. Under those conditions, a system employing alternating current induction motors for all constant speed work is the ideal system that would be carried out, for heavy tools running at constant speed, on group tools, on galleries or portions of the shop not served by cranes. The balance of the shop, as for instance, the lathe work and portions of the shop where heavy tooling is to be done, would be operated by a variable speed method, using direct current motors. To obtain this current from the central station it would be necessary to use a motor generator set, but, as Mr. Lozier has pointed out, the cost of this set and its depreciation, and the extra loss in transformation cuts so small a figure on the output of the plant that it is hardly worth consideration.

Mr. Toltz said there was no doubt that the alternating current motor had great advantages in constant speeds or in groups, but in most cases we can group. We use constant speeds for almost every tool in the railroad shop, because each machine is assigned to a certain class of work, which it will do year in and year out. For instance, take a tire wheel lathe; we have in a big shop probably six or eight, each one assigned to a certain size of tire, which we run at the highest speed we can obtain with the power. There are, of course, a few tools that have a variation. Take the boring mill where you want to bore out a tire 86 inches in diameter, and at the same time bore out the hub or centre of the driving wheel. In railway shops there are but few tools that we have to run at variable speeds. Take the C.P.R. shops, which are under construction at Montreal; out of 12,400-h.p. aggregated in tools, we will not have 150-h.p. in variable speeds; the balance are all grouped. Of course, the large tools with constant speed have individual motors, but they are very few. We have not got the A. C. variable speed motor so that we could do away with the D. C. motor, which necessitates either a rotary set, a converter set, or a motor generating set. In regard to the speeds of the tool he did not agree with Mr. Lozier that the operator should have a chance to monkey with the controller. The shop system should be such that the operator of the tool is told what speed he has to use, or in other words, if it is a mechanical speed regulator, what cone, what back gear, and, if it is a controller or electrical device, what notch he should use for a certain piece of work. At any rate, the shop system should tell the operator what to do. At the same time such a system is a check on the workman, if he does the work in proper time. There is a difference between the railway and manufacturing shop; the manufacturing shop is a place where you do one hundred and one different kinds of work in one day on one kind of machine.

The discussion was at this point laid over.

Mr. Higman in reply to a question said: The policy of the Government in respect to fees, is that as the fees for the inspection of meters increase, the registration fees will be decreased. At present, companies having an installation of 500 lights pay $5 a year; those having 1,000 lights and under pay $10; those having 1,000 to 2,000 and those over pay $25; these will be reduced as the fees meet the expenses.

On motion of Mr. Dion, the standing committees for the year were named as follows: A committee on statistics, and two committees on legislation, one for Ontario and one for Quebec.

Mr. Yule reported for the Legislation Committee of the past year, stating that owing to the incessant work of the committee in defending the interests of the companies, there was a shortage of funds. On motion it was decided to devote $300 of the Association's funds to liquidate the accounts of the committee.

The paper by G. U. G. Holman on "Submarine Power Cables," which appears elsewhere, was then read. The author explained that owing to the action of the tide at Quebec, and the unevenness of the river bottom, it was decided to use rubber covered cable instead of a lead covering, with paper insulation. If a break occurred with the paper covered cable, water would get in and spoil it. The cable was protected from ice at the shore ends, by bringing it up through the crib-work of a dock, removing the stones for that purpose. It was anchored by means of ¾-in. chains tied around the cable and wrapped around the crib work, the bell being brought up inside a cable box.

Discussion on Mr. Lozier's paper was resumed by Mr. Gossler, who advocated a shop system by which every machine tool could be operated up to its full output. This gave a more constant day load, and permitted of more over-selling of power than any other method. His company (the Montreal Light, Heat & Power Co.), had 7,000 to 10,000-h.p., which from the 15th September to 15th March, is off at 4 p.m., and not used again till 7 p.m. This permitted of over selling power for lighting, and of quoting prices for power that steam cannot compete with.

In reply to a question, Mr. Lozier said the objection of the union machinist to the electrically operated tool was got over by giving him a bonus, the bonus amounting to about 75 cents a day, which is a compensation for reducing the time of a given piece of work about 20 per cent.

Mr. Scott said the premium system called attention to the fact that the electric motor in the machine shop is not only superseding other forms of drive, but is leading to changes in the construction of the machines themselves, and changes in the tool steel, changes in fact in the whole shop organization. The bonus system was illustrated in this way: Suppose an average workman can do a certain piece of work in ten hours. With the electric drive if they do that much well and good, they get their ordinary pay, but if they do more, then comes in the bonus. In this way the superior workman increases his wages, while the company gets a greater output from its tools. This is of more real consequence than the difference in cost of power. In the large locomotive works at Philadelphia, where the question was gone into, it was found that the total cost of power, including interest on investment in power plants, fuel repairs, etc., was 3 or 4 per cent., but by doubling the cost of power, it was possible to increase the output ten per cent. or to make the labor ten per cent. more efficient. Regarding the range in speed of motors, Mr. Lozier had mentioned a range of 1 to 100, but that he took it would be a rare exception. A change gear, or a number of change gears, or a cone pulley to give several speeds could be used with a motor having a less range of speed. The requirements of different shops vary so much, but in a large proportion of shops the devices for getting the different speeds will be such as are already in use. It may be laid down as a general rule that if we rely on this system for doing the more difficult things, we must do it at some sacrifice in cost and simplicity. If variable speed changing is thrown into the mechanical operations, we will have more mechanical complications; and if it is thrown into the electrical apparatus, that apparatus must be made at some sacrifice in cost or simplicity.

One arrangement of the electrical system was that in which the direct current motor, having a fairly wide variation through changes in its field strength, is supplied with two voltages like that from the Edison Direct Current System, 110 and 220 volts; this does not give the same number of differences of speed by shifting from one circuit to another that is obtained in the more complete multivoltage system in which there are twice that many voltages available, more or less, but it has certain advantages in the way of simpler circuits and in some cases, simpler generating equipment, and is found to cover quite a wide range of usefulness. There are a number of plants in which both direct and alternating current motors are used, not only water power plants with long distance transmission, where the alternating current is supplied, and it is a choice of either using it directly immediately, or of using some type of converting apparatus to get it into direct current. There the chief thing is to use in the form of alternating current all the available power that can be used to save expense, and thereby make a simpler plan for those variations of work. Where the desirability of using direct current for the variable speed is such as to justify the introduction of converting devices, well and good. Not only is this true in plants which have alternating current plants to begin with as transmission plants, but I know of a number of isolated plants which have been put in where it is a choice of making the direct current the one and only one thing, or putting in an alternating plant, and then adding a rotary converter for that portion of the power which is needed for variable speed and direct current control. For example, in a certain rubber mill where the service was deemed to be very hard, and the simplicity of the alternating current and induction motor appealed to the engineer, who was selecting the apparatus, it was determined to put in alternating generators and to run the main part of the power, some 2,000-h.p., more or less, by alternating current, and then transform into direct current the few hundred horsepower they required for that type of work. He was an advocate of the induction motor, not because the induction motor is the only thing, but because it is a good thing, and he was pleased to recognize that each type of motor and each system has its own characteristics.

In reply to questions, Mr. Lozier said they were adopting 240 and 250 as the standard voltage. They take that voltage in the so-called Bullock System and split it up into 90 and 160, so that the sum of the two is 250, and in that way they had three voltages with three wires; that gives the standard three wire plan, cutouts, switches, and so forth. It makes one more wire to the wiring system, so that it is the same as the common three wire system, 120 volts on the side, but they split it up so as to get out of it all that there is in it. As concerns the balancer, the balances are really remarkably small; the balance goes something on the system of a life insurance policy, we do not expect all our policy-holders are going to die at the same time. The motors balance themselves up. The more motors you have on the balancer the smaller the balance will be.

Afternoon Session.

At the afternoon session a resolution of sympathy with J. J. Wright, first president of the Association, in his long continued illness, was passed.

On motion of A. A. Wright, seconded by H. O. Fisk, the following resolution was passed: That in the interests of science, the Canadian Electrical Association, this day assembled in their annual convention, approve of the proposed Government's assistance to Capt. Bernier, in aid of his purely Canadian Polar Expedition, and heartily recommends the project to public support, and it is further moved that Capt. J. E. Bernier be appointed to a life membership in this Association, and the Secretary is hereby instructed to forward a copy of this resolution to the Right Hon. Sir Wilfrid Laurier, Premier of the Dominion, to the Hon. Mr. Prefontaine, Minister of Marine and Fisheries, and also to Capt. Bernier.

The paper by W. A. Layman, St. Louis, Mo., on "Single Phase Alternating Motors as a Means of Increasing Station Earnings," and that by J. W. Farley, on "Transformers for High Voltage Transmission Lines," were then read.

Friday, 12th.

On assembly, Mr. Dion explained the position of matters regarding the work of the Committee on Standardizing Accounts. As the National Electric Light Association of the United States had threshed out the question more thoroughly than the Association, he moved that their report as published, be accepted, and recommended by this Association. This was carried.

Mr. Dion referred to the generous contribution of $500 made to the funds of the Association two years ago, by Frederic Nicholls, on behalf of the Canadian General Electric Company. The Executive Committee decided that this fund or a portion of it should be devoted to procuring prizes for the best papers to be submitted at the annual meetings, or for accounts of original investigations, etc. Rules had been drafted but never ratified, and the Association should now decide what was to be done. It was not supposed that the manufacturing companies were looking for any of these prizes, but that they were intended to elicit talent from the control stations. He suggested that a portion of this money be devoted to prizes for the best answers in the "Question Box" department. After further discussion, it was agreed that the matter be left with the Executive to arrange for prizes to the amount of $100, for answers to questions, and that a "Question Box" editor be appointed.

It was decided to hold the next annual meeting in Hamilton.

The election of officers for the ensuing year resulted as follows: J. J. Wright, Toronto, president; K. B. Thornton, Montreal, first vice-president; A. A. Wright, M.P., Renfrew, second vice-president; C. H. Mortimer, Toronto, secretary-treasurer.

Executive Committee: John Yule, A. B. Smith, P. G. Gossler, A. A. Dion, Gordon Henderson, B. F. Reesor, C. K. Greene, C. B. Hunt, J. A. Kammerer and H. O. Fisk.

Committee on Statistics: A. A. Wright, D. R. Street, and J. W. Purcell.

Committee to confer with Underwriters: P. G. Gossler, A. A. Dion, J. J. Wright, G. U. G. Holman, and Mr. Wight.

Committee on Legislation (Ontario): C. B. Hunt, A. A. Wright, B. F. Reesor, A. A. Dion, W. H. Breithaupt, R. O. McCullouch, J. J. Wright, and J. W. Purcell, with power to add to their numbers.

(Quebec): E. A. Evans, J. McCarthy, P. G. Gossler, A. Sangster, and G. U. G. Holman, with power to add to their numbers, the first named in each case to be the convener.

The social features of the convention included the following:

At 4 p.m. on the first day the members were treated to a Tally-Ho drive to points of interest in the city, by courtesy of the Canadian General Electric Co. Among the conveyances provided was an electric Tally-Ho. A large number of the delegates, with several ladies, enjoyed the drive. In the evening a trip was made to the Island by steamer, where an open-air concert was provided by the band of the Queen's Own Rifles.

On the afternoon of the second day, special cars were provided to convey the members to the new works of the Canada Foundry Co. in the northwestern part of the city. A large party availed themselves of the opportunity to see this important and growing industry. The party was saluted by the blowing of the steam whistles. After being photographed, they were shown over the works, and witnessed with great interest the splendid machinery and appliances which are employed in turning out some large contracts now on hand. Afterwards the party was entertained to a banquet in one of the new shops, when a hearty vote of thanks was tendered to the Foundry Co. for their great hospitality, on motion of A. A. Wright, M.P. An early opportunity will be taken by the Engineer to describe more in detail these works. In the evening the annual dinner of the Association was held at the King Edward Hotel, at which a larger number than ever before were present. The management made a splendid spread in the handsome American dining-room, and the dinner was pronounced a magnificent success.

Though not on the programme, the Association enjoyed on the last day, a trip over the Metropolitan Electric Railway to Bond Lake, by the courtesy of J. W. Moyes, the manager. This trip was also much appreciated.

Notes.

The Canadian General Electric Co., the Westinghouse Co., and the Bullock Electric Mfg. Co. had rooms at the King Edward and kept open house. They had numerous callers. The Westinghouse Co. entertained at a lunch in the grill room.

The Mayor of St. Louis and Business Men's League extended an invitation to visit the World's Fair in that city. At that time an electrical congress will be held.

The Question Box was one of the most interesting features of the convention.

Handsome souvenirs were distributed by the Canadian General Electric Co. and the Bullock Mfg. Co.

Among the ladies present were: Mrs. J. E. Skidmore, Cobourg; Mrs. W. H. Breithaupt, Berlin; Miss Bell Maunder, the Misses Haworth, Miss Howland, Toronto; Miss F. A. Reesor, Lindsay; Mrs. J. W. Purcell, Walkerville; Mrs. C. H. Mortimer, Toronto; Mrs. Bolwby, Miss Boyd, Berlin; Miss Reagan, Cincinnati; Mrs. Evans, Quebec; Mrs. R. J. Parke, Toronto, and a number of others.

The King Edward Hotel, the headquarters of the Association, was greatly admired.

The four papers which follow were read at the Electrical Convention.

VARIABLE SPEED MOTORS AND THEIR RELATION TO NEW SHOP METHODS.

By Robert T. E. Lozier.

Progress does not always follow a single road; many times we find it advancing along converging byways which come together in the main highway along which it then rapidly goes towards its destination, which is the ultimate ideal. Many times those travelling the byway know little of the companies which they are to join at the cross roads, and so it was that where George Bullock ten years ago in his first shop decided to put individual motors on his tools because it appealed to him as being good engineering, he little knew that on a parallel road Ward Leonard was progressing with his Multi-Voltage System for controlling such motors, while on still another road the engineers at Bethelem, Pa., and elsewhere, were determining how to run a shop from the standpoint of true engineering rather than by the rule of thumb.

The speed of the individual motor could not have been fully controlled successfully if it were not for the Multi-Voltage System, which would never have had its application if it were not for the development of the individual motor, and the new shop methods could never have reached their present development if it were not for the individual motor properly controlled. In fact, the shop methods would never have gone beyond the highly developed theory of the academician. I am not losing sight of the possibility of using a mechanical means of varying the tool speed while it works, but these devices have not been developed as yet. What these three factors now joined together are able to accomplish is this: Working every machine tool in a shop at its highest output, thereby making it possible to increase the output of the average shop operating under the old conditions by 300 to 400 per cent. This is the one great feature which is the resultant of these combined improvements which subordinates all others, although of the latter there are many.

Let us consider for a moment each of these methods from its own standpoint, and in its natural order.

New Shop Methods.

In days gone by, if a certain piece of work was to be done, a drawing showing the essential dimensions accompanied the stock which went to the machinist, who followed his own way in (a), setting the work; (b), selecting the cutting tool and grinding it as he best knew; (c), choosing the running speed; (d), determining the cut; (e), and adjusting the feed. The completion of the work was, (1) limited by his intelligence; (2) restricted by his experience; (3) governed by his inclination; (4) and was subject to the limiting conditions laid down by that despot, the walking delegate. Result: Four hours taken to do what could be accomplished in less than one, and with a greater degree of accuracy in the latter case. The first step towards improvement was to take the method of doing the work out of the hands of the operator and place it in the hands of an expert. This expert issued what has been termed a "method card," on which the machinist is told how to perform all the operations involved; setting the work, the kind of tool and its cutting edge, the cut and feed, and last, but not of least importance, the speed. It was at once found that the all prevailing method of driving from pulleys of fixed speed on to cones of limited range and few steps, was entirely too inflexible and greatly restricted the desired results; one step on the cones would be too slow and the next too fast. The exact speed could only be obtained by chance. Furthermore, it was found that the higher cutting speeds that were possible could not be obtained without changing the driving pulleys. In the desire to work the cutting tool to its highest rate of displacing metal, exhaustive experiments were made in the quality and temper of the steel during which the so-called air-hardened steel was discovered. With this new steel it was found that a cutting speed of 100 feet a minute was ordinary, where 20 feet a minute with the old tool steel was the limit. Five times faster could the tools be run than formerly. But we find the highest speed obtained by the old arrangement of belts and cones five times below that required to work the new cutting tool up to its requirements. Change the pulley ratios, and speed up the cones, and two conditions at once develop; first, the cones have not steps enough, before they were applied through a ratio of 7 to 1; now through a ratio of 35 to 1, and while the four changes were almost inadequate for the 7 to 1, now they are five times so. But that is not the only trouble; the belt will not pull the load, because the high rate of cutting the metal requires a proportionate increase in the power. It is now readily seen that if we are to benefit by the new cutting steel and improved methods, we must have a means of driving the tool that will give it as much range of speed as is desired and as much power as the cutting tool demands to perform its work. We are all aware that subdivision of power by electric transmission is a good thing, but the element of broad speed variation brings it down to the individual application of the motor to the tool.

And now we are down to the meat of the nut we are cracking. What kind of a motor do we want and how much and how are we going to vary its speed. In most cases a standard shunt wound direct current motor of about 600 revolutions at 250 volts is the thing for all classes of work. Its principal features should be: (a) Its armature coils of a type designed to carry heavy overloads without deterioration of insulation. (b) Its design to provide for low armature reaction to permit of high speeds with weak fields without sparking. (c) Its structure to be of the protected type (but the enclosed motor is to be avoided except for special cases). (d) It should be on a condensed and handy form, so as to be conveniently applied to any class of tool. (e) It should be interchangeable so that it can be applied to any tool without being specially designed for that purpose. In this manner, a stock of motors can be drawn upon for such necessities as may arise and of such capacity as the particular tool in question may demand, one motor being readily exchanged for another should circumstances require. It must be particularly borne in mind that this motor is no ordinary machine that drives a load, the maximum limitations of which are fixed by a belt that provides a means of slipping. The tool motor must be all guts.

Now as to the range of speed that it must operate through. This is really the backbone of the whole system, and involves a careful consideration of every process of the work performed in the shop to be driven. It might be said in determining the speed range for a shop, that the minimum speed of any one tool is determined by the hardest material it is to cut, and having the largest surface to be machined, while the highest speed is determined by the softest or easiest material that is to be machined on the tool, and having the smallest dimension to be machined. For example, if we have a lathe working high carbon steel, the surface to be machined having a diameter which is the limit of the tool's head stock, and we cut at a rate of 10 feet a minute, we may assume this to be the slowest speed that the tool's spindle will be called upon to run at. Now, if on the same lathe we expect to machine a piece of soft iron having a diameter to be machined 1-10 of the capacity of the lathe (that of the head stock diameter), we then have a circumference 1-10 of that in the first case, and the spindle must run ten times as fast to keep up the same cutting speed, but we can machine soft iron ten times faster than hard steel, i.e., 100 feet a minute, consequently our spindle speed must be 10 x 10 or 100 times faster than in the first case. This gives us a speed range of 100 to 1, which determines the limits of the speed for this particular tool if it is to be used for the purposes above described. In determining the speed ratio to be used in a shop, it should be selected with a view to meeting the maximum requirements of any operation in this shop. Of course, there may be one or two special processes which may have a special speed arrangement for their particular cases, but it will be found that in the average shop the speed requirements vary within certain fixed limits that will apply to the majority of cases. Having determined what our speed range is to be, the next step is to select the methods for obtaining same. Of these there are three, namely: (1) Mechanical. (2) Electrical. (3) A combination of the Electrical and Mechanical. Let us consider these in the order in which they come.

Mechanical.

Under this heading we have two sub-divisions—

(a) Those devices that permit of a change in speed only when a tool is not doing work. (b) Those devices that permit of a change in speed when a tool is doing work.

Of the former, there are the well-known and commonly used back gears, and I believe we can truly include the common cone pulleys, the belts of which are changed while the spindle of the tool is in motion, but hardly while the tool is doing work. Of the latter, there is to be found a great variety such as the Evans' Friction Cone, Reeves' Pulley, Combination of gears and friction clutches which will release clutch from one combination to another, sun and planet gears, etc., etc., but as yet no one of these methods has been able to fulfil all of the conditions of transmitting relatively large horse-powers at high speeds as demanded by the new shop methods. Each of these devices has perhaps its own application, but in a limited way only.

Electrical.

In the electrical system we vary the electrical conditions in the motor itself, so that the speed may be changed within a given range with perfect ease, whether work is being done by the motor or not. The relative advantages and disadvantages of these two systems may be stated as follows: Any of the mechanical methods has the advantage that in reducing the speed of the tool, the size of the motor may remain the same if the same amount of work is to be done by the cutting tool. This does does not hold true if the motor speed is varied within itself electrically. The electrical method has the advantage that it can vary the speed of the motor as it runs, at will, and while the work is being done this has an advantage that the mechanical method does not as yet possess to anything like the same degree. It therefore appears best to combine the advantages of the mechanical and electrical methods of control wherever the requirements of the case demand a large range of speed. The practice now is to use a mechanical arrangement in connection with a variable speed motor, the former consisting of a single or double reduction back gear which enables the motor to reach the lower speeds of the range which are thrown out, and the motor run directly on the spindle in the higher speed range. It will be noticed, of course, that when driving through the gears the motor speed is varied in the same manner as when running direct. Now, having determined the range of speed and the methods to be employed in covering same, the next thing is to determine exactly what part of the range the motor will cover by its own speed variation, and to what extent it must depend upon gears.

In my paper before the American Institute of Electrical Engineers, of December, 1902, volume 19, No. 10, subject, "The Operation of Machine Shops by Individual Electric Motors," I give graphic illustrations of the two methods of varying the speed of motors in such a way that the motor can operate constantly at any one speed of its range independent of whether the load varies or not while on that speed. Of these two methods one is the Multi-Voltage System, which reduces the speed of the motor, and the other is the field control, which increases the speed of the motor by weakening the field, and these two methods determine the range of speed that a motor can successfully cover. I might state that the Multi-Voltage System covers the amount of current that must be handled at the lowest voltage, while the field weakening determines the high limit when it reaches the sparking point of the motor, or perhaps the armature's peripheral speed. In common practice the speed ratio in the motor itself of 7½ to 1 is found to fit the majority of cases. In this arrangement, the lowest voltage is 90, and the highest 250, the field of the motor being weakened so as to increase its speed by 150 per cent. There are, however, several combinations to select from, and it is only necessary to determine just what rating a motor should have to get the desired speed range for a given horse-power to be exerted throughout that range. Mr. William Cooper, in his paper before the Cincinnati Chapter of the American Institute of Electrical Engineers, subject "Methods of Speed Control," volume 20, No. 4, presents a method for determining the exact horse-power and speed rating of a motor in which can be combined to the best advantage field control and Multi-Voltage control in order to cover a given speed range with a given minimum horse-power. I would refer you to Mr. Cooper's paper, which can be obtained by application to the secretary of the Cincinnati Chapter of the American Institute of Electrical Engineers, Norwood, Ohio, for a full description as to the use of his methods. In presenting his paper, Mr. Cooper has stated the following interesting deductions: (1) The total range of speed using both variable voltage and field regulation will be as the square of the range of voltages. (2) Change of horse-power will be directly proportional to change of voltage on armature, field being constant. (3) Change of horse-power by change of field strength will be inversely proportional to change in speed, voltage on armature remaining constant. (4) The relative size of motor as referred to the maximum speed will be directly proportional to its speed variation when using variable voltages. (5) The relative size of motor as referred to maximum speed will be as the square of the speed variation when using field regulation.

Having the method to determine the exact range of speed that the motor is to cover in itself, it then simply remains to attribute the balance of the range to the mechanical device, and this may be accomplished by using one or two gears as may be necessary. The controller should have as many steps as will provide a speed curve having a geometrical development.

We have departed somewhat from our text in following the progress which enabled us to successfully apply the electric motor to the new shop methods, but, perhaps, I have been able to show that the same exact engineering has been applied in giving the maximum result for the minimum expenditure in the development of this feature of the new shop methods as has been applied in determining the operating and mechanical features of this new shop method, and all of which contribute to get the maximum result for the minimum expenditure from:—(1) Fixed charges or general expense such as interest on investment, superintendence, etc. (2) Workmen's time. (3) Power required to operate plant.

The individual motor contributes the following collateral advantages quite independent of the other features of the new shop methods: Clear overhead space, permitting the use of cranes, and giving improved light and ventilation. Condensed shop space, because the tools can be set much closer when individually driven than if operated by belts with counter-shafting. Ease with which shop lay out can be arranged or rearranged, because the tools do not depend upon fixed lines of shafting, and can be readily moved from place to place. A much lighter shop structure, because the side walls and ceilings do not have to support heavy line shafting.

I have not attempted to introduce engineering data to bear upon the matter herein discussed. It would take too long, and I would refer those who are particularly interested to the considerable matter that has already been presented to the American Institute of Electrical Engineers and Engineering Journals, etc., but suffice it to say that the individually-applied motor goes a long way towards enabling the new shop methods to place in the hands of the employer a means of discounting the demand of the labor union for shorter time and higher wages, which means consists of working his men and his tools at a far higher rate of efficiency, the ultimate result of which is a much greater output, despite the increase in pay roll and the shortening of the hours worked.

The Sarnia Gas & Electric Light Co. has been authorized to increase its capital from $75,000 to $250,000. The International Harvester Co. of America has been granted a supplementary license in Ontario, J. A. Publow, of Brockville, attorney. The Buckler Brick Co., of Nova Scotia, is authorized to increase its capital from $6,000 to $30,000.

SOME POINTS RELATING TO SUBMARINE ELECTRIC POWER CABLES.

By G. U. G. Holman, Quebec.

The sub-marine power cable belonging to the Canadian Electric Light Co., which supplies one thousand horse power to the Quebec Railway, Light & Power Co., in the City of Quebec, is laid on the bed of the St. Lawrence River, the terminal cable bells being approximately 3,400 feet apart. A description of the laying of this cable has been published, but as some of the audience may not have noticed this article, I will say that we laid this cable amid floating ice conditions on December 18th, 1901. The interruptions of service have taught a few lessons to us, as well as to the Cable Manufacturing Co., and it is these which I intend to mention in this paper.

This cable, which we will call No. 1, since we are now laying a second cable in the St. Lawrence River, is composed of four nineteen strand conductors, each of an equivalent of 2-0 solid copper. Each conductor is covered with a 40 per cent. Para rubber compound to the thickness of 4-32 of an inch, and then wrapped with one layer of 3-inch black insulated tape. The four conductors are twisted one revolution in four feet, about a common jute centre with 4 No. 14 B. & S. gauge, solid copper, rubber covered wires, as pressure wires, laid-in between the four heavy conductors on the periphery of the cable. The whole was then covered with heavy rubber filled tape and served with two layers of tarred jute. An armor of thirty No. 6 B. W. G. galvanized steel wires were spirally laid over the cable. The weak point was early shown to be the pressure wires. One of the pressure wires open-circuited in June, 1902, six months after the cable was put in service. In August, 1902, a second one open-circuited, and in October of the same year a breakdown in the cable occurred, which showed itself on one of the pairs of conductors—the cable being used for two phase transmission. Upon minute examination of the break, which was much more difficult than would appear in the writing of this account, it was evident that a ground between the armor and one of the power conductors so weakened the insulation by virtue of the heating at that point of the rubber insulation, that a short circuit ensued between the two neighboring conductors. Further, it is the opinion of Mr. Henry and Mr. Reed, the general superintendent and the construction superintendent respectively of the Canadian Electric Light Co., as well as my own judgment, that the insulation between the armor on one conductor was weakened by the continuous inductive spark at the point in one of the pressure wires where it had open-circuited. From a careful weighing of all the facts it is evident that—overlooking they only have developed through the apparently insignificant fact of the minute sparking at such open-circuited point in the pressure wire. The repairing of the cable at this point was effected, and the cable has been in successful operation since that time, except from a defect caused from what we term a mechanical cause, or a cause from the exterior of the cable and by ice, in contra-distinction to an internal electric cause.

Although the engineer of the Cable Manufacturing Co. and the writer carefully discussed the question before the cable manufacture of the insertion of pressure wires in this cable, it was not deemed bad engineering at that time to place such wires in the cable under discussion. This engineer had as much submarine cable experience as anyone in America, but he has learned something through the faults in our No. 1 cable, so that in placing the order last fall for a No. 2 cable, four flexible power conductors alone are in this No. 2 cable. We even discussed, at the time of placing the order for the No. 1 cable the question of placing the pressure wires in the centre of the cable rather than towards the periphery, but it was not at that time deemed unwise to place them in the peripheral position, but our experience shows that what we thought to be very unlikely actually did occur; that is, that it is a mistake in cable design to place the pressure wires on the outside of the larger conductors where such small wires would be subjected to greater mechanical movement than in the centre of the cable, and that even if they had been placed in the latter position, there is too much danger of their causing trouble to the insulation of the larger conductors. Of course it can be theorized that had we made the No. 14 solid pressure wire of strands of wires we would not have had the breakdown, owing to the break that we did have, possibly occurring at the point where the solid wire was jointed by an electric weld.

The greatest danger in future with our cables in the St. Lawrence River, and in fact any rivers of this northern climate, is from the ice conditions in the spring of the year. It is, consequently, absolutely essential to not only protect the shore ends from the action of the ice grinding against the cable itself near what would be the surface of the river, but to protect the cable as it lays on the river bottom where the cable approaches the shore ends. This has been shown by some experience that we have had and that experience has taught us that in laying up the cable to the shore end where is, as may be expected, the greatest movemnt of the ice down river, we should approach the shore within several hundred feet at a point about the same distance down stream and thence make a detour of the cable towards the terminal point. The river depth at such a distance from the shore is invariably greater than near the shore. As the ice catches on the bottom of the river and rotates huge cakes no damage is likely to ensue if the line of the cable be in the general direction of the movement of the ice. The overturning cakes of ice will not tend to catch in the cable as they would if the cable be laid at right angles to the direction of the flow of the river, and, where it does cross at right angles, it would lay at a point considerably below the surface of the river where the ice will not touch the cable. The cable bells, or ends, which we have used, have proven very satisfactory and are merely brass tubes five inches in diameter, with ⅛-inch walls brought down to a conical shape with a small hole of the size of the exterior of the cable, the tube being two feet long and flanged, or belled for an inch. So that with this cable end slipped over the cable and the insulation compound melted and poured in, the bell is completely filled between its walls and the four conductors separated as far as possible at equal distances from each other, and about one inch from the mouth of the bell, the insulation compound, ozokorite, being brought to the top. I will say that in our method of laying this cable on the two occasions that we have done so, we have had the use of a special large reel capable of holding it entirely. The reel is on trunnions geared about 10 to 1 to cranks on each side of the reel, which are moved by man power. Our experience shows us that it is essential to lay the cable slowly in order to be sure and follow every indentation in the river bed, as in the drop of 170 feet, which is the depth at some points of the St. Lawrence River where our cable is situated, more time is necessary for the cable to be laid on the bottom of the river than what, at first thought, might be considered possible. Briefly, our experience is to never put conductors of materially different sizes within the same armored cable, and also to be very careful, in our climate, of the shore ends.

The No. 2 cable, which we are about to lay, has nearly twice as heavy armor as No. 1, as it will have No. 4 B. W. G. instead of No. 6 B. W. G. galvanized steel wire spirally served on the cable, as in the river between Quebec and Levis there are four other cables of the telegraph and telephone companies, and as the gentleman who assists us in our cable laying operations has charge of similar work for the telephone and telegraph companies, we are able to say that the problem of laying a 100 pair telephone cable is a different proposition from laying a two-pair cable of an electric power company, weighing seven pounds per foot. For protection against static discharges, and lightning entering the cable to ground, we are using G. E. lightning arresters on each conductor, and with success.

One effect of cable transmission is very noticeable, and that is the smoothing out of the voltage variations. The output end of the cable presents a smoother record curve than the in-put end. The cable is a condenser into which energy is pushed and the surplus energy overflows. We also find a curious inductive effect, producing 1,300 volts on opposite leads of the two phases, although there is a difference in voltage between phases of 2,200 volts.

In cable repairs we use pure Para rubber tape several inches wide, and about 1-32nd of an inch thick. Also a mucilage made of pure rubber clippings dissolved in gasolene. The mechanical joints in the stranded conductors are made in the usual manner, but removed six or eight inches from each other along the cable length. The pure rubber tape is then laid on and the foregoing described mucilage pasted between the rubber tape layers. The insulation joint is so perfect that cutting it discloses a solid rubber covering. The joints are then laid in together as are the cable conductors and wound with tarred jute. The armoring of a cable joint is the most difficult job mechanically, but the steel wires are intermingled for several feet and then tightly brought upon the cable by wrappings of smaller galvanized steel wires.

HIGH TENSION TRANSFORMERS.

By J. W. Farley.

In a complete high voltage electrical power installation there are three distinct elements. These are: 1st, The generating plant; 2nd, the transmission line with its raising and lowering transformers; and 3rd, the apparatus for the distribution and application of the transmitted power. Each of these divisions has its peculiar problems which must be met and solved, and each has its own special features. The first and third—the generating and distributing elements—have received more attention, perhaps, than the second—the transmission system. This is doubtless due to the fact that the rules and precedents governing the construction of a complete high tension system are not so well codified and as thoroughly understood as is the case in most other branches of electrical engineering. The high tension installations already in successful operation have been designed and built by busy men, who have not found time to lay before the public the valuable experience which they have acquired.

The present transmission line, with its raising and lowering transformers, constitutes the link between the generator, which may be located at some place where power is cheap, and the motor or rotary converter situated at the point where the energy is to be utilized. It is axiomatic that with a given cost of conductor and a given loss the distance to which power can be transmitted depends upon the voltage. To raise the voltage to the figure demanded for economical transmission, and then to lower it to a pressure adapted for rotary converters, motors or lights, is the function of the high tension transformer, and it is on this account that it plays so important a part in the consideration and design of a long distance system of transmission. The great progress in electrical power transmission which has occurred in the past few years is due in a measure to the advance made in the science of designing generators and motors and in the art of manufacturing them. It is, however, the development of the transmission system itself and especially of its high tension transformers which is the criterion of the great advance now being made in the electrical field. In 1891 the company with which I am associated furnished transformers for the first long distance transmission installation in America. This was a 10,000 volt system between Pomona and San Bernardino, Cal. The groups of raising and lowering transformers were made up of twenty separate units, each wound for a high tension voltage of 500, the high tension windings being connected in series for 10,000 volts. The object of this was to divide the full voltage among many units, in order to insure adequate insulation between the coils, and ground was obtained by heavy wrappings of insulation material, and by the use of oil. In 1895, experiments were undertaken on a high tension transmission line installed at Telluride, Colo. Voltages as high as 60,000 were used and a great deal of valuable qualitative data was obtained. These tests were continued later upon an experimental high tension line at the Westinghouse Company's Works, East Pittsburg, when a long and careful series of measurements was made under varying conditions. The manufacture of high tension transformers has been going on continuously for several years, and on the whole so successful has been their operation and so marked have been the improvements in the design and construction of the higher voltage transformers, that to-day consulting engineers and prospective builders of transmission lines have become accustomed to the use of voltages of 40,000 and 50,000, and are seriously considering voltage as high as 60,000. No little confidence, of course, has been established by the successful operation of several high voltage systems in the West, notably the plant of the Missouri River Power Company, which transmits energy at 50,000 volts from Canyon Ferry to Helena and Butte, distances of 17 and 65 miles respectively. Mention is so frequently made to-day of transmission at voltages in the vicinity of 50,000, and so many projects are being planned which embody transmission lines of approximately this voltage, that the successful inauguration early this year of a 50,000 volt line almost one hundred miles in length did not attract the attention it would have done even twelve months ago. I refer to the transmission system of the Shawinigan Water and Power Co., extending from Shawinigan Falls on the St. Maurice River, P. Q., to Maissonneuve, a suburb of Montreal. Since the middle of February, this line has been delivering energy generated at Shawinigan Falls to Montreal, ninety miles distant, at a pressure of 50,000 volts. From the time this line was first thrown into service no shut downs whatever have occurred

The generating plant and the transmission line each merit detailed description. It is the purpose, however, of this paper to describe only the transformers as typical of the latest and best engineering practice in the design of high tension apparatus. The raising transformers are designed to step up from the generator pressure, 2,200 volts two-phase, to 50,000 volts three-phase. The lowering transformers step down from 44,000 volts three-phase (allowance being made for a line drop of 12 per cent.), to 2,400 volts three-phase, two transformers being connected in T. Taps for 86.7 per cent. are provided in both the high tension and the low tension windings; since two transformers connected in this way have a slightly higher efficiency and a better regulation than they would if connected either in V or in T, with the full windings of both transformers in use.

No reference has as yet been made to the capacity of either the raising or lowering transformers. In the rating of these units lies one of their special features, well worth mentioning at this time. The generating plant at Shawinigan Falls was designed with the idea of furnishing power at 2,200 volts to industrial establishments in the immediate vicinity. For the power service contemplated a frequency of 30 cycles was chosen. When the plans for the transmission lines to Montreal were made it was decided to use the 30 cycle generators already installed, transmitting at that frequency and changing at Montreal to the frequency in use there (60 cycles) by means of motor-generator outfits. Future contingencies were, however, kept in mind and it seemed advisable to have the high tension transformers so built that at a later date, if desired, 60 cycle generators could be installed at Shawinigan Falls and the company's Montreal customers supplied with 60 cycle current direct from the secondaries of the step-down transformers. In fine, the transformers were to be designed for operation at either 30 or 60 cycles. This was done in the following manner: A design was made for a 30 cycle transformer of the specified capacity (1,110-K.W. for the raising, and 1,000-K.W. for the lowering), the characteristics being such that high efficiency and good regulation would be obtained. Both high tension and low tension windings were made in two equal parts, with terminals arranged for either series or multiple connection. For 30 cycles the windings were designed to be connected in series. For 60 cycles, however, the two parts were to be connected in multiple, the same voltage being applied to but half the number of turns. The result of this is that while each part will carry the same amount of current as with the 30 cycle connection, the two parts together will deliver twice the amount of current with the same copper loss and at the same voltage as before, thereby doubling the capacity of the transformer. Thus, while the raising transformers have a capacity of 1,100-K.W. for 30 cycle operation, they are rated at 2,220-K.W. for 60 cycles, and the lowering transformers are likewise rated at 1,000-K.W. and 2,000-K.W for 30 and 60 cycles respectively. Operating at 60 cycles the transformers will deliver their rated output (2,200 K. W.), with an ohmic drop only one-half of that for full-load at 30 cycles. The inductive drop will be the same under either condition. The regulation, therefore, at 60 cycles is better than at 30 cycles, the exact figure in the case of the raising transformer being for loads having a power factor of 100 per cent., the extremely low value of 0.376 per cent. With the number of effective turns decreased by the same amount, the flux density in the magnetic circuit will be the same, the loss per cycle being slightly more at the higher frequency than at the lower. The iron loss is, therefore, a little more than double at 60 cycles. Its percentage value, however, is increased but very little.

In the preliminary consideration of these transformers, there was but little choice concerning the general type to be employed. With the construction used at present, in the air blast transformers, the limit of its voltage is in the neighborhood of 25,000 or 30,000. The oil-insulated transformer, however, has been built for voltages far in excess of those now in commercial use, so that the voltage of transmission lines of the future will not be determined by the limitations of the transformers. For voltages above 30,000, then, we are safe in saying that the feature of oil insulation is essential. For transformers of small capacity the cases may be designed with a surface of such an area that natural radiation will keep the temperature of the transformer at some conventional figure. The cost of this radiating surface increases, however, as a high power of the increase in capacity, so that for large transformers recourse must be had to artificial cooling of some kind. In the Shawinigan transformers the heat is removed from the oil by means of the conventional cooling coils, through which water is circulated. These coils are of brass tubing and have no joints nor connections of any kind inside the case, so that the danger of leaks is reduced to a minimum. The Shawinigan transformers are placed in an upright position in boiler iron cases. A more detailed description of these cases will be given later. Both high tension and low tension leads are brought out through the case iron tops, long specially made tubes of fullerboard and mica being used for the high tension conductors. The coils of these transformers are wound up in sections of only one turn per layer. The turns are well insulated from each other and the several coils and sections are protected by wrappings and washers of heavy insulation. A very generous provision is made for ventilating ducts between the sections and between the laminae of insulations. There has been a tendency in the design of some transformers to overlook the fact that there are losses generated in the insulation and that in high tension transformers some provision must be made to dispose of the resulting heat. Careful attention was given to this point in the transformers in question and the insulating material, as well as the copper itself, is kept at a temperature only slightly higher than that of the oil. This point was proved by careful exploration with thermometers during the tests. The ducts through the windings are vertical, so that when a transformer is operated a pronounced chimney effect is produced, the oil rising to the top with such a velocity that the surface of the oil is visibly distributed. The iron laminations are also separated at frequent intervals by ventilating ducts, which permit the oil to circulate to within less than an inch and a half of every part of the magnetic circuit. The low tension leads from the coils are brought direct to a heavy marble terminal board, so arranged with studs and connectors that the somewhat complicated combinations referred to earlier can be easily and quickly made. The terminal board for the high tension leads presented a more difficult problem; its solution was found, however, in the use of standard porcelain insulators mounted on pins and cross arms. Since the insulators are under oil, a compact arrangement was effected which has the merit of making this one of the strongest points in the transformer. The cases of all these transformers are provided with sight gauges at the top to show the height of the oil level. Gauges are also placed at the bottom of the case in order that the presence of water may be detected.

A thermometer is furnished with each transformer, its bulb extending into the oil just below its surface. This thermometer has electrical contact devices, whereby an alarm may be sounded in case the temperature of the oil exceeds any predetermined value.

Too little attention has ordinarily been paid to the consideration of adequate means for handling large transformers. In some instances no provision is made, a great deal of temporary rigging being required in order to install the transformers or to remove them from their cases for inspection or repair. Sometimes a travelling crane is provided which renders the lifting of the transformers very simple. Both the temporary lifting device and the crane, however, interfere very seriously with any high tension wiring which may be located above the transformers. Inasmuch as the logical position for the high tension wires is overhead, any method of handling the transformers which will not interfere with this wiring or which could be employed while the wiring is alive, is of decided advantage. Each of the Shawinigan transformers is placed upon a heavy cast iron base which normally rests upon six flanged wheels let into the foundation proper, cast in the bottom of the base. In front of the transformers parallel with the line in which they are placed is a track on which is a shifting or transfer truck supplied, in addition to the four wheels on which it moves, with six wheels placed in exactly the same manner as those on the transformer foundation. When for any reason a transformer is to be removed from its case, the truck is run up directly in front of the transformer, from which the leads and piping have been disconnected. The transformer, moving easily on the fixed wheels, is then pulled out on the truck. The truck and transformer may then be moved to a point beneath a permanent hoisting device. If the travelling crane has been installed for other apparatus in some other part of the building, the above scheme can ordinarily be employed to bring the transformer within range of this crane. A novel feature was introduced into the design of these transformers which lessens to a great extent the risk to surrounding property from the presence of the quantities of oil in which the transformers are immersed. This scheme, which was suggested by Mr. R. D. Mershon, involves the safe and rapid transfer of the oil to a place of safety in case of fire in the transformer building. The transformer cases are made of heavy iron. The top is of cast iron, heavily ribbed and arranged to bolt to the tank, an air-tight joint being effected by means of a lead gasket. The manholes in the top are also made with air-tight joints, and all the leads and cooling coils are brought out through the stuffing boxes. At the bottom of the tank is placed a large valve which connects direct with the water mains. If a fire occurs in or near the building in which the transformers are housed, and apprehension is felt lest their cases be damaged and the oil be ignited from the heat of the burning building, the emergency water inlet valve may be opened and the oil forced out of the top of the transformer into the sink hole. In this place it will be safe from destruction and the danger of great damage to surrounding property through the release of hundreds of gallons of burning oil will be averted. The substantial construction of the case, together with the water which will then fill it, will protect the transformer itself from harm, the only damage liable to occur to the transformer being the wetting which it will receive. A wet transformer, however, may, by proper treatment, without any great difficulty, be put again into condition for operation.

(To be continued.)

The town engineer has been ordered to have the streets of Outremont surveyed, and the crooked streets straightened.

The city of Sherbrooke has offered to purchase the plant, water power, and franchise of the Sherbrooke Power, Light & Heat Co., for $150,000.

SINGLE PHASE MOTORS AS A MEANS OF INCREASING STATION EARNINGS.

PART I.

An electrical central station with its auxiliary distribution system, is a manufacturing plant, and the same general principles of operation apply to it as to any other form of factory. There must be the greatest possible simplification of output; production must be maintained on as nearly uniform basis as possible; and the full productive capacity must be sold, if possible. Economical operation of central stations is therefore inevitably drifting toward the ideal basis of generation of one form of current, and the development by every means possible, of a high load factor. Further than this, operating engineers are specifying the installation of consuming devices, which afford the lowest first cost, and the simplest possible system of distribution. The single phase alternating current motor lends itself readily to the development of this general scheme of economic production in ways it is the purpose of this paper to briefly set forth. The following concise statement of facts will be accepted—the writer believes—by all central station men who are familiar with the performance of the single phase alternating current motors, as built by the Wagner Electric Mfg. Co.

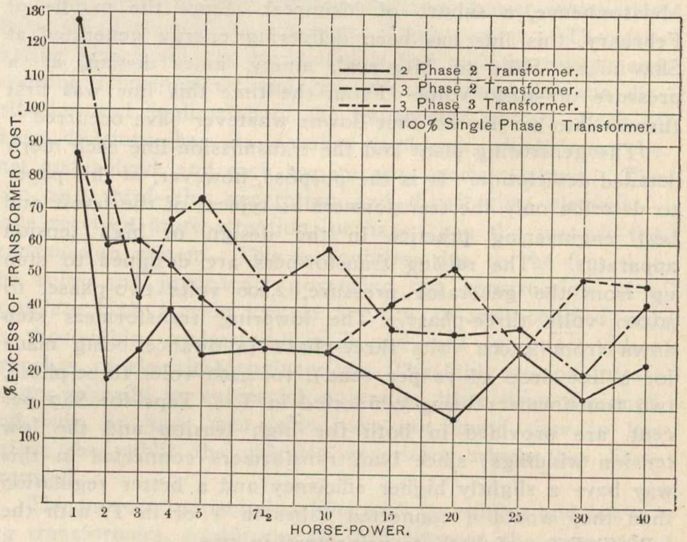


Fig. 1.

Curves showing excess of first cost of transformers for multiphase motors as compared with single phase. (These curves are based on price list of one of the large companies).

1st. The single phase motor has reached a high stage of mechanical and electrical development, and is to-day thoroughly reliable for all kinds of power service, not involving frequent starting and stopping, and speed variation.

2nd. The average single phase motor is equal in its electrical characteristics to the average polyphase motor.

3rd. The single phase motor calls for no larger degree of inspection and maintenance expense than the polyphase.

4th. The operating engineer of a large alternating current station would prefer an equipment of polyphase generators, with single phase distribution system, for service of all kinds, if possible. Difference of opinion exists between operating engineers of polyphase plants as to the extent to which single phase distribution may be judiciously employed, based upon the results obtainable with single phase motors.

5th. The operating engineer of a small station would prefer single phase generators, and single phase distribution exclusively.

The writer of this paper is an advocate of the following arrangement of station service:

(a) For large plants. Polyphase generators, with switchboard arranged for operating:

1st. Polyphase feeders for all large power and rotary converter service.

2nd. Single phase feeders for all general lighting service, and for all small power work, the switchboard facilities being such that any single phase feeder may be switched to either phase of the generator busses.

3rd. Independent feeder regulators for all polyphase as well as single phase feeders.

(b) For small stations. Either polyphase generators with single phase feeders, which may be thrown by the proper switchboard devices to either phase of the generator, and each feeder provided with independent pressure regulator; or single phase generators, with single phase feeders, each feeder being operated with independent pressure regulator.

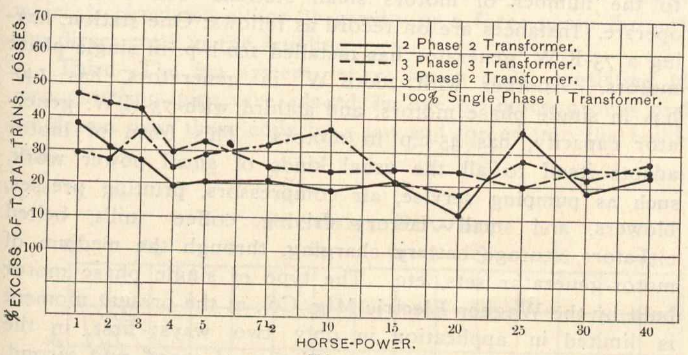


Fig. 2.

Curves showing excess of transformer losses for multiphase motors as compared with single phase.

This policy with respect to station and distribution equipment is advocated on the conviction that the single phase motor has come to stay, and that it affords an alternating current central station—polyphase or single phase—the ideal means of distributing small power. There may be a difference of opinion between the writer and central station engineers as to the scope of the term "small power," but in the writer's belief it is a generally conceded fact that the single phase motor is the central station man's best instrument to economical power service up to units of a certain magnitude. The writer believes single phase motors should receive preference of the operating engineer of multiphase stations, up to units of at least 15-h.p. capacity, and, in selected instances, up to units of even 35-h.p. capacity. The limit of size is fixed naturally by the unbalancing effect produced between phases of the polyphase system. Polyphase stations of the writer's knowledge are successfully operating single phase motors of 35-h.p. Single phase stations with individual generators not exceeding 75 K.W. capacity, are also successfully operating with single phase motors of 30-h.p. each. The justification for the use of single phase motors by polyphase plants arises from the lower first cost of individual power installations, and also the higher efficiency in small units of these installations. As illustrating the high first cost in step-down transformers alone, for polyphase motors, as compared with single phase motors, your attention is called to Fig 1, and as illustrating the high core losses of step-down transformers for polyphase motors, as compared with single phase motors, your attention is called to Fig. 2.

The curves in these two figures are plotted on the basis of standard sizes of step-down transformers now prevailing, and the sizes of transformers required under the various conditions of service are those shown in the following table:

Transformers Required.

H.-P of Motor.	Single Phase	2-Phase 2-Trans.	3-Phase 2-Trans.	3-Phase 3-Trans.
1	1-1 KW	2-6 KW	2-6 KW	3-6 KW
2	1-2 "	2-1 "	2-1.5 "	3-1 "
3	1-3 "	2-1.5 "	2-2 "	3-1 "
4	1-4 "	2-2 "	2-2.5 "	3-1.5 "
5	1-5 "	2-2.5 "	2-3 "	3-2 "
7½	1-7.5 "	2-4 "	2-4 "	3-2.5 "
10	1-10 "	2-5 "	2-5 "	3-4 "
15	1-15 "	2-7.5 "	2-10 "	3-5 "
20	1-20 "	2-10 "	2-15 "	3-7.5 "
25	1-25 "	2-15 "	2-15 "	3-10 "
30	1-30 "	2-15 "	2-20 "	3-10 "
40	1-40 "	2-20 "	2-25 "	3-15 "

When the increased cost of polyphase line construction is taken into consideration, there becomes quite evident a material advantage for the single phase motor, even though the first cause of the motor, as compared with a polyphase motor of the same size, may be somewhat in excess of the polyphase motor. There is a rapidly developing tendency toward the installation of single phase motors, on polyphase stations, and as the possibilities of the single phase motor as to-day built, are becoming better understood, it is the writer's opinion the use of single phase motors will grow with even greater rapidity. An instance recently occurred in which the contracting department of a large company agreed to supply polyphase current for 50 ½-h.p. polyphase motors to be located in retail stores at isolated points on the distribution system. Each motor required an equipment of two step-down transformers. Upon installing the first motor, it was found the idle transformer losses exceed the effective load on the motor, and it is needless to say the operating department declined to carry out the contract made by the contracting department, and insisted upon the substitution of single phase for the polyphase motors. Great development has been made in the application of single phase motors by using non-inductive starting boxes for holding down the starting current. These boxes conform in general character to the usual direct current motor controlling rheostats. By their use motors of larger capacity may be used judiciously without injurious unbalancing effects on polyphase systems. The single phase motor built by the Wagner Electric Mfg. Co. possesses a starting torque characteristic when starting rheostat is not used, as illustrated in the broken curve in Fig 3. Instances are exceedingly rare where torque of this great magnitude is necessary to successfully start the load. Therefore, a starting rheostat may be used and starting current held down to a low limit without sacrificing the necessary starting torque required for the usual installation. Fig. 3 illustrates a test made by one large company, in which full load torque was maintained from rest to full speed, without the current exceeding at any time the full load current. This is a better result than will be developed by the average motor, the manufacturers of the Wagner motor not claiming to be able to start full load torque in much less than 125 per cent. of full load current.

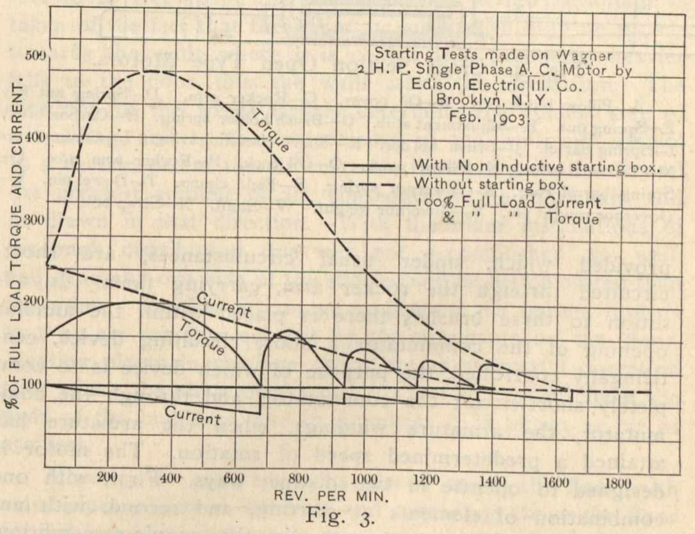


Fig. 3.

It is not necessary to dwell at any length upon the desirability of actively canvassing for motor load. Canadian stations are perhaps in advance of the average American companies in having for a number of years endeavored with great activity to secure a large load factor. The writer therefore believes that the operating engineer attending this convention will, without entering into the discussion in greater detail, accept this statement—that the single phase motor affords an exceedingly useful adjunct to the development of larger station earnings, by not only taking care of one form of business, which it has hitherto been difficult to take on, namely, the isolated power customer—but also by enabling the handling of a larger power business, even in the concentrated business districts at a lower first cost of installation, and therefore on the basis of a larger percentage of profit per horse-power installed.

In concluding this paper, and for the benefit of those who are not especially familiar with the Wagner single phase motor, a description of that motor may prove of interest. A great amount of time and thought has been devoted to the production of a commercially successful single phase motor. Early efforts to produce such a motor were broadly confined to two characteristic types—the synchronous motor, and second, the direct current motor, slightly modified to operate on alternating current. These efforts proved futile and no large degree of success in the production of a single phase motor was attained until the present form of induction motor, built by the Wagner Electric Mfg. Co., was placed upon the market. The motor consists essentially of a primary or stationary element, commonly referred to as the field, and a secondary, or revolving element, commonly referred to as the armature. These elements are entirely independent of each other. The current from the source of supply is fed into the field, and this induces all currents set up in the armature windings. In general terms, the armature may be said to be of the well-known direct current form, a progressive winding being connected to a radial commutator in the usual direct current armature fashion. Brushes are

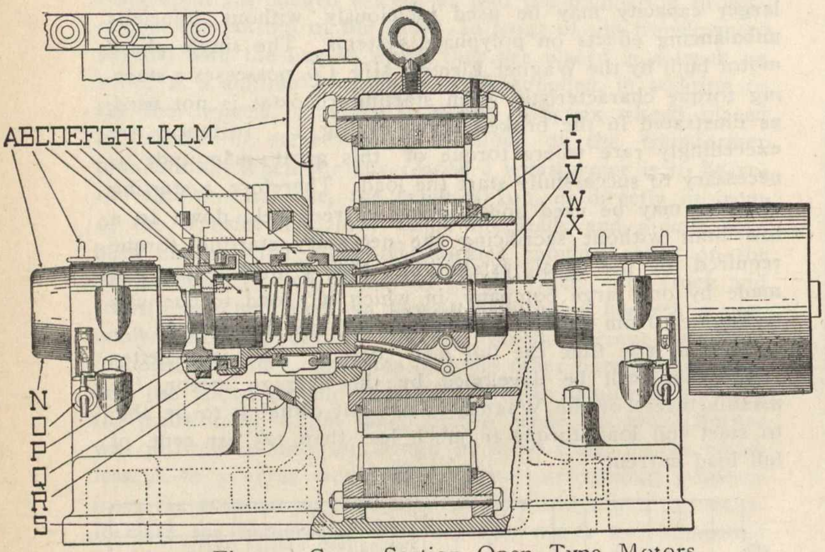


Fig. 4. Cross Section Open Type Motors.

A—Pillow block cap. B—Oil cover. C—Rocker arm. D—Spring nut key. E—Spring nut. F—Adjustment stub. G—Brush holder spring. H—Carbon brush. I—Spring barrel. J—Brush holder. K—Short circuiting ring. L—Commutator. M—Terminal cable. N—Pillow block. O—Oil cock. P—Rocker arm tube. Q—Spring barrel ring. R—Governor spring. S—Field clamp. T—Dowel pin. U—Governor weight pin. V—Governor weight. W—Shaft. X—Strap bolt.

provided which, under usual circumstances, are short-circuited through the rocker arm, carrying them. In addition to these brushes there is placed within the annular opening of the commutator a short circuiting device, centrifugally controlled, the purpose of which device is to completely short-circuit the commutator, and through the commutator, the armature windings, when the armature has attained a predetermined speed of rotation. The motor is designed to operate in two distinct ways. First, with one combination of elements at starting, and second, with another combination of elements in the running condition. In starting, the induced currents of the armature windings are given a directional control through the brushes which results in a rapid acceleration of speed, up to what may be termed the normal operating speed. At this point the centrifugal device comes into play, forcing the short-circuiting links into the annular commutator opening. Simultaneously the brushes are removed from the commutator, and thereafter the armature revolves, performing its function in a manner quite similar to the ordinary polyphase motor. The motor is shown in cross section in Fig. 4. The perfection of mechanical and electrical design of this motor is evidenced by its successful operation over a period of a number of years on almost all the leading central station systems of distribution. That the commutator arrangement meets satisfactorily the requirements of the service, is evidenced by the fact that the Wagner Company has been building this form of motor for almost six years, and has not supplied up to the present time, more than half a dozen renewal commutators, and this limited number of commutators was supplied to a single customer, who had installed a number of 30-h.p. motors to perform a special service involving an enormous number of stoppages daily.

At a number of conventions enquiry has been made as to the number of motors small stations can successfully operate. Instances are on record as follows: One station, having a 75-K.W. generator has installed 100-h-p. in single phase motors. Another with 180-K.W. in generators, has 140-h.p. in single phase motors, and a third with 75-K.W. generator capacity, has 45-h.p in motors. This form of motor adapts itself to all the usual kinds of small power work, such as pumping service, air compressors, printing presses, blowers, and small factory driving, coffee mills, belted elevators, storage battery charging, through the medium of motor-generator sets, etc. The type of single phase motor built by the Wagner Electric Mfg. Co., at the present moment is limited in application in only two ways; first, in the handling of work requiring a variation of speed, and second, in the handling of work calling for a great number of starts daily.

HEATING AND VENTILATING THE MACHINE SHOP.

BY J. I. LYLE, M.E.

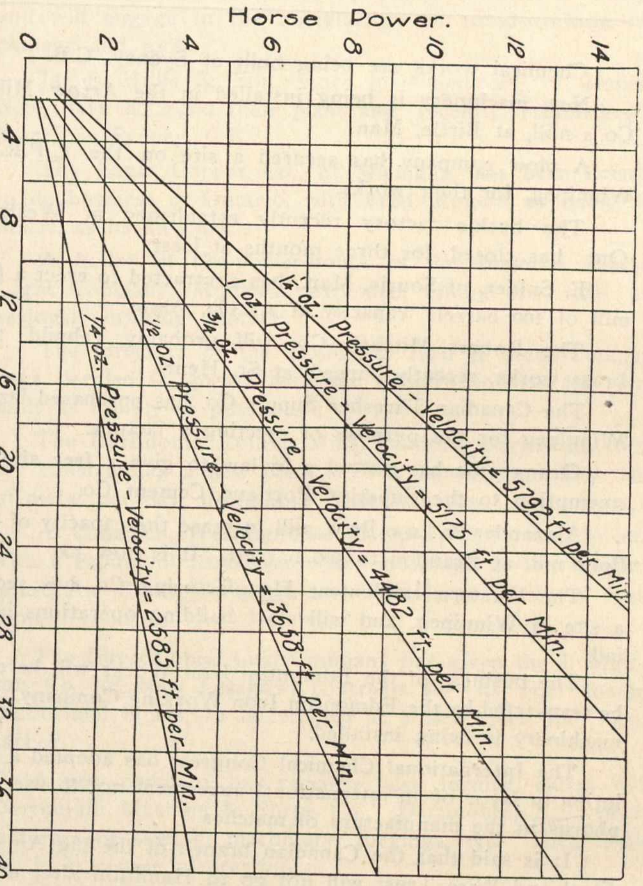
I very vividly remember, while serving my apprenticeship as a machinist in a railway shop that the temperature in the shop often dropped below 40 degrees and frequently to freezing, if the outside weather was within 15 degrees of zero. With a temperature of 40 degrees a workman's hands become numb, and it is almost impossible to do good work with hand tools. This shop was considered by those in charge as being amply heated with an overhead direct steam system. The employees, instead of working to keep warm, as a rule, chose to loaf to keep warm, and I do not believe that the amount of work produced on such cold days, when estimated very conservatively, amounted to more than 75 to 80 per cent. of the normal output. In this building there were about 150 employees earning approximately $2.50 per day; considering, however, the output to be 85 per cent., the loss on cold days amounted to something like $37.50. An efficient heating plant for this shop would cost about $3,750 complete. Without considering the cost of steam, of which there was plenty of exhaust going to waste; allowing for depreciation, etc., making a liberal total of 12 per cent. or $450 per year, as the amount that the cost of the heating plant should earn, it would take only twelve days with the thermometer below 15 degrees above zero to make the expenditure a paying investment.

Practically all railway shops have exhaust steam from the shop and electric lighting engines and air compressors, which is available for heating, so any system not adapted to the economical use of exhaust steam should not receive serious consideration. In considering the advisability of utilizing exhaust steam and returning the water of condensation to boilers, the questions of back pressure and cylinder oil carried over with the steam should not be overlooked. Regarding the question of back pressure and the minimum required for the various systems of heating, it will be found that ordinarily five pounds is carried, and while this could be reduced in moderate weather, the general practice is to establish this as the minimum and increase the pressure in extremely cold weather. With a carefully designed plant, however, this is higher than should be necessary unless there are some adverse conditions. The minimum pressure required for circulation depends more upon a proper proportioning of the supply main, and the distributing branches, than upon the return main. The question of expansion of the steam and the proper removal of the condensation at the required points in the supply main should receive careful consideration. A great many plants require a higher pressure to secure circulation than would otherwise be necessary had proper consideration been given to the dripping of the main and its branches. Wherever possible, the use of traps in return lines should be avoided, as a pump and receiver or the boiler feed pump, controlled by a pump governor, make the best kind of trap. The three system adapted to the use of exhaust steam are:

First—Direct steam heat consisting of pipe coils placed along the walls or overhead.

Second—Direct hot water, where the exhaust steam is used in some form of feed water heater to heat the water which is circulated either by gravity or a force pump through the direct coils in the building.

Third—The fan system, where steam coils, consisting of wrought iron pipe, are placed in one or more groups and air drawn over these coils by a fan and forced into the building.



The sole advantage of direct steam for shops is its extreme simplicity, requiring for its operation the opening and closing of a few valves. This feature is a good one, but it is offset by the disadvantages of having the heating surface distributed through the shop where it is always subject to damage from many sources. Very often it is difficult to place the coil surface to procure proper drainage. With the installation of overhead cranes in shops covering considerable area, and especially those provided with a monitor type of roof, it becomes a difficult problem to install a direct system of either steam or hot water, and an installation of this type frequently requires changes in shafting and machinery to make room for the required amount of heating surface. As a rule, a great deal of glass surface with its high condensing influences requires a large amount of coil surface that cannot be completely installed satisfactorily below windows and between door openings. Coils overhead do not secure an equal distribution of heat satisfactorily, and while the fan-like effect is obtained from the pulleys and belts when the plant is in operation, during the time the plant is idle the bulk of the heat is where it is least required. Often to secure a perfect circulating system it becomes necessary to install a considerable amount of trenching. Trenching as far as practicable should be eliminated from shops, as it becomes a pocket for the collection of dust, waste, water from leaks, etc.

Direct hot water lays claim to the advantages in comparative simplicity and in control of the temperature, but on the other side of the balance sheet it has the same disadvantages of having the heating surface spread throughout the shop subject to injury. The fan system has the advantages of having all the heating surface assembled in one place. Nearly all the heating surface can be set vertically, thereby procuring perfect drainage. The warm air being forced into the building, a constant circulation of the air is maintained, thus heating all portions of the building more evenly than with any other system. Because of this forced circulation, there is a less difference between the temperature of the air near the floor and that near the roof, than when natural circulation is used. Its disadvantages are in having a fan and engine or motor to be cared for, and in having large hot air pipes placed overhead.

The fans installed in the various railway shops differ very materially in their design. Two types of fans are used for heating; the disc or propeller type, and the centrifugal or steel plate type. The latter is used almost exclusively, as the disc fans, except for very small installations, have not been a success. With the centrifugal type of fan, the most economical results for heating are obtained when running the fan in the coldest weather at a speed so the periphery of the wheel will travel at a velocity of approximately 4,500 to 5,200 ft. per minute. In no part of the fan system design does practice differ so greatly as in construction and location of the hot air ducts. Several schemes are used, the most common being to construct the ducts of galvanized iron and to carry the horizontal runs overhead through the truss work, with warm air outlets spaced from 15 to 40 ft. apart, these outlets being placed from 8 ft. to 20 ft. above the floor.

In the early installations, the idea was to distribute very thoroughly, through ducts running practically all over the shop, a relatively small volume at a high temperature and to discharge it 6 ft. or 8 ft. above the floor and direct it so it would blow on the workmen. This practice resulted in much adverse criticism of the fan system, as the workmen in the line of the discharge were given colds and would be overheated, while those not in the direct path would not be heated sufficiently. The later practice for large shops has been to use large volumes of air at rather low temperatures and to use much shorter pipes and allow the air to travel free in the building for some distance. The outlets are usually from 10 feet to 20 feet above the floor. In this design advantage is taken of the fact that the warm air discharged high up travels towards the walls where it is cooled and becoming heavier falls to the floor, thus the walls assist the circulation. The direction of the winds largely determine the coldest side of a building, and as the temperature of the wall will control to a certain extent the air currents, the coldest wall will cool the greatest amount of air, consequently the more air will be drawn in that direction. With the older installations of thorough distribution this was not accomplished so well and generally one side of the shop would be better heated than the other. Another advantage in placing the outlets high is that no air currents are felt by the occupants on the floor. Heating plants in machine shops are in successful operation now where the air is discharged 100 feet to 175 feet from the ends of the buildings, and in foundries it is blown as far as 250 feet.

Masonry or concrete ducts placed under the floor with stand-pipes placed at intervals and extending above the floor from 8 feet to 12 feet are in many cases used. In the Brown Hoisting Machinery Co., Cleveland, Ohio, shops, the underground concrete duct is used and connected to the hollow steel columns supporting the building, which are used for the risers, discharging the air about 4 feet above the floor. In the Philadelphia and Reading shops, at Reading, Pa., no distributing pipes are used, but the hot air is discharged from the fan into the building overhead and the air returned to the apparatus by means of underground ducts with openings at the floor line and distributed through the shop.

The velocities of the hot air in the main ducts leading from the fans should never be greater than 2,500 feet per minute, and this velocity should be reduced gradually in the different branches so that the air is discharged from the outlets at from 800 to 1,200 feet per minute. Where the outlets are high, as in large buildings, 1,200 feet per minute can be used without any objectionable results; but where a thorough distribution is desired, and the outlets are placed within 6 feet or 8 feet from the floor, the velocity of air from the outlets should not be greater than 800 feet per minute.

In any shop installation, provision should be made for re-circulating the air, also for the use of cold, fresh air from the outside of the building. Occasionally it is found that a building can be heated easier by using part outside air and part return air than to use all return air. This is accounted for in the following way: Where the fan is blowing into and exhausting from the building as in re-circulating, the pressure maintained in the building is not greater than the outside, so the leakage of air around windows, doors and crevices may be very great, while by the use of a part fresh outside air, a slight pressure can be maintained and to a large extent prevent this inward leakage. In either case cold air will of course be entering the building, but in the latter case the outside air will pass through the heater where it can be heated more economically and easier than by mixing it with the heated air in the building as it leaks in. In some cases it is found difficult to maintain uniform temperature throughout the buildings when using entirely return air, because it is difficult to keep the lower strata of air along the floor sufficiently warm, owing to leakage, though in the upper part of the building the temperature may be as high as 80 or 85 degrees. Because of the influence of local conditions, fan makers hesitate to give out data about their apparatus. The capacity of the steel plate centrifugal exhaust fan (inlet on one side only), when running under "free delivery" will be given approximately, however, by the formula:

$C = 1.57\ D^2WR.$

In which C = capacity in cubic feet per minute. D = diameter of the blast wheel in feet. W = width of the blast wheel at the periphery in feet. R = R.P.M. By "free delivery" is meant to set the fan in the room and simply draw the air into the inlet and discharge into the same room without any piping, thereby avoiding ducts with the attending friction, other than the air passing through the fan. In factory buildings, where short pipes of rather large diameter are used, thus reducing the friction, the formula $C = 1.25\ D^2WR$, will be found to be approximately correct. With long ducts terminating into many small outlets, the capacity will reduce from 10 per cent. to 20 per cent., as given by this last formula. The delivery or capacity of a fan within the limits used in heating, varies directly as the speed of the fan. In a good installation with the fan running with a peripherial velocity of 5,200 feet per minute (approximately one ounce pressure with air at 62 deg.), from 2,200 to 2,500 cubic feet of air per minute will be delivered per horse-power expended.

By proportioning the fan to meet the severest conditions of weather say zero or colder, then in moderate weather of 20 degrees to 25 degrees above zero the fan will do the work easily at three-fourths the speed; the delivery varying with the speed, and the horse-power will be reduced more than one-half, giving 3,850 to 4,300 cubic feet of air delivered per minute per horse-power. As the number of zero days during the winter are comparatively few, it will be found in the majority of cases that the cost of power to run the fans on such days at one ounce pressure is less than the interest on the increased cost of a larger fan designed to operate at a slower speed in the severest weather.

As to whether a steam engine or electric motor is the better for driving the fan depends upon the local conditions. If there is not sufficient exhaust steam to do the heating, an engine-driven fan is the more economical as its exhaust can be used. Fully 75 per cent. of the heat of the steam supplied to the engine is available for heating, as the cylinder condensation and expansion will not amount to more than 25 per cent. An engine-driven fan also has the additional advantage of being independent of the electric plant; so the heating plant can be operated when the electric plant is shut down. Where electric current is constantly available, together with sufficient exhaust steam, an electric motor is the most convenient and economical, as it is probable the electric generating units in such cases are large and consequently more economical than a small steam engine. If the fan apparatus is placed very far from the source of steam supply, the condensation in high pressure steam pipes necessary for an engine is an item well worth saving. Where engines are used, it is preferable to have them direct-connected, but belted electric motors are preferable because of the large and expensive motor necessary for direct-connection of the slow speed of the fan.

The curve shows the horse-power required to move a given volume of air at different velocities or pressures.

Industrial Notes.

Chemical works are being built at Sydney, C.B.

New machinery is being installed in the Arrow Milling Co.'s mill, at Birtle, Man.

A plow company has secured a site on the C.P.R., at Winnipeg, for their works.

The buckle factory recently established at Westport, Ont., has closed, for three months at least.

E. Snider, of Souris, Man., has contracted to erect a flour mill of 100 barrels' capacity at Arcola, Assa.

The Robert Mitchell Co. will probably rebuild their brass works, recently burned, at St. Henri.

The Canadian Thresher Supply Co. has purchased land at Winnipeg for the purpose of erecting a factory.

Orangeville has passed a by-law to give a free site and exemption to the Superior Portland Cement Co.

Alexander & Law Bros. will increase the capacity of their flour mill at Brandon to 500 barrels. It is now 300.

The Western Implement Manufacturing Co. has secured a site in Winnipeg, and will start building operations in the fall.

The business of the Edmonton Iron Works will hereafter be transacted by the Edmonton Iron Working Company. New machinery is being installed.

The International Chemical Congress has adopted a resolution in favor of an international agreement not to use phosphorus in the manufacture of matches.

It is said that the Canadian branch of the big American Steel and Wire Trust will not go to Hamilton after all, but will be at either Humberstone or Welland.

Three mammoth steel elevators, with a storage capacity of approximately 3,500,000 bushels and estimated to cost $750,000, are to be built in Duluth within the next year.

The Yale-Columbia Lumber Co. has commenced the erection of a new sawmill at Cascade, with a daily capacity of 40,000 feet. Dry kilns, planer, trimmers, lath and other machines are to be operated.

F. Skelton, of Cleveland, Ohio, and R. W. Munnell and S. P. Hooper, of Waynesburg, Pa., are looking for a place to establish a shovel factory in Canada, and are thinking of the Miller foundry at Morrisburg.

The name of the Union Furniture and Merchandise Company of Bass River, N.S., has been changed to Dominion Chair Company. The company is in its forty-fourth year. A fine new building has just been occupied.

The Montreal Witness contains an advertisement for a shop superintendent for large bridge building and construction works in England. It is rather remarkable England sending to Canada for such a man.

J. L. Sutherland, a Nova Scotia railway contractor, and another man, were killed by an explosion of dynamite on the Northern Colonization Railway near Montreal. It was caused by the foolish act of a workman, who struck the sticks with an iron bar to dislodge them. Mr. Sutherland has several brothers who are prominent civil engineers, one of them holding a position in the Springhill mines.

The condensed milk factory at Huntingdon, Que., is almost completed and ready for operation.

The Perrin Plow Co., of Smith's Falls, has been authorized to increase its capital from $60,000 to $100,000.

The Wolvin Syndicate has purchased valuable timber limits about 150 miles square, at St. Ann des Monts.

R. Stewart has made a number of improvements in his planing mill, at Guelph, including a new engine and boiler.

The Granby Rubber Co. has bought the Granby Last Works and will run them in connection with their own business.

The International Harvester Co. is going to build an immense wharf at Hamilton, which will involve a lot of filling in.

Taylor & McKenzie have started new works at Guelph, and will engage in the manufacture of wood-working machinery and tools.

James Hillis & Son, stove manufacturers, of Halifax, N.S., have enlarged their plant and recently established a branch in Sydney, C.B.

The Eagle Copper Co., of Michigan, has been licensed to do business in Ontario, with Fred. Rogers, of Sault Ste. Marie, as its attorney.

A boiler in the power-house of the Imperial Electric Light Company, Montreal, exploded, killing one man and seriously injuring another.

The directors of the Dominion Iron & Steel Company have decided to go on with the construction of the steel mills as rapidly as possible.

The Dartmouth Rolling Mills, Limited, Dartmouth, N.S., are constructing a new plant with a capacity of fifty tons of metal per day, using four blast furnaces.

A Canadian Westinghouse Company is to be formed, with a capital of $2,500,000, which will take in the Westinghouse Air Brake Company, and build large works at Hamilton.

The Intercolonial Coal Company has given the I. Matheson Co., of New Glasgow, contracts for its coal loading shoots and hoists, to be erected at a new pier on Pictou harbor.

A new company has recently been formed, called "The Dartmouth Machine & Forge Co.," Dartmouth, N.S., manufacturers of sawmill machinery, forgings, etc. Their building is in course of erection.

The old board of directors of the Laurie Engine Co. have been re-elected, namely: C. E. L. Porteous, president; Wm. Yuile, vice-president; John Laurie, F. L. Wanklyn, C. W. Davis, Walter H. Laurie and W. G. Ross.

The Canada Iron and Foundry Company, of which R. J. Mercur is manager, has purchased twenty-two acres of land at Hamilton on which they will build a large foundry for heavy castings. Their old foundry will still be used.

The machinery in a new cannery, about the largest on the Fraser river, is being installed. There are four separate sets of machinery, so that, if the supply of salmon is sufficient, the cannery will have a capacity of 60,000 to 80,000 cases.

The Dominion Tar and Chemical Co.'s works, at Sydney, will be in operation about October. The company will distill tar, one of the by-products of the Dominion Steel Company, and manufacture such chemicals as pitch, creosote oil, carbolic acid, cresylic acid, etc.

It is hard at the present time to obtain small grey iron castings that are both perfect in form and easy to drill and work. The Belleville Hardware Co., manufacturers of locks and builders' hardware, Belleville, Ont., require in their business the highest grade of castings, and the study they have made of such casting fits them for filling special orders for manufacturers requiring better than ordinary work. The company would be glad to come into touch with firms requiring high-grade castings.

A new building and construction company has been organized in Winnipeg, embracing the leading contractors. It has a capital of $500,000, and is known as the Manitoba Construction Co.

The King Mercantile Co., of Cranbrook, B.C., is constructing a second sawmill on their limits, with a capacity of about 35,000 feet, giving a combined output for the two mills of 65,000 feet.

The Red Deer Lumber Company, of Red Deer Lake, Assiniboia, is erecting a mill which will be one of the best in Western Canada. The Waterous Engine Works Company has the order for the machinery.

The Babcock & Wilcox Co. will supply the boiler equipment for the new C.P.R. shops at Montreal. The contract amounts to upwards of $75,000, and includes boilers, superheaters, economizers, pumps, patent shaking grates and feed pipes.

The warship Scorpion, at Hamilton, Bermuda, will be brought to St. John, N.B., and broken up for scrap by the Portland Rolling Mills Co. The Scorpion was built in England for the Confederate States, and of late years has done harbor work at Hamilton.

The Lake of the Woods Milling Co. is erecting a building for a steam plant at Keewatin. It is to be 32 by 50 ft., and will be equipped with two boilers and a large engine. The plant will furnish heat for the mill and power for the barrel factory. The company's elevator is to be re-modelled.

Wm. Hutchison, the Canadian commissioner to the Exhibition at Osaka, Japan, has returned to Ottawa and is now preparing the Canadian exhibit for the Fair at St. Louis. The raw materials and natural resources of Canada will be the chief features of the Canadian pavilion.

Newfoundland is offering bounties for the production of iron and steel in that colony—$1.50 per ton on steel billets manufactured with Newfoundland coal and iron, and $1 per ton when produced by coal from Canada or other countries. An export duty of 20 cents a ton on iron ore mined in the province is also proposed.

Large additions have been made to the McClary stove and graniteware works at London. The opening was celebrated by a banquet and picnic, at which 5.000 persons were present. The works were begun in a small tinware factory fifty years ago, and now include stoves, graniteware and tinware.

The buildings of the Manitoba Iron Works, Winnipeg, are approaching completion. They consist of machine shop, two stories, 60 by 125; foundry, 50 by 80; boiler shop, 40 by 60; pattern shop, 30 by 40; forging shop, 40 by 40; core room, 16 by 32; cupola room, 16 by 18; tumbling room, 16 by 20; lavatory and heating rooms, 20 by 40. The most modern machinery will be installed at a cost of $30.000, and the establishment is intended to be one of the best equipped in Western Canada.

The Aluminum Production Co., of New Brunswick, expects to produce the aluminum used by the McAdamite Metal Company, as McAdamite is a compound into which aluminum largely enters. Tesla, the great electrician, claims that McAdamite is destined in time to drive brass out of the market for all purposes. McAdamite is a beautiful metal closely resembling silver in appearance, but has the peculiarity that it will neither tarnish nor corrode and consequently does not require cleansing.

A floating sawmill is in operation on Lake Champlain, with great success. It is a two-storied, ark-like affair, upon a heavy float. The boiler and sawing machinery occupy the main deck. A high stack rises at the stern, giving the craft the appearance of an antiquated steamer. In the same end are wide doors, through which the logs are hauled to the saw. The lumber is passed out through one porthole, and the slabs through another. The sawdust and scraps are carried to the fireroom, and furnish the fuel. The upper story is a dwelling for the crew. As soon as the mill has finished one batch of logs, a tug tows it to the next cove The mill can be hired by the week, or by the job, and in some cases the logs are cut on shares.

The capacity of Hugh Walsh's flour mills, St. Andrew's, Que., has been doubled.

Owing to the large orders received by the Syracuse Smelting Works, Montreal, for their babbitt metal, solder, Columbia phosphor tin, etc., they have been obliged to add more furnaces and to work day and night.

The mud drum in one of the boilers of the Montreal Light, Heat & Power Co. exploded, wrecking the boiler house, killing one man and fatally wounding another. The drum is said to have become thin from corrosion, showing the necessity for more rigid inspection.

B. E. Kingman, and some United States capitalists, are about to establish at Shawinigan Falls, Que., a factory for turning out ferro-manganese, using power from the Falls to the extent of 500-h.p. The material to be worked is a bog ore, which will be treated by a newly-discovered electrical process.

The Buffalo Steam Pump Company, whose works are at North Tonawanda, N.Y., has been purchased by William F. and Henry W. Wendt, who are also owners of the Buffalo Forge Company, and the Geo. L. Squier Manufacturing Company. The North Tonawanda works of the Steam Pump Co. are to be continued as heretofore and the main offices will be in Buffalo.

A system of waterworks, for both domestic and fire service, has been designed by John Galt, C.E., of Toronto, for the town of Shediac, N.B., to cost about $25,000. Two artesian wells are being drilled, and it is intended soon to complete the system, consisting of pumping station, with boilers and pump, also water mains, valves, fire hydrants and storage tank of about 70,000 gallons' capacity.

Marine News.

It is proposed to dredge Tunnel Bay, at Brockville.

The Plant line has been sold to a syndicate of Boston and Halifax men.

A third steamer is to be placed on the Canadian-Jamaica route, giving a fortnightly service.

There are now nineteen steamers running on Lake St. John and the rivers tributary thereto.

A new steamboat line is projected between Toronto and Hamilton. A turbine boat will probably be procured.

The Dominion Government will make a survey with a view to establishing a harbor at Lake Winnipeg beach.

Further shipping facilities are to be provided at Montreal, the Government giving a loan of $3,000,000 for that purpose.

Two of the Allan steamships, the Norwegian and the Iberian, have been ashore, but both got off without much damage.

Soundings have been taken of the Assiniboine from Portage la Prairie to Winnipeg with a view to making it navigable.

The first steamer ever built at Louisburg, C.B., was recently launched. She is of composite build, steel frame and oak planking.

The Otonabee river, at Peterboro, is to be dredged. The dredge Trent is being put in order for the work, including a new steel dipper.

The Rainy River Navigation Co. has let a contract for the construction of a new boat. It will be a passenger and freight steamer of latest design.

The locks at the foot of the Lachine Canal are being enlarged to the standard length of 270 feet, with a width of 45 feet and 17 feet of water on the sill.

The Gananoque river is being dredged. The material removed is largely sawdust and bran dumped in from the mills forty years ago. Some good timber has been recovered.

The White Star, which runs from Toronto to Oakville, was badly damaged by her walking beam breaking and will take two months to repair. The Niagara has taken her place.

John R. Purdon, naval architect of the Fore River Ship and Engine Company, of Quincy, Mass., has reported strongly in favor of Lacoste's ship brake, after seeing it thoroughly tested.

The C.P.R. now has five steamship services—the Pacific, the Atlantic, the British Columbia coast, the Upper Lakes, and the British Columbia Lake and River Service. The total fleet numbers sixty-two boats.

The Columbia, of the R. & O. Line, made the passage from Prescott to Montreal in seven hours and ten minutes, the best on record. She was built at Chester, Penn., ten years ago, and recently came to the St. Lawrence.

The St. Lawrence route is again this season the scene of numerous mishaps to shipping. The smoke caused by bush fires is, however, partly to blame.

The steamer Kingston, of the R. & O. line, broke her shaft when about 10 miles from Toronto, and drifted helplessly till the Hamilton, of the same line, came along and towed her to Kingston for repairs.

The Minister of Marine has ordered twenty-five of the latest pattern gas buoys, which will be placed on the St. Lawrence, between Montreal and Quebec, so as to make it navigable at night. They will be put in position this season.

Two tenders were received by the Government for the proposed Atlantic fast line, one from the Allans, the other from the British & North Atlantic Steam Navigation Company, understood to represent the Dominion Line. Neither were satisfactory.

The Canadian Government surveying steamer Gulnare has made an exhaustive series of surveys off Cape Race, to determine the variability of the currents and tides, and prevent the frequent marine disasters which occur there. It is expected that valuable scientific results will be achieved.

The steamer W. D. Matthews was launched by the Collingwood Steel Shipbuilding Co. on June 20th. She is 390 feet over all, and is declared by a Scotch expert to be equal to any of her class built on the Clyde. This is the third iron vessel built at Collingwood. The Midland King will be ready to launch in about a month.

The Marine Iron Works, Station A, Chicago, Ill., have just issued a new illustrated catalogue, sent free on request. This company's sole business is to design and build modern marine machinery (steam only), suitable for vessels ranging from 30 to 160 feet in length, and including paddle-wheel as well as screw propeller machinery, condensing or non-condensing, for either salt or fresh water, as may be required. The large line of marine boilers, which they build, includes the Roberts' Safety Water Tube, as also the better class of shell marine boilers, and for either hard coal, soft coal or wood fuel, as desired. The catalogue illustrates thirty-five different sizes and types of screw propeller engines and thirty-six different paddle-wheel engines, all of modern type. Fifty different sizes and types of marine boilers are listed.

Municipal Works, Etc.

The Waterous Engine Co. has sold one of its gasoline fire engines to Minnedosa, Man.

Henry and Gibson, who had the contract for stone crushing at Peterboro last year, have again secured the contract for this year.

Two spans of the bridge which crosses the river at St. Rose, Que., were burned, having caught fire from a cigar stub, involving a loss of $3,000.

The sum of $75,000 has been voted for pavements, sidewalks, a new public bath and street expropriations, in Montreal. Three new fire stations are also to be provided.

An electric lighting plant is to be installed at Moosomin, N.W.T.

Granby is contemplating the purchase of a steam fire engine.

The gas mains are to be considerably extended at Niagara Falls, Ont.

Good water has been obtained at Arcola, Man., by means of artesian wells.

Plans for waterworks and electric light systems have been prepared for the town of Whitby.

Iroquois, Ont., has voted $19,000 for the completion of the water works and electrical light systems.

A considerable sum is to be spent in putting the road to Cordova mine, near Marmora, in good order.

A number of Winnipeg contractors have made an agreement to pool their interests in purchasing material.

George Y. Malcolm, in April, wheeled from White Horse to Dawson, 337 miles, in 8 days. He found good roads most of the way.

A new reservoir for the Hamilton Water Works is to be built. A site has been procured at the head of James street, at a cost of $3,500.

The Public Works Department will rebuild the bridge between Bryson and Calumet Island, on the Ottawa, and place it on concrete piers.

The C.P.R. irrigation department will put several engineering parties in the field at once, to complete the surveys for the proposed Bow river irrigation canal.

The city of Winnipeg has received a shipment of 546 barrels of liquid asphalt for its streets, from the Acme Works, San Pedro, Southern California. It came by way of Vancouver and the C.P.R.

Street Commissioner Jones, of Toronto, has a plan for keeping down the dust on asphalted streets by flushing, which would be done at night. He estimates that this can be done for $10,000 a year.

A meeting of representatives from the several local municipalities in the County of Essex was recently held, to consider the question of road improvement, but no plan of action could be agreed on.

The recent drought had the effect of increasing the consumption of water in Montreal from about 21,000,000 gallons a day, at the same date last year, to over 25,000,000 gallons a day. Numbers of people have been found using water without permission.

The 80,000 shrubs from France, planted on Sable Island, with the hope that their growth would prevent the sand from shifting, have not flourished. They are fast dying out for lack of nourishment, and the fierce gales tear them up from their feeble roots.

Port Arthur ratepayers have voted in favor of the proposed system of waterworks. The water will be taken from Thunder Bay, through a sand filter, and pumped to a sandpipe and reservoir on the hill, about 200 feet above the lake level. Willis Chipman is engineer.

Assistant Provincial Engineer McColl, of Nova Scotia, has been in the United States studying road-making systems and the best machinery to use. It is expected a competent official will be employed to give instruction in road-making throughout the Province.

The Dalhousie township council has awarded the contract for the iron bridge over the Mississippi, at the upper end of Dalhousie Lake, at a cost of about $1,850. Mr. Bradford, of Almonte, has the concrete and stone work at $936, and the Hamilton Bridge Co., the superstructure, at $795. The council will do the filling in and the covering by day work. E. T. Wilkie is the engineer in charge.

Owing to labor strikes Warren Brothers' Paving Company have been unable to deliver to the city of Montreal the civic asphalt plant contracted for, and repairs are to be done by contract. Two tenders were received, one from the Barber Paving Co., of the United States, and one from D. Drysdale & Co., of Montreal, both for the same price, $1.31 a yard. It was stated to the council, some of whom feared a combine, that the similarity in price was a mere coincidence. It was recommended that the offer of the United States company should be accepted.

Gananoque has determined to proceed with water-works, under the supervision of Willis Chipman, C.E.

It is estimated that a bridge across St. John harbor to connect the city with Carleton would cost at least a million dollars. It is being discussed by the city council.

The town of Glace Bay has awarded to Warren Bros. & Co., of New York and Boston, the contract for paving three of its streets. The material to be used is known as vitulithic, a mixture of bitumen and very fine stone.

The County Council of Wentworth has decided on having a system of good roads 170 miles in extent. They will get $33,000 from the Ontario good roads fund, and raise $66,000 themselves.

The Toronto City Engineer has recommended that the contract for a new engine for the main waterworks station be given to the John Inglis Co. for an Allis engine, at a cost of $155,000, with an allowance of $5,000 for the old engine. The Allis-Chalmers Co., of Milwaukee, is to be made a party to the contract.

A splendid flow of water has been struck in the artesian well sunk at Listowel, by the corporation, at a depth of 180 feet. The water in the eight-inch hole rose to within 17 feet of the top, and in a test with the fire engine at its full capacity was not perceptibly lowered. From this test it is estimated that the flow will be equal to 250,000 gallons in 24 hours. The council has decided to sink a second well.

Galt is considering a new bridge over the Grand River on Main street. An iron or concrete arch bridge would be preferred, but Mr. McIlroy, C.E., of Hamilton, who has examined the site, says such a structure would be too high in the centre or too low at the ends, and recommends a single span bridge, which would, of course, necessitate having the iron work overhead.

A great deal of damage has been done to bridges, railway tracks and in other ways in British Columbia by floods, caused by the rapid melting of the snow in the mountains. In some places bridges have been blown up by dynamite lest, acting as dams, they might cause reservoirs to form, which breaking away would cause still greater damage. At North Bend a reservoir, which supplies the little town with water, did burst and washed away the C.P.R. track soon after an express train had passed.

Three engineers are to be appointed before July 15th, to adjust the difficulty between the Montreal Water & Power Co., and the Westmount town council, over the water supply. Each body will choose one, and they will select a third, and these will investigate the conditions which prevail at the intake, study the currents and decide what should be done to put beyond question the freedom of the water supply at the present intake from contamination from Verdun and the River St. Pierre; and also ascertain whether the present pipe is free from leaks.

Winnipeg is outgrowing the capacity of its waterworks, and the city engineer has recommended the installation of two additional filters, at a cost of $2,000. About 2,000,000 gallons a day are being pumped, and 1,800,000 gallons put through the softening process. It is estimated that 4,000,000 gallons a day will be consumed during the summer months. Fifty more hydrants are being put in for fire protection, To accommodate the houses so constructed that the service would be in danger of freezing, samples of small hydrants that cannot freeze are being obtained. They are practically large taps which are connected direct with the mains.

At an investigation at Ottawa into the cause of the break at the waterworks pumping station on the occasion of the fire on the 10th of May, City Engineer Ker made some astonishing statements. It was found that there had been a bad leak for fourteen years. It was not of imminent danger to the main that blew out, but was serious, as it was causing a waste of water. Before he could shut down the pump, which had to be done to repair this leak, it was necessary to repair the other pumps in order to keep up the pressure. This had been begun in December last, but had to be discontinued, as the appropriation had given out. The work was resumed in February. A leak for fourteen years looks bad, though not so wasteful as if the pumping had been done other than by water-power.

Science and Invention.

Repairs are made on locomotives in England for about every 50,000 miles run, while in the United States it is customary to run engines from 70,000 to 120,000 miles between general repairs.

The hydroscope is an invention by Signor Pino, an Italian, by which the eye is enabled to penetrate the sea to an enormous radius. The invention ought to nullify the dangerous character of submarine boats.

Dr. Lunden, a German scientist, claims to have proved by experiments that rays reflected from radium enable the blind to see more or less clearly. He instances the cases of two Russian blind boys, who permanently regained their sight through the use of these rays.

Artificial clay, for use in the manufacture of artificial stone tiles, etc., is made in Germany. It is made up of sand, chalk, cement, liquid glue and petroleum, intimately mixed. A chalklike mass is the result, which is easily moulded and made hard by the application of heat. The product is fire proof, resists the weather, and does not absorb moisture.

Kuhlow says that unless the world looks to its forestry, iron will before long replace wood for railway sleepers. The life of the latter is about equal to that of steel rails. Wooden sleepers give a better road, more comfortable to travel on and less destructive to the rolling stock, less liable to accidents from broken rails, and affording facilities for repairs and alterations for junctions and sidings.

A Swiss life preserver consists of a hollow tank fastened to the back, which serves to keep the person afloat, and a provision and drink chamber fitted on the chest. The latter is divided into three compartments, containing drinking water, alcohol and air. Access to the water and stimulants may be had through tubes. Condensed food is carried in three tins on the top of the water tank. There is also a compass, chart, pistol, and ammunition for signalling, and a small sail and signal of distress.

It is known that the radio-active substances like radium impart radio-activity to other substances, and R. Geigel has attempted to show whether the absorption of energy is accompanied by any increase in weight. He was unable to detect any such effect. With a much more sensitive apparatus, Carl Forche has repeated the work, making numerous weighings of 56 grains of lead, and has found that a large mass of active material half an inch below the lead increased the weight of the latter about one part in 25,000,000.

Coherers, instruments that respond to electric waves, are of many forms. That used by Marconi, a tube of metal filings that the waves make conducting and cause to pass dot and dash signals, is unsatisfactory and often unreliable, and require constant tapping to keep the particles separated. The Lodge-Muirhead apparatus, requiring no tapping, is claimed to work regularly in all weather. This coherer consists of a small fine edged steel disc rotated by clockwork upon a globule of mercury, from which it is separated by a film of oil, and its action depends upon the breaking down of the film by the electric oscillations, which thus close the local circuit and cause the signals to be given. The system of telegraphy, of which this forms the essential part, has been in course of development since 1894.

An apparatus, patented by a native of Dusseldorf, for receiving, cooling, and transporting bars, after they have passed through a rolling mill or straightening apparatus, consists of two fixed rails, on which the bars rest, and are moved forwards step by step by means of a long carriage mounted on wheels between the fixed rails. The carriage is reciprocated by a rack and pinion, and fitted with pawls which catch on the rails in the forward movement, but turn down and pass under the rails in the backward movement. When bars have to be removed from a straightening apparatus with a hydraulic cylinder, the receiving end of the carriage is bent downwards, in order to lift the bar over the straightening bench. The intervals between the ends of the rails facilitate cooling. A rotating cylinder at the delivery end of the table discharges the bars to one side.

Dr. Knot, the celebrated æronaut, as the result of experiments, states that nausea and ultimately death of balloonists at high altitudes result from escaping gas due to the decrease of atmospheric pressure, and not from atmospheric conditions. He says he and others experienced no change in their physical condition till the gas made itself felt. Inconvenience might be experienced, but a post mortem has never shown that death has resulted from decreased atmospheric pressure. A height of six miles has been reached and Dr. Knot thinks much greater altitudes could be reached if a balloon could be constructed from which the gas could be prevented from descending on the æronauts.

Professor Sir William Crookes, before the International Chemical Congress, dealt with the possibility of reducing all the elements of matter to one, and of ultimately finding this resolvable into a single form of energy. The subject was "Modern Views on Matter—the Realization of a Dream." Sir William cited the utterances of Sir Humphrey Davy and Faraday, as anticipating the possibility of reducing the elements to simpler bases, and sketched the significance of the Roentgen rays and Becquerel rays, and the experiments of Curie and others, and said: "All these observations find internal connection in the discovery of radium, which is probably the basis of the coarser chemical elements here. Probably masses of molecules dissolve themselves into the ether waves of the universe, or into electrical energy. Thus we stand on the border line where matter and force pass into each other. In this borderland lie the greatest scientific problems of the future. The one element suggested is radium.

Light, Heat, Power, Etc.

Negotiations are going on to have all the electrical wires in Montreal put underground.

The Ontario & Quebec Power Co. has obtained the right to build a dam at the Little Chaudiere Falls, one mile above Ottawa.

Rat Portage has been given the right to expropriate land at the entrance to the Winnipeg river, and will develop 5,000-h.p. by water power for manufacturing purposes.

The Clergue Co., which possesses valuable waterpower privileges on the Kaministiquia river, announces that it will proceed with the development of that power at once.

The town of Red Deer, N.W.T., has contracted with the Western Telephone Co. for the installation of an up-to-date telephone system, and has also made an agreement for the erection of a power-house and electric plant of the finest modern class to furnish light and power. The cost will be about $30,000.

Long distance telephone communication will be established this year between Lethbridge and Cardston and Calgary and Edmonton. Cardston and Calgary will be connected next year, thus completing the chain. Two rival companies are canvassing for telephone franchises in Cardston and Magrath.

The Cataract Power Co., of Hamilton, is entering into power development on a large scale. They are now developing 9,500-h.p. on Twelve Mile Creek, thirty miles from the city, and expect within a year to transmit 50,000-h.p., most of which has been contracted for. The Deering works will take a considerable quantity at half the cost of energy produced by steam.

The importance of careful wiring where electric current is used was shown at the public buildings at Ottawa recently, when it was discovered that the high voltage electric wires had set fire to the cedar ducts through which they enter the western departmental block, which was partially burned some years ago. Little damage was done before the fire was discovered.

Palmerston has voted in favor of purchasing the electric plant by the town.

The town of Bruce Mines, Ont., is getting plans for a water and light plant.

A new telephone company is seeking incorporation for Ottawa and Carleton County.

The town of Lachine will soon call for tenders for a 1,500,000 gallon electric pump. Dupont & Leduc, C.E., of Montreal, are the engineers.

Alcohol has been found to be a good substitute for oil in oil engines. Where a cheap grade of alcohol can be produced, as in Cuba, Brazil and the Philippine Islands, and where it has not to pay an excise duty, it will prove to be a cheap fuel.

The direct economy of electric over oil lighting in mills, etc., is small. The indirect advantages are, however, great. Breakdowns are largely due to inattention. It is impossible to properly watch machinery without ample light, hence the less breakdowns. A broken-down machine can be more readily repaired where there is ample light to work in. Stoppages are responsible for serious increases in the cost of mining and milling.

Dr. G. A. Peters, commanding officer of the Toronto Mounted Infantry, has invented an electric target. It is divided into sections, each electrically connected with an annunciator or dummy target, close to the marksman, and the impact of the bullet on any section of the target is announced by the dropping of a disc on the corresponding section of the annunciator. There is also an apparatus called the challenge-board, by which the working of the conducting wires and the annunciator can be tested and discs disturbed by a shot restored by the pressing of a button.

Ernest Karl Gruhn, a German, has been granted a patent for the telechirograph, a device which transmits over an ordinary telephone wire a written message in the handwriting of the sender. The same amount of amperage and the same intensity of voltage of current as is used in the telephone will serve for the telechirograph. Any current which will transmit the sound waves of the voice in speaking will equally transmit the muscular pressure of the hand in writing or drawing. A third or return wire is necessary to complete the circuit for the vertical and horizontal motion currents.

Winnipeg has three offers to supply electrical power —from Great Falls on the Winnipeg, from Lac du Bonnet on the same stream, and from Keewatin. There is a strong feeling, however, in favor of a municipal plant, and the Assiniboine might be used for this. Some years ago a survey was made by J. T. Fanning, C.E., who estimated the cost of the latter for 10,000-h.p., at $399,000. The rental of 2,500-h.p. at $10 per horse-power per annum, would return an interest of 5 per cent. on the cost of this proposed work. The cost of steam power in Winnipeg is about $100 per horse-power per annum.

Miller Reese Hutchison, whose invention of the acousticon, the electrical device whereby the deaf are enabled to hear, resulted in his being presented with a gold medal by Queen Alexandra of England, has a new invention, a dry storage battery of practical size, which solves a problem which has long puzzled electricians, and opens up a wider field than ever for the application of electricity to motive power. From a battery measuring only three inches high by two and a half wide, and one-half an inch thick, a current of thirty-five amperes and six volts can be secured on a short circuit. By a special device, also, the battery can be recharged from an ordinary electric lighting circuit or from the regulation bluestone cells. It is well adapted for blasting work where the blasts are ignited by an electric spark. The batteries now used for such purposes are nearly ten times as large and very heavy. The Hutchison battery weighs but six ounces, and can be carried in the pocket like a cigarette case, to be used at any time by the blast foreman. With one charging it will run a miner's lamp twelve hours. In the latter instance it obviates the danger of fire damp explosions and gives a cheaper and better light. The battery in larger size can be used for automobiles.

Engineers of the French army are using successfully between the islands of Martinique and Guadeloupe, a wireless telegraph system of their own inventing.

The Ernest S. Harrison Co. has been awarded the contract for supplying the machinery and electrical supplies for the Killarney, Man., Electric Light and Power Company.

The foundation of one of the water wheels at the Electric Light plant, at Magog, gave way, allowing one of the wheels to drop about three inches, resulting in the smashing of all the wooden cogs in one of the gears.

A new power house is being built by W. A. Kribs, at Preston, for the Preston & Berlin Railway. It will be of brick, 48 by 104 feet, with a 100-foot chimney. It will have room for three engines and five boilers. Car barns and a station will also be erected.

Thos. A. Edison has been appointed to the board of technical engineers of the Marconi Wireless Telegraph Company of America, and has acquired an interest therein as a stockholder. Mr. Edison expressed the utmost confidence in the Marconi system.

Owing to the fact that it will not be possible to obtain power from Niagara for at least two years, the Toronto Railway Co. has decided to increase the power plant so as to give from 6,000 to 10,000 adidtional horse-power to meet the growing traffic of the road.

Work on the St. Therese dam and power house, about eight miles below St. Johns, Que., has been discontinued. It was an adjunct to the Chambly dam and power house, which some time ago gave way and is now being repaired. Chambly, meantime, gets its power from Shawinigan.

J. Moriarty, patrolman for the Guelph Electric Light & Power Co., had a narrow escape recently. While adjusting a light the current was turned on and he received a charge of 2,000 volts. The resistance caused the plug to be blown out and saved his life. His hands where he grasped the wire were badly burned.

Joseph Poirier, a lineman employed by the Montreal Light, Heat and Power Company, was badly burned by coming in contact with a live wire while working on a pole. He fell across the wires and hung there unconscious till the Fire Brigade was summoned with a ladder to take him down. One of his fingers was burned off.

Personal.

John H. Dickson, of Kingston, an engineer for years in the employ of the St. Lawrence River Navigation Co., is dead.

James Quigley, of Kingston, has been recommended for appointment as engineer at the Royal Military College, in place of the late Michael Madden.

Rolland Prefontaine, C.E., son of Hon. R. Prefontaine, since graduating at McGill University, has gone to continue his studies in engineering in Europe.

John M. Brinker, who built the Gorge railway at Niagara, at a cost of about a million dollars, and who first proposed the Pan-American Exposition at Buffalo, is dead.

John W. Rutherford, C.E., of New York, one of the most successful builders of waterworks plants in the United States, died in California. He at one time lived in Galt.

J. Ferns, who has been in the employ of the Montreal Fire Department for thirty-six years, has been promoted to be assistant superintendent of the Fire Alarm Department.

Prof. Rutherford, professor of experimental physics at McGill University, has been elected a fellow of the Royal Society for his great research work in his branch of science.

Major Villiers Sankey, city surveyor, Toronto, has been appointed district intelligence officer for No. 2 military district, in connection with the new corps of Guides organized for militia service.

George H. Waring, at one time chief engineer on the Prince Rupert, and also on the Prince George, running on the Bay of Fundy, is now chief engineer of one of the Standard Oil Company's steamers running to China.

Jas B. Peck, of Peck, Benny & Co., nail manufacturers, Montreal, died June 9th.

J. Walter Wells, B.Sc. has severed his connection with the Ontario Bureau of Mines, to take a position with the Algoma Commercial Co. at Sault Ste. Marie, looking after grading of ore shipments.

Duncan McDonald, former superintendent of the Montreal Street Railway, who has been for about two years connected with a large traction company in Paris, France, has resigned the latter, and will return to his former position in Montreal.

The Boston branch of Jenkins Bros., lately moved from 17 Pearl street, now occupy handsome and convenient warerooms at 35 High St. The demand for their well-known valves and packings has increased greatly during the last few years. J. D. Stiles is manager of this branch.

A unique watch charm, a perfect working model, nicely nickel plated, of a standard monkey wrench is put on the market by the Mechanics' Supply Co., of Quebec. By referring to our advertising columns our readers will gain full information regarding this novelty, and its price.

Wm. Robertson, of St. Catharines, superintendent of the Niagara, St. Catharines and Toronto Electric Railway and Navigation Co., which controls the old Niagara Central Railway charter, and intends to extend the line from St. Catharines to Toronto, running over the Beach with a branch into Hamilton, worked himself into his present position from a telegraph message boy.

William Lawson, B.A.Sc., of Toronto, a graduate of the School of Practical Science, has been appointed technical adviser to the Utah Sugar Co., a corporation operating four large beet-sugar factories in Utah and Idaho. He has been associated with the beet-sugar industry in California for the past four years, acting as chief chemist and assistant superintendent at the factory of the Alameda Sugar Co.

Arch. P. Rankin, chief engineer of the engine department of the American Shipbuilding Co., of Cleveland, has been visiting his old home in Toronto. Mr. Rankin is a mechanical and marine engineer of high repute, and is now well known on both sides of the Great Lakes as an expert in marine engine work.

James Ross, vice-president and managing director of the Montreal Street Railway Co., has resigned both positions and retired from the directorate, so as to devote more of his time to the affairs of the Dominion Iron & Steel, and the Dominion Coal Co.'s. F. L. Wanklyn succeeds him as vice-president and managing director.

Two civil engineers are among those included in the Imperial Service Order, the King's new order of merit, in the awards that come to Canada. These are Kivas Tully, engineer of the Public Works Department of Ontario, and Dr. Martin Murphy, provincial engineer of Nova Scotia. Dr. Martin Murphy is past president of the Canadian Society of Civil Engineers.

John Woodman, late divisional engineer of the Western division of the C.P.R., has left the service of that company to start business on his own account with offices in the Merchants' Bank Block, Winnipeg. Mr. Woodman will design and supervise architectural work, bridges, waterworks, sewerage, docks, steam or electric railways, transmission lines, power houses, elevators, etc., and will report on any engineering projects for persons at a distance.