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MISSING

The Canadian Engineer

VOL. XI.—No. 11. TORONTO AND MONTREAL, NOVEMBER, 1904. PRICE 10 CENTS $1.00 PER YEAR.

The Canadian Engineer.

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

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

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

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CONTENTS OF THIS NUMBER.

THE STEAM TURBINE IN MARINE WORK.

For marine service the first acquaintance of Canadian engineers with the steam turbine is in the work of the steamer Turbinia, which has been running between Hamilton and Toronto for a part of the season now closing. She has run daily without accident, and her engineers are highly satisfied with her performances. Her coal consumption has averaged 2.21 tons per hour under a speed of 23 miles per hour, or 1.48 lbs. of coal per indicated horse-power per hour, as compared with 1.58 lbs. with the best average results of the reciprocating triple expansion engine. The Turbinia is a vessel of 1,060 tons gross, and has engines of 3,400 horse-power. Passengers on the Turbinia are sensible of a vibration, but this is a vibration of a different kind from that due to the motion of the crank and piston of a reciprocating engine. It is caused in the case of the Turbinia by the rapid whirl of the propellers. It is not the racking sort of vibration of the old walking beam, or the present day compound engine, but a trembling less damaging to the frame of the boat, and less disturbing to the passengers. It is believed that this quivering can be greatly reduced by a special arrangement of the bearings of the propeller shafts.

Apart from economy of coal when running at high speeds, the chief points in which, in the opinion of the engineers of this boat, the turbine engine is superior to the reciprocating are: the smaller space required for engine and machinery, this leaving more room for cargo, coal, or passenger accommodation; greater simplicity of the parts of the engine and less liability to break-downs; reduction of weight of machinery; reduction in the staff of engineers, and no vibration of the kind to which a reciprocating engine subjects a ship. Two engineers run the Turbinia; but it is stated that the reduction on a larger boat would be greater in proportion to tonnage. An Atlantic liner of the modern type would require seventeen engineers with reciprocating engines against ten or twelve with turbine engines.

These are all important considerations, and the only serious charge against the turbine marine engine is that while it is more economical of coal at a high speed it is of relatively low efficiency at slow speed. This charge could be ignored in the case of a merchant steamer where constant high speed is the rule and quick time the thing aimed at in a long voyage, but in the case of a warship the lazy rate of progress in cruising or feeling for an enemy would be uneconomical with the present style of turbine. But it is practically certain that this defect of the turbine will be overcome in time; and when we recollect that in a hundred year's record of the reciprocating engine coal consumption has been reduced from 12 lbs. of coal per horse-power to say 1½ lbs., we should think it strange if improvements are not made in turbine engine practice in the near future. In fact two or three new types of turbines of recognized merit are now being tested, while combinations of the turbine and reciprocating engine are now being put into some new English boats. Since the turbine engine gets 127 expansions against 27 expansions in the reciprocating, and since there is less efficiency in the early expansions of the former than in the latter, the idea is suggested that the turbine might be used to replace the low pressure cylinder in a compound engine. In this combination, however, the simplicity and compactness of the turbine would be lost along with the more favorable use of super-heated steam, so that this hybridizing is scarcely likely to offer the best line of improvement.

The difficulty of reversing is a minor defect in the turbine. The Canadian Turbinia has three propellers, one a high pressure in the middle of the ship, and two low pressure, one on each side. The latter are reversing, the former non-reversing. The officers say this ship is easily handled when getting in and out of dock. An experiment in a combination of engines to deal better with the problem of reversing is now being made by the Yarrows, of London, who are building a first-class torpedo boat which has the middle screw driven by a reciprocating engine, and the outside screws by turbines. These turbines are not of the Parsons or Curtis type, more commonly known, but are the invention of Prof. Rateau, of Paris, who in a paper which will be quoted in next issue, states that the combination of reciprocating and turbine engines affords the easiest solution of the problem of marine propulsion.

We may add that the commission of experts recently appointed by the Cunard Company to investigate the performances of two sister ships—the Brighton with turbine engines, and the Arundel with the latest development of reciprocating engines—has reported, and though the report is not published in detail, it is known that these experts report definitely in favor of the turbine principle. A commission of experts from the United States navy also paid a visit to the Turbinia as she was running on Lake Ontario and has announced unofficially that it will endorse the turbine.

THE MODEL OF RAILWAY OPERATION.

The railways of Canada have before them two models upon which they may base their system of operation—the British and the United States. So far as the construction of rolling stock is concerned, the climate of the country, the relatively great distances between stations, and the habits of the people all point to an approximation to the United States system as the most suitable for Canada. But because the style of locomotives and freight and passenger cars approximate more nearly to the system of the United States, there is no reason why all the evils of the United States system of operating railways should be adopted as the model for Canada. If all the railways of Canada were owned by the state it is probable that before now, public opinion would have compelled the adoption of some at least of the European safe guards, which would make travelling much safer in this country than in the United States. A direct responsibility to the public, and a common ownership throughout all the provinces would render such reforms easier of accomplishment because each step in the reform could be applied at once to the whole country, and would have the sympathy of the people in carrying it out.

But whether our railways are owned by private companies or the state, there is no reason why Canada should deliberately select as its model the worst operated railway system in the civilized world—that of the United States. If Canadian railways could be either persuaded or compelled to adopt the more essential of the safe guards in use on the railways of the British Isles and in some European states the result in the lessened casualty list would be one of the best advertisements the country could have in the eyes of the world, and especially in the eyes of our American neighbors. The present loss of revenue caused by the increased expenses of these reforms would be more than made up by ultimate increase of traffic and enhanced reputation.

It is not an unusual thing for a British railway company to get through a whole year without losing the life of a single passenger, and in the year 1901, every railway in Great Britain and Ireland was free of a death list, though 476 received injuries in minor accidents. Compare this with the woeful record of railway operation in the United States. The bulletins prepared by the Interstate Commerce Commission show that last year in the States 9,984 people were killed and 78,247 injured in railway accidents. What an appalling disregard of human life! According to the press report an officer of the commission stated that the "increase of fatalities annually is regular, growing with the extension of the railroads and population. We have received reports from England which are as remarkable as the killings here. Approximately, the English average less than 50,000 miles of track to our 200,000, yet they do greater per mile business than we do. They haul more passengers than we do, yet there was not one passenger killed in a recent year." The records of the commission show that in the last ten years 78,152 persons have lost their lives in railroad accidents. These deaths are distributed yearly as follows:—1895, 6,136; 1896, 5,845; 1897, 6,437; 1898, 6,859; 1899, 7,123; 1900, 7,865; 1901, 8,455; 1902, 8,588; 1903, 9,840; 1904, 9,984.

We gave in last issue some statistics of accidents to Canadian railways. The causes of this heavy death and accident list on railways in this country and the United States are various. Lack of efficient signaling systems, the want of a safe train order system, and the long hours of train hands and station hands are among the most fruitful causes of disaster. As regards the last named cause some managers shelter themselves behind the fact that train hands and others, in order to earn extra pay, contravene the company's rules which usually limit the hours of duty. Since no plea of this sort coming from an employee would be tolerated by the companies themselves in the case of breach of the rules against intoxication, it is equally flimsy as a plea from a railway manager to the public when an accident is caused by the drowsiness of a train-hand or station-hand exhausted by long hours on duty.

Although it is a question whether the heavy loss of railway property (apart from the awful loss of human lives), and the many damages that have to be paid for personal injuries would not cover the extra cost of operating large roads on the British system, yet the idea of economy is at the root of the present reckless system of operation on this continent. A railway expert in Chicago said the other day: "The life of a railroad manager is short—in that office, I mean—and his only care is to make a good showing in earnings. That is one reason for the American system of operating railroads." While doubtless unjust to many railway managers personally, this is too true of boards of directors and is true of the American system as a system.

"A great deal has been said about the immunity from accidents on the English and continental railroads," says another critic of United States roads, "and the fact that the block system is universally used there is given as the cause. This system tends to prevent accidents, but we must go farther to find safety in this country. Many hundreds of miles are protected by fixed signals here, but I know of four accidents which happened within the limits of fixed signals on one railroad in this country. Yet it is supposed the signals were working perfectly. Foreign railroad managers operate their roads entirely differently so far as the rules for moving trains are concerned. There trains cannot move without signals; here they cannot move without train orders, which are never used in Europe. Here the signal is only auxiliary. It will be absolutely necessary to revise our rules for the movement of trains before we can expect to get any benefit whatever from any possible combinations of signals, except the automatic stopping device, and the sooner the people are made aware of the fact the sooner will this reform take place."

The Scientific American in a recent article on this subject under the appropriate heading, "How much, then, is a man better than a sheep?" makes a comparison of the death lists of the two countries, and says:—"We have to confess that, so far from there being any mitigating circumstances, the more we look into the question the more inexcusable does our own shocking death list appear; and for the following reasons: First, the total number of passengers carried is greater in Great Britain; second, this greater number is handled upon one-eighth as many miles of track—24,000 miles in Great Britain as against 200,000 miles in the United States; and, thirdly, the average speed and the frequency of the trains is greater there. So that the slaughter that is going on is actually less excusable than the mere figures—and Heaven knows they are bad enough—would show. For with a smaller total number of passengers and trains, and in spite of the fact that they are spread over eight times as many miles of track, we kill 77 in 15 days while they kill one in 15 months. But why this appalling difference; and what, if any, shall be the remedy? Perhaps the trouble is that we have not as yet arrived at a proper estimate as to by how much a man is better than a sheep." The writer then goes on to show how the habitual disobedience of orders by engineers who are too ready "to take chances" in running past signals, could be effectually dealt with if the companies made the saving of life their purpose.

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ELECTRIC SMELTING.

P. Heroult, of La Praz, France, discoverer of the electric process of manufacturing aluminum, and inventor of an electrolytic process of steel making, recently visited Canada, and is reported to be interesting himself in the development of his process in iron and steel making in this country. He recognizes the advantages Canada possesses in having great powers within transmissible distance of iron and other mineral deposits, and we may look for an electric smelting plant on a commercial scale at an early date. Dr. Haanel, of the mines department of the Geological Survey, with whom Mr. Heroult had a conference, is reported as making the following statement on the subject: The application of electricity to the smelting of ores promises important results for Canada. So far as magnetic iron ore is concerned, there is little doubt of the superiority of the electric over the blast furnace. For the treatment of refractory ores, which abound in Canada, the blast furnace does not yield sufficient heat, probably not more than 2,000 degrees. By means of electricity 3,000 and more degrees of heat are developed. Electricity is also indispensable for the extraction of titanium and phosphorus and sulphur from the ores. Furthermore, the electric current can be regulated to a nicety and kept under control. Wherever water power exists electricity can be economically generated, and costs less in the smelting of ores than fuel. Steel can be produced by the electric process for $12 a ton, and perhaps less. At this rate it can easily undersell steel from the blast furnace.

An estimate, for instance, has been made that the cost of electricity from the Chats Rapids on the Ottawa River would be only $4.50 per horse-power per annum. Within easy access are the Bristol iron mines. There are, of course, many other situations equally favorable for the electric reduction of ores in different provinces, and Canada ought to lead the world in the new metallurgy.

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—In our Sept. issue it was mentioned that the St. Clair Tunnel Co., which operates the Sarnia tunnel for the Grand Trunk Railway, were investigating the question of introducing electric locomotives for hauling trains through the tunnel. The necessity for such an investigation was demonstrated in a tragic way before October was half out, for on Sunday, the 9th ult., a freight train parted while being taken through, and in the endeavor to clear the tracks six men perished from the fumes of coal gas. The night was foggy, and the heavy air gave no draught through the tunnel, and but for the heroism of one of the rescue party more lives would have been lost. The lowest part of the tunnel being under the river, the problem of ventilation is a difficult one. Carbonic acid gas (carbon dioxide) settles always in the lowest parts of a confined space, such as a mine or tunnel, and where, as in this case, direct overhead ventilation cannot be obtained, the use of coal burning locomotives will always present grave dangers to passengers and railway employees. For years past the special suitability of the electric locomotive for just such situations as this has been demonstrated on three or four continents and if the St. Clair Tunnel Company had been as anxious to save lives as to earn dividends it could have settled this question long ago without any expensive enquiries. The coroner's jury never called any witness to demonstrate that other means of haulage could have been adopted, and its verdict that if the company had "had better equipment for ventilation it would, in a measure, have prevented the accidents that have occurred since the opening of the tunnel for traffic," is rather a lame conclusion to so important an enquiry. If electricity were used there would be practically no need for ventilation, as there would be no carbonic acid gas generated. The Railway Commission has called the company's attention to the necessity for a change in the method of operating trains and has sent its experts, Messrs. Mountain and Duval to report. These gentlemen will have no difficulty in getting the most satisfactory evidence that the electric locomotive will provide a perfectly feasible and safe system for performing all work at this tunnel.

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—We print elsewhere the opinion of a New York financial paper on the commercial aspect of the various Niagara Falls electric development works. The Canadian Engineer does not share the pessimistic views of that paper. One of the companies on the Canadian side of the Niagara is financially identical with the power company which installed the first large works on the United States side, and has undertaken its Canadian works with its eyes open, and after several years' experience as a pioneer in the development of large units for transmission to Buffalo and other towns as well as for consumption around Niagara Falls. The other two Canadian power companies are undertaken by men who not only understand the electrical business, but are skilled financiers, and know pretty thoroughly the commercial prospects of what they have undertaken. It is true that the 375,000-h.p. in course of development on the Canadian side is in excess of the visible present requirements in the Niagara peninsula and Toronto, but electric power can be transmitted to Ontario points as far west as London, and the local chemical and industrial works of the Canadian side of the Falls are certain of creation when the power is ready. In fact the electro-chemical industries of the Canadian side of the Niagara will be one of the wonders of the Falls second only to the scenic wonders, and these can and will be the direct creation of electric power. Some of these electro-chemical industries afford enough profit to enable a power company owning them to supply the electric energy for nothing. At all events, the men at the head of the electric developments at Niagara are not taking any anxious thought about the future of their enterprises. In the meantime they have no difficulty in finding all the money needed for accomplishing what they have undertaken.

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TELEPHONE AND TELEGRAPH.

The International Telephone Co. is laying a telephone cable fifteen miles long, connecting Vancouver, Victoria, Marietta, Wash., and several intermediate points.

The Bell Telephone Co., which is extending its long distance equipment steadily in Manitoba, intends to connect with the American Bell system at Pembina and St. Vincent.

Stephen D. Field, nephew of the Atlantic cable inventor, has invented an amplifier which may be applied to a wireless receiving instrument, so as to make possible the recording of a telegraphic message. The amplifier can also be attached to ocean cables and greatly increase the speed of transmission.

On October 19th, a deputation of Brantford aldermen visited Toronto Junction and inspected the "Stark" telephone, light, and power system in operation there. As a result, a recommendation will be made that the company's offer for a franchise in Brantford be accepted. The deputation were enthusiastic in their praise of the system.

H. E. Brockwell, superintendent of service for the Bell Telephone Company, and J. McMillan, of the Canadian Pacific Telegraph, are superintending the installation of the composite telephone in Manitoba. The new system is so designed that telephone and telegraph messages can be transmitted over the same wire simultaneously.—Winnipeg Free Press.

William Marconi has been on this side of the water recently. His plans in brief are as follows: The Glace Bay station is to be moved to a more protected site inland, and the power of the transmitter greatly increased. The Poldhu, Eng., station will then be similarly increased in power, and by the new year Mr. Marconi hopes to have commercial connection across the Atlantic.

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—E. L. Chadwick, representing W. H. C. Mussen & Co, Montreal, was in Toronto about the end of last month.

—St. John, N.B., has decided to purchase the electric light plant, in Carleton, a suburb of the city.

—The new tug Togo, built for G. S. Campbell & Co., Halifax, N.S., for harbor towing work, was given her trial trip Oct. 20th. The Togo is fitted for use as a fire and wrecking tug.

—The steamer Kenosha of the Kawartha Lakes Navigation Co.'s fleet was burned to the water's edge at Lindsay, October 22nd. The boat was valued at $7,500, and was insured for $4,000.

—The New Brunswick Southern Railway is making improvements in its roadbed, and is adding to its rolling stock, and hopes within a few months to have a through fast express from St. John to Boston.

—A rich nickel-copper deposit was discovered recently on the Montreal river in the Temagami reserve. Asbestus and mica have also been located on the reserve, of which the Crown Lands Department expects detailed reports later.

—The Temiskaming and Northern Ontario Railway is now running three trains each way per week from North Bay to New Liskeard. It is expected that the rails will be laid some thirty miles beyond New Liskeard before the end of the year.

—The contract for the air-brake equipment of the Grand Trunk Pacific has been awarded to the Canadian Westinghouse Air Brake Co., of Hamilton. It is said that the contract will take half of the output of the factory for the next four years.

—The Peterborough Shovel and Tool Co. was recently incorporated by Thos. Fortye, A. L. Sykes, A. Elliott and others of Peterborough, with a capital of $50,000. A building will be put up immediately, and the factory will be in operation as soon as possible.

—The Dominion Department of Marine has placed thirteen gas buoys at important points on the ship channel of the St. Lawrence between Grondines and Ile Bigot. They are steel spar buoys showing acetylene gas lights 13 ft. above high water mark.

—We regret that, through an oversight, the valuable article on Insulation, which commenced in our last issue, and which is concluded on page 351 of this number, was not credited in the initial instalment to our esteemed contemporary, The Electrical Engineer, of London.

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FIRST TURBINE ATLANTIC LINER.

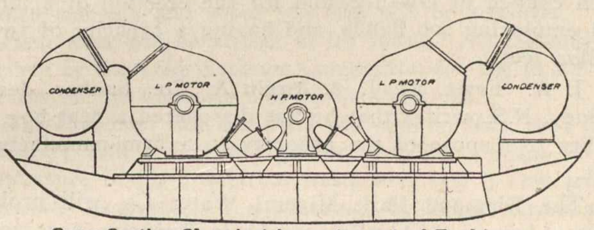
There has been launched from the shipbuilding yard of Workman, Clark & Co., Belfast, the steamer Victorian, the first of the two turbine-driven ships ordered by the Allan Line.

The Victorian is the pioneer turbine vessel for the Atlantic or any other ocean service, and, as such, her launch is an event of more than ordinary interest. She and the Virginian, now being built on the Clyde, are sister ships as regards dimensions, capacity and power. This pair of twelve thousand tonners will form a notable reinforcement to the fine fleet of the Allan Line, which already numbers twenty-eight steamers, and comprises several vessels of ten thousand tons each engaged in the mail passenger, and general service between the United Kingdom and Canada. Splendid ships, however, as are the Bavarian, Tunisian, Parisian, and Ionian, the Victorian exceeds them in size by 2,000 tons, and, as regards speed, is expected to be a long way in advance of them.

That she is one of the handsomest vessels ever built in Belfast was the opinion of every expert who saw her on the stocks before the launch or in the water afterwards. She is a striking contrast to the ordinary straight-sided ocean steamer of to-day. Her lines fore and aft are sharp and clean, swelling gracefully into a noble breadth amidships, which suggests high qualities of steadiness and stability, as well as a capacity for speed, which could hardly be excelled. Before she took the water people viewed with interest her three propellers—a novel feature in an Atlantic liner.

For a considerable time it has been debated whether the turbine would be practicable as a means of propelling the giant ships that carry our cross-Atlantic passenger traffic, and while other great shipping companies were looking for more light and hesitating to plunge into a practical experiment that might involve heavy loss, the Allan Company boldly assumed the responsibility of giving the lead. They lost no time either. Twelve months ago the keel of the Victorian was laid by Workman, Clark & Co. Now she has been successfully launched, and before the end of the year it is expected she will be ready for sea. Her trial trip will of course be the crucial test, and upon it much will depend. For it may be taken for granted that other important companies which have decided to adopt turbine engines for new liners will watch with attention the earliest performances of the Victorian.

Originally, the Victorian was designed to be driven by reciprocating engines, but after some progress had been made with her hull, Messrs. Allan decided that she should have turbines instead. Workman, Clark & Co. made the necessary alterations in her structural design, and at the same time undertook what was a far more difficult and delicate task, the construction of the great turbines—the largest ever made—which are to drive her. This was by arrangement with Parsons & Co., for it was the Parsons turbine that was decided upon. A high-pressure and two low-pressure turbines will drive the three propellers of the ship, which, by the way, strike one as being unusually small to drive a monster possessing a cargo capacity of more than 8,000 tons, besides accommodation and equipment for upwards of 1,300 passengers. These propellers, however, revolve at very high speed—from 270 to 300 revolutions per minute. The central one, arranged as in



Cross Section Showing Arrangement of Turbines

a single-screw vessel, is worked by the high-pressure turbine, the others, which are arranged as in a twin-screw ship, by the low-pressure turbines. The two latter have each a reversing arrangement which enables them to be driven full speed astern, either together or independently. Thus the ship will be as easily and effectively manœuvred as regards turning or backing as an ordinary twin-screw. This disposes of the objection which has sometimes been urged against turbines, that they are defective with regard to reversing motion.

The principle of the steam turbine is less generally understood than that of ordinary reciprocating engines. Briefly, a turbine engine is a fixed cylinder upon the inside surface of which are mounted rings of brass blades projecting radially inwards. Inside this revolves a drum armed on its outer surface with similar rings of blades set at an angle to the fixed blades, and arranged so that they are "sandwiched," so to speak, between those of the fixed cylinder. Steam is admitted at one end of the turbine, and passes through longitudinally in a zig-zag path, being deflected from the fixed rows of blades in the turbine casing against the rows of blades on the drum, causing the latter, which is built on the propeller shafting, to revolve, and thus drive the propeller. The "fixed blades" (those in the cylinder), act as guides to deliver the steam with proper direction and velocity against the "moving blades" (those on the drum). Thus the full power of the steam is utilized, and in a direct and continuous way.

The term "blades," when used in connection with the machinery of an ocean liner seems to suggest a screw propeller or something equally formidable. But these turbine blades are surprisingly small—no larger than a lady's little finger. Their number, however, is prodigious, there being no less than a million and a half separate pieces used in the blading of the three turbines of the Victorian.

It may be easily imagined, when the principle of the steam turbine is grasped, that everything depends upon the proper "set" and inclination of the two sets of blades. Hence the difficult and delicate character of the constructive work. The manufacture of the turbines is well forward. Workman, Clark & Co. have a special engine shop, equipped with the necessary plant devoted to them, and C. E. Allan, one of the members of the firm, personally superintends their construction. It will, however, require some weeks longer of skilful and arduous labor before the turbines are ready to be fitted in the Victorian.

The energy of the steam is used up to the last ounce in its passage through the turbine. But economy of power and room are not the only advantages which the turbine promises in connection with ocean traffic. There is a complete absence of the unbalanced forces which cause vibration in an ordinary steamer, and which is thus reduced to vanishing point. Then there is very little fear of breakdown, because there are no moving parts to break or get out of order. It is usually the breaking of a crank shaft, or connecting rod, or some such appliances that cause trouble on a modern steamer. Here the steam acts directly, driving the shafts of the ship with an even turning movement, enormously reducing the stresses to which the moving parts of ordinary engines are subjected. Indeed, it is claimed for the turbine that there is a saving in weight, space, attendance, up-keep, to say nothing of a considerable increase in speed.

Owing to this economy of space the builders have been able to provide accommodation on board the Victorian, such as is probably not to be equalled by any vessel of her size afloat. They have utilized the saving not to increase the number of passengers carried, but to give every possible comfort and luxury to all three classes of passengers. The Victorian will be emphatically a comfortable ship so far as the perfection of appointment can make her so. Care for the humble steerage passenger has always been a leading point of policy with the Allan Line; in the Victorian it is exemplified in a remarkable degree. Even in their unfinished condition, the music-room, dining-room, and other special accommodation for this class challenge admiration for their roominess and completeness of equipment.

The steam to drive the turbines will be generated by eight large boilers.

The length of the Victorian is 540 feet; her breadth, 60 feet; her depth 40 feet 6 inches. She is divided by bulkheads into eleven compartments, and with the sub-divisions of her double-bottom she has twenty watertight spaces. She is built to the highest class of the British Corporation Registry of Shipping, and her hull has been specially strengthened above the requirements of the Corporation in order to make her doubly secure against the heavy weather of the North Atlantic. The first-class accommodation, which, as usual, is amidships, is of the most complete and approved order. Perfectly heated and ventilated staterooms, and suites of rooms, a spacious and well-fitted dining-saloon, an elegantly appointed music-room, and a luxuriously equipped smokeroom are some of the features. Not less comfortable proportionately are the second-class quarters, and, as already indicated, third-class passengers are catered for in the most liberal manner. Electric light throughout, a complete printing outfit, and an installation of Marconi's wireless telegraphy are among the arrangements for the comfort and convenience of passengers.

As regards facilities for the handling of cargo, the ship is as perfectly fitted as possible. She has ten steam winches and derricks for working the holds, and she is provided with insulating chambers and refrigerating plant so as to enable her to carry fruit, dairy produce, etc., from Canada.

The Victorian will take her place on the Allan Canadian mail and passenger service from Liverpool, to be followed by her sister steamer Virginian, now building on the Clyde.

These steamers, with the Bavarian and Tunisian, will land to land provide a service which by reason of the shorter mileage of the route, will compare in length of voyage favorably with the swiftest of the other Atlantic mail services, and as much of the voyage is in land-emcompassed seas, the Canadian route cannot fail to become increasingly popular with that great section of ocean travellers to whom a short and smooth sea voyage is an attraction.

FAIRBANKS SCALE AT POINT EDWARD.

Editor Canadian Engineer,—

Sir,—We were greatly astonished at reading an item in your last issue relating to our scales. This item is doubtless copied from another paper. We may say that these scales were sold to the elevator people and that the engineer and the elevator people admit defective material was used in the installation of one of these scales. This timber broke and the entire weight of the hopper came upon the levers of the scale, which, naturally, broke them.

"Fairbanks" Hopper Scales have a reputation extending throughout the Dominion, and every important elevator has them installed with possibly one or two exceptions. There is in all the great elevators at Port Arthur and Fort William nothing but Fairbanks Hopper Scales, and in elevators being erected at these points this season Fairbanks scales have been exclusively used. The elevators at Depot Harbor and at Coteau Landing (Canada Atlantic Railway), are equipped with Fairbanks scales, as well as those of the Canadian Pacific and Grand Trunk Railways. The Canadian Government elevators at Montreal are also equipped with Fairbanks scales.

This is the first instance in which any trouble has been caused, and both the engineer and elevator people admit it was not the fault of the scale but was the fault of the mechanic who installed the scale permitting inferior timber to be used, which was furnished not by the Fairbanks Co., but by the parties owning the elevator.

Yours truly,

THE FAIRBANKS CO.

Montreal, October 7th, 1904.

Walker House, Toronto, Oct. 25th, 1904.

Messrs. The Fairbanks Co., Montreal, Que.

Gentlemen,—Your letter of recent date, enclosing clipping from Canadian Engineer regarding scale at Point Edward Elevator, is received.

In reply would say that the whole statement as printed is largely misrepresentation, and is evidently inspired by your Canadian competitors for the sole purpose of injuring the Fairbanks scale.

The accident to the scale at Point Edward, was due entirely to the use of a defective timber in supporting the scale, and was in nowise attributable to the scale itself. The timber was sound and looked well, and had passed the elevator company's inspector; and was supposed to be all right. It was, however, of soft white pine, and although the scale had been in use for several months, the timber gave way and allowed the scale to fall to the next floor. The scale, of course, was partly wrecked, and other damage done. The statement, however, that difficulty arose as to who should stand the loss is utterly false and malicious. When the accident occurred, I at once recognized the moral obligation on my part, not to allow the loss to entirely fall upon the Elevator Company alone, I therefore requested that your company replace the broken parts of the scale, and to again supervise the erection of same, all of which you did free of cost either to the elevator company or to myself, and all of which was done without any objection on your part.

To cover the balance of the loss, I gave the elevator company a check in amount sufficient to let them out of this accident about, if not fully even.

Yours very truly,

J. H. TROMANHAUSER.

Architect and Builder Grain Elevators, Minneapolis.

[Note.—The foregoing letters refer to a paragraph in last issue, which stated or implied that the accident was due to some fault of the scale. It is clear from these letters that the accident was entirely the fault of the defective timber in the building, as acknowledged frankly by the contractor himself. We very much regret the injustice done The Fairbanks Co. by the publication of this paragraph, which did not originate with this journal, but was quoted from a Hamilton paper.]

INDUSTRIAL NOTES.

The American Horse Shoe Co. is erecting a plant in Hamilton.

Schultz Bros., of Brantford, have been given an $18,000 contract for a new rink in that city.

The Dowsley Spring and Axle Co., of Chatham, Ont., will put in a new engine and increase their power.

The Henderson Roller Bearing Co., of Canada, Limited, head office and factory at Toronto, proposes to erect a factory in Winnipeg.

It is stated that the John B. McCutcheon Co., machinists, of Battle Creek, Michigan, may open a machine shop at Yorkton, N.W.T.

The International Association of Steam Engineers of the United States will hold its next annual convention in Toronto, in September, 1905.

An English company is now bringing out machinery to equip a salt works at Winnipegosis, Man., on property belonging to Paul Woods, of Sifton, Man.

The Mount McKay Brick and Tile Company, of Fort William, Ont., have installed a complete plant, capable of producing upwards of 3,000,000 brick in the season.

The Dominion Government is to build a wagon road from Edmonton to Peace River Landing, a distance of 480 miles. Work will commence in December.

The business of the Kemp Manure Spreader Co., of Stratford, Ont., has been bought up by the Massey-Harris Co. It will still be operated in Stratford.

J. E. Webb, contractor, of Toronto, has started clearing away the ruins of the old Clifton House at Niagara Falls. Plans for the new Clifton are said to be complete.

The Carney Lumber Co. has arranged terms with the town council of Owen Sound for the erection of a lumber mill employing 200 hands, and having a capacity of twenty million feet.

J. A. Ervin, of J. A. Ervin & Co., lumber dealers, Sydney, N.S., writes that he has discovered a peat bog, and wishes to dispose of the property to a firm manufacturing peat.

The Diamond Park Mineral Water Co. will probably erect a large new bottling works in Arnprior next spring, and are asking the town for a nominal assessment for a period of ten years.

The ratepayers of Hespeler have passed a by-law to loan Clark & Demill, of Galt, manufacturers of woodworking machinery, $20,000 to move and establish their plant there. The company will proceed immediately to erect suitable buildings.

The Metal Shingle & Siding Co., of Preston, who were burned out in July, suffered again by fire last month, when their temporary premises were destroyed at a loss of about $30,000. The town has made a loan of $15,000 to the company to enable them to resume business.

Work on the foundation of the new C.P.R. hotel at Victoria, B.C., is being pushed and should be finished by the end of the year. Tenders for the construction of the building—which is to be a seven-story structure of brick and stone—will be received by the divisional engineer at Vancouver up till December 29th.

There has been considerable activity in Renfrew County in connection with the opening of the corundum mines by the Corundum Refiners, Limited. A new post-office has been established near Palmer Rapids, known as Jewellville. Contracts have been let for the construction of thirty dwellings in the new village.

The Canada Car Co., the incorporation of which was noted last month, announces that a large plant, comprising the best features of the plant of the Pressed Steel Car Co., will be erected at once near Montreal, and will be in operation next summer. It will have a capacity of twenty-five wooden cars, fifteen steel cars, and fifteen passenger coaches a day. Besides this the works will have a capacity for steel underframes for twenty-five cars a day and thirty or forty steel truck frames.

A Chicago furniture company will establish a branch factory in Winnipeg, employing 150 hands.

Lewis Bros. & Co., wholesale hardware dealers, of Montreal, have secured a site in Winnipeg on which to erect a large branch warehouse.

After another short term of operation the Belleville rolling mills again closed down on the 11th ult. The city made a seizure for taxes which the company resisted.

The coke blast furnace at Sault Ste. Marie, Ont., one of the two furnaces built to supply pig-iron for the steel plant was started up on the 18th ult., and the charcoal furnace is getting ready for operations.

The John Bowman Hardware Co., of London, Ont., assigned last month with liabilities of $112,901, and assets of $96,234. Montreal, Toronto, New York, and other United States firms are the principal creditors.

The Crowe & Nicholls chair factory, in Stratford, is just about completed. It is the first building in that city constructed of cement. The Stratford Mill Building Co. installed the boiler and engine.

Certain shareholders of the Cramp Steel Company have brought a claim for $300,000 against the officers and directors. Plaintiffs call for the cancellation of three hundred thousand dollars' worth of shares on which the directors voted for transfer, also for an injunction to prevent the transfer of assets to the Northern Iron and Steel Company.

Prof. Prince, Commissioner of Fisheries, has visited the fish reduction works at Boston, Portland, and other Atlantic coast ports, to get information for the purpose of establishing similar works in Canada, where the manufacture of fish and fish offal costing two or three dollars per ton into products worth $25 or $30 a ton can be carried on. Of three plants to be erected, the site of one has been fixed at Canso, N.S.

The coke oven plant to be erected at Sault Ste. Marie by the Lake Superior Corporation will have a capacity of about four hundred tons daily. Some 350,000 tons of coke will be handled annually and about 300 men will be employed. Construction work will be started in the spring. All the coke will be taken by the Lake Superior Corporation for use in the blast furnaces on the Canadian side of the river.

The Dominion Iron and Steel Co., Sydney, N.S., have closed a contract with a German firm for installing a plant for the manufacture of pig iron from waste iron ore. This process, which was discovered a few years ago by Bruck, Kretsham & Co., Germany, reduces the cost of the production to not over 75 cents a ton. The plant will have a capacity of 75 tons per day, and this will be enlarged should the process do all that is expected.

The Stirling Company, Limited, of New Jersey, have obtained judgment at Osgoode Hall against the Nickel-Copper Company, of Hamilton, for $68,231. The plaintiff company about two years ago advanced $65,000 to the Nickel-Copper Company on options, but the latter company were unable to fulfill their obligations in the deal, hence the suit to recover the money and interest. The Stirling Company will not be able to realize on the judgment for some time, as Mr. McConnell of Ottawa comes in first with a mortgage for about $200,000 on the Nickel-Copper Company's property. Recently the Hoepfner Refining Company, of Hamilton, which is comprised of some members who are officers in the Nickel-Copper Company, seized the latter's property for about $48,000 rent, alleged to be owing to the Hoepfner Company. In this matter a sale has been hanging fire since the seizure, and it is doubtful if the sale will now take place.

—The Pittsburg Meter Co., manufacturers of water meters and gas meters, East Pittsburg, Pa., have been awarded the gold medal by the international jury at the World's Fair, St. Louis. This is the highest award given to any meter company at the Exhibition.

—The Electrical Development Co., of Toronto, has awarded contracts amounting to $120,000 on the sub-station for the Toronto and Niagara Power Co., at Niagara Falls. The concrete and brick work went to Thomas Mumford, Niagara Falls, for $40,000, the steel work to the Canada Foundry Co. for $45,000, and the galvanized iron work to Wheeler & Bain, Toronto, for $3,600.

RAILWAY NOTES.

Much of the machinery has been removed from the C.P.R. shops, in Perth, to the Montreal shops, and the Perth shops will be used only for repairs.

The Grand Trunk Railway contemplates extending its shops at Point St. Charles, Montreal, at a cost of $200,000, and employing a couple of hundred more men when they shall have been completed.

G. A. Mountain, engineer of the Government Railway Commission, accompanied by Joseph Hobson, chief engineer of the Grand Trunk, is investigating the recent railway accident at the Sarnia tunnel.

The Egerton Tram Co. has completed an electric line connecting New Glasgow, Trenton, Stellarton, and Westville, N.S., "the city of the four towns." The line was formally opened on October 14th.

Col. John McNaughten, railway promoter and builder, of New York, has under consideration a line of railway from Grand Forks, B.C., up the north fork of the Kettle river for a distance of fifty miles.

The location of the C.P.R. Toronto-Sudbury line has been completed as far as Craighurst. The point nearest Barrie is about six miles out. A line has been obtained shorter and easier than the one passing through that town.

Fire broke out in the boiler room of the T. H. & B. shops in Hamilton on October 4th. The blacksmith, the machine shop, the car repairing shop, and the interlocking switch tower were destroyed, besides some rolling stock. The loss is estimated at about $35,000, fully insured.

The C.P.R. is considering a scheme for reducing the grade over the Selkirk Mountains at Rogers' Pass, by a tunnel three miles long through the mountain, between Glacier station and Bear Creek. It will be a heavy work, but it is thought that the reduction in the cost of haulage would justify the expense.

The Grand Trunk Railway Company has awarded an order for twenty-five engines of the Richmond compound mogul type to the Kingston Locomotive Works. The new engines are for the Grand Trunk Pacific Railroad, and will entail an expenditure at the works of $400,000. The engines will be forwarded within the next eighteen months.

The Victoria, B.C., Terminal Railway Co., from Victoria to Sidney, now controlled by the Great Northern, may be operated as an electric road. A branch from Oliver siding to New Westminster Bridge is now being built. This will give a direct route from Port Guichon to Vancouver through New Westminster. The Sooke water supply is being examined as a source of power.

The Chronicle reports that the contract has been signed by the Quebec and Lake St. John Railway Company with Edmund Conway, for the branch line from St. Gabriel Station, on the Jacques Cartier river, to the township of Gosford. This line will follow the old route of the Gosford wooden railway for a number of miles and will give access to the magnificent hardwood lands of the township of Gosford, which abound in maple and birch. Mr. Conway expects to have three miles of track laid this fall to a point near the Riviere aux Pins.

In response to a circular from the Railway Commission, railways of the Dominion have agreed among themselves to draft a uniform set of rules to govern the operation of trains. All roads will be compelled to introduce block safety systems wherever business is heavy enough to make it necessary. Automatic switching devices will be insisted upon, so that semaphores will first denote danger before a switch is opened. Hand and light signals will be made uniform on all roads, and a rule will be introduced that no train hand shall work more than a specified number of hours each day, whether he wants to or not.

The Canada Foundry Co. turned out its first locomotive last month, and for the present will turn out one new one per week. The new locomotive is of the consolidated type, compound cylinders, high pressure, 23-inch diameter, and low pressure 35-inch diameter; 26-inch stroke, with four coupled driving wheels on each side, each 57 inches in diameter. The combined weight of the engine and tender without either coal or water is 208,000 pounds. The tender has a capacity of 5,000 imperial gallons, equalling 25 tons of water, and eleven tons of coal. Frederic Nicholls, the general manager, notes the interesting historical fact that this is the first locomotive built in Toronto since early in the fifties, when the old Northern Railway Co. made locomotives of the small dimensions no longer seen on Canadian railways.

The Chicago and Northwestern Railroad has installed at a cost of $30,000, at Lake Shore Junction, near Chicago, an electric switch and derail system to guard against wrecks. Mechanism in the depot, by means of levers and switchboards, controls five switches and five derailing devices, the electricity being generated by a 5 horse-power gasoline engine, which charges a 56-cell storage battery, which supplies a constant current. An approaching train signals its coming when a mile and a half away through an extra raised rail at the side of the track. This rail is pressed down by the wheels of the engine forming a contact which produces a current and sounds a buzzer at the depot, also dropping the name of the division on the switchboard apparatus. When a train has the right-of-way the derailing apparatus is set automatically so as to throw any trains on the other routes from the track in case they approach the junction.

The Transcontinental Railway Commissioners announce that they have eleven parties in the field in district "A," which covers the Province of New Brunswick, and a like number in district "B," which constitutes that portion of Quebec from the New Brunswick boundary line to Clear Lake, with the following engineers in charge: J. E. Sirois, C. A. Bourget, P. C. Talbot, Alphonse Larue, Samuel Lepage, F. Hibbard, Paul Mercier, J. A. Beaudry, R. E. Hunter, B. Bourgeois. In district "C" eight parties are out, four of them up the Gatineau and four up to the head waters of the Ottawa. The engineers in charge are: W. Osborne, E. O'Sullivan, A. B. Haycock, R. A. Hazelwood, D. B. Brown, J. Wilger, J. F. Armour, J. P. Pim. Mr. Hoare, chief engineer of the Quebec bridge, has a party surveying the approaches to the bridge. Two parties are being despatched to the west side of Lake Abitibi. It is stated that all the engineers in charge of these parties are Canadians. Major Hodgins, C.E., has been appointed district engineer for the Winnipeg district, and has been notified to proceed to Winnipeg and organize the staff preparatory to the commencing of the location surveys from that end. Mr. Armstrong, of the Canadian Northern, has been appointed chief engineer of the division between Winnipeg and the Pacific coast. F. W. Morse, third vice-president of the Grand Trunk, is to take up his residence in Winnipeg, and administer the affairs of the G.T.P. in the West. The Winnipeg Free Press states that the terminal facilities in that city will be arranged by the Government Commission. The point of entry has not been decided, and surveys have not been brought nearer than ten miles of Winnipeg, in order to give a choice of location for the depot, etc. This will be settled so that work may begin in the spring.

MUNICIPAL WORKS, ETC.

Prince Albert, N.W.T., will instal a waterworks system.

Amherstburg ratepayers defeated a by-law to raise $6,000 to purchase a new pump for the waterworks.

A by-law will be submitted to the ratepayers of Brantford, Ont., to raise $60,000, for the erection of a new city hall.

Montreal city council has decided not to purchase the gas plant next spring, consequently the company's franchise will continue for five years.

St. John, N.B., will commence work at once on the extension of the waterworks, using Loch Lomond as a source of supply. F. A. Barbour, C.E., of Boston, is the supervising engineer. The work will cost about $170,000.

The city council of Charlottetown, P.E.I., owing to the high prices charged by local companies for power and light, has asked the De Lano-Osborn Engineering Co., Montreal and Toronto, to prepare plans for a municipal electric lighting and power plant.

The Board of Trade of Clinton, Ont., is investigating the advisability of the purchase by the municipality of the electric light plant of the town.

The municipal gas plant at Owen Sound, recently equipped with new appliances, caught fire a few days ago, and was damaged to the extent of $800. Supposed cause: the overheating of lime in an outbuilding.

Waterloo, Ont., has passed a by-law to purchase the local gas company's plant, and carry it on as a municipal undertaking. The cost of the present plant is $11,000, but $9,000 more is voted for extensions.

London, St. Catharines, and Brantford have recently purchased tapping machines by which connections may be made to water mains without cutting off the flow during the operation. The machines are said to give perfect satisfaction.

Willis Chipman, C.E., Toronto, has reported to the Stratford, Ont., council recommending a new waterworks scheme at cost of $100,000, including engines and boilers. The source would be artesian wells. He recommends placing meters on large consumers.

Toronto has decided to buy stock in the Consumers' Gas Co., and to spend $50,000 on a subway at Lansdowne Ave.,and $45,000 for fire stations at Cowan Ave. and Kew Beach. The by-laws were all carried by a vote taken on October 22nd.

Robert Howe, inspector for the Canadian Fire Underwriters' Association, has advised that Winnipeg should immediately construct a high pressure system for fire protection, with a pumping station on the Red River.

Red Deer, Alta., is installing a waterworks system, having given a $2,900 contract to H. Ramsay, of Calgary. The contract includes a basin, 40 feet by 50 feet, in the Red Deer River, the laying of pipes from there to the pumping station and water mains up to the chief business sections of the town. The pipes to be used will be iron bound wood.

F. L. Fellowes, C.E., engineer of Westmount, Que., has reported recommending a municipal lighting plant in combination with a refuse destructor, the whole to cost about $225,000. The electric plant for arc and incandescent lighting was estimated at $118,076. It is estimated that the cost per kilowatt hour for a 14-hour service would be 6 7-10 cents, against 14¼ cents now paid.

The Water, Light and Power Commissioners of Fenelon Falls, Ont., have closed a contract with the Ambursen Hydraulic Construction Company, of Boston, for the construction of a concrete-steel power dam in the Fenelon river for municipal lighting. The dam is 200 feet long and is about 10 feet high. The work was commenced on the 6th of October and will be finished about the 1st of November. E. Bradley, C.E., of Montreal, is the Canadian representative of the Ambursen Hydraulic Construction Co.

S. Chant, ex-Mayor of St. Thomas, Ont., gave the World representative an account of the progress of that city under municipal ownership of the street railway, which was taken over two years ago. Under private management the road gave a very poor service and finally broke down altogether. As a municipal enterprise it gives a steady service, the cars run on time, and the citizens can depend on them. The result of this improvement is to be seen in the increased patronage of the road, which made a better showing last summer than it ever did before. Tickets good any time during the day are sold at a rate of eight for 25 cents. In addition to these, workmen's and children's tickets sell at the rate of ten for 25 cents. The ten for a quarter tickets may be used by anyone during certain specified hours. So successful has been St. Thomas' experiment with its street railway, that it proposes to extend the system to Port Stanley, a distance of seven miles. The city also intends to own and operate the gas and electric light systems. It has been greatly hampered by the Conmee Act, which was passed just as St. Thomas was making ready to instal a competing system. The city was compelled to proceed under the provisions of the Conmee Act, under which the matter is now being arbitrated. The present charge for gas is $1.50 per thousand, but when the plant is owned by the city, the citizens expect to get it at $1.

The fire committee of the Winnipeg city council has recommended an appropriation of $20,000 for the purchase of two steam fire engines.

The natural gas wells at Medicine Hat, N.W.T., were recently examined by Eugene Coste, M.E., who estimates the output of the deep well at 1,100,000 feet per day. He considers the well an excellent one, but advises the council to sink another deep well as a reserve. The council expect the revenue from gas to reach about $45,000 next year.

The Kerr Engine Company, Limited, of Walkerville, Ont., has been awarded the contract for the supply of the waterworks valves for the City of Winnipeg, Man. This company has recently established agencies in the City of Winnipeg, and report a decided increase in the shipments to that city. E. H. Bissett, 339 Main street, is representing them in the waterworks hydrants and valves, and David Philip, 470 Main street, has charge of the sales of the steam lines, brass globes, gates and iron body valves for steam. The same company are supplying the hydrants and valves for the Boulevard St. Paul work, at Montreal, Que.

LIGHT, HEAT, POWER, ETC.

New machinery has been installed in the electric light power-house at Edmonton, Alta.

The Pictou, N.S., electric lighting plant is about completed, and will be put into commission in a few days.

The Carberry Gas Co. has repaired the damage done to its acetylene lighting plant by the explosion in September.

The Brantford Gas Co. has contracted to supply natural gas in Brantford at 85 cents per thousand for all purposes.

Geo. Alexander has been granted exemption from taxes for seven years in consideration of putting in an electric lighting plant at Kaslo.

The Morris Piano factory at Listowel, was struck by lightning recently, and the dynamo was burned out. Little damage was done to the building.

The Canadian Niagara Power Co. expect to let water into their forebay before ice forms this winter. About half of the power house equipment is in place and just about ready for operation.

The Mexican Light and Power Co., which is controlled by Toronto and Montreal capitalists, have secured a contract from the Federal Government of Mexico for the entire lighting of the City of Mexico and suburbs till 1917, also for the lighting of the post offices and Government building in that city.

The Central California Electric Co., which operates three water-power electric plants, is about to instal a new hydro-electric plant of about 25,000-h.p., working under a 2,100 foot head, the highest head in the world. The installation will be located at Alta Station, on the banks of the American river, about sixty miles from Sacramento.

The Central Ontario Power Co., Peterboro, Ont., will deliver some six thousand electric horse-power to the towns of Bowmanville, Port Hope, Cobourg, and Peterboro, from Burleigh Falls, which is owned by the company, and from Buckhorn Falls. Bowmanville manufacturers have assured nearly fifteen thousand dollars revenue, and the company's rates will cut their steam power bills down by from 30 to 50 per cent.

The Huronian Co. has been organized in New York to generate power for the Canadian Copper Co. A 6,000-h.p. installation, later to be increased to 15,000, is to be made at Turbine, Ont., and the power transmitted thirty miles to Copper Cliff. A contract for generators has been awarded to the Crocker-Wheeler Co., Ampere, N.J., which calls for two 2,000 K.W. alternating current generators of Brown-Bouverie type. These machines will be direct connected to 3,500-h.p. water turbines, which have not yet been contracted for. Power will be derived from High Falls, on the Spanish River. Ross & Holgate, of Montreal, are the consulting engineers, and D. T. Trainor, purchasing agent of the International Nickel Co., New York, is placing the contracts.

The Southwestern Traction Co. have completed plans for their new power house, and as soon as the site is chosen tenders will be called for. The structure, with its machinery, will at the outset cost in the neighborhood of $200,000. It will furnish power for thirty miles of road, which means that, with the extension of the line to Woodstock on the east and Strathroy and Glencoe on the west, it will have to be at least doubled in capacity. Two sites are under consideration, one at Lambeth, and the other near St. Thomas.

Contractor A. C. Douglass has completed the tunnel of the Canadian Niagara Power Company on which he has been working for over three years. It is the first part of the works of the company to be completed. The Jenckes Machine Company has finished the conduit of the Ontario Power Company. It is over a mile long, eighteen feet in diameter, and constructed entirely of steel. The Toronto and Niagara Power Company has awarded the contract for the erection of their transformer house to Thos. Mumford, of Niagara Falls. The contract for the Ontario Power Company's transforming and distributing station was given to Horne & Elmsley, of Toronto.

The Jandus Interchangeable Arc Lamp, sold in Canada by the Packard Electric Company, Limited, of St. Catharines, is commanding much attention. This lamp is of exceptional merit because of its adaptability to many uses. Among the many points of this lamp, the following are some for which convincing claims are made: One lamp interchangeable for all circuits, individually superior burning qualities, long life, quickest trimmed, low expense for carbons and trimming, compact and neat appearance, uniform 12-inch upper carbon trim, handsome ornamental case of colonial design, accessibility of parts for inspection, non-breaking inner globe that is easily cleaned, etc. The Packard Electric Company have recently prepared a special pamphlet describing the Jandus Arc Lamp in detail, which will be sent free upon application.

After three years of litigation in which the action went through four courts, the case of Randall v. Ottawa Electric Co. was decided last month, by Justice Britton, at Osgoode Hall, Toronto. The claim was brought for Thomas E. Randall, by his next friend, and by Randall's wife, to recover damages for injuries sustained by Randall in Sept., 1901. Randall was a linesman in the employ of the defendants, the Ottawa Electric Co. In doing work on a pole he accidently came in contact with a live wire, was thrown to the ground, and so seriously injured that he became insane. The action was brought against the Electric Company and Ahearn & Soper, Limited. At the first trial the action was dismissed as against the electric company, and the jury disagreed as to the other defendants. The case was taken to a Divisional Court, to the Court of Appeal, and to the Supreme Court, with the result that a new trial was ordered as against defendants Ahearn & Soper. That trial took place at Ottawa last September. In answer to questions submitted the jury found that these defendants were guilty of negligence, which was the proximate cause of the injury to Randall, in leaving the tie wires uncovered, and in not having the ends of these tie wires cut off close, and that he could not by the exercise of reasonable care have avoided the injury. Defendants Ahearn and Soper did not own the pole on which they put their wire, and as to which the jury found negligence, nor had they, so far as appeared, the consent of the owners to use it, and the electric company were not shown to have had any express consent or authority to use that pole, but Randall, in the ordinary course of his employment, was sent to this pole to put upon it a transformer, for the purpose of supplying light to the adjacent building. The Judge held that as between Randall and Ahearn and Soper, the former was not a trespasser, but was rightfully upon the pole. Ahearn and Soper must be taken to have known, in using that pole, that other persons would be just as likely to use it. It was in a central place, with large buildings nearby requiring light for illumination and for ordinary lighting. Ahearn and Soper ought so to have fastened the live wire placed by them on the pole as to render it reasonably safe for persons requiring to use it for any proper purpose connected with transmitting the current.

The jury were told that they might apportion the damages between the two plaintiffs. They assessed the damages at $2,500, and apportioned it, $500 to the husband and $2,000 to the wife.

MARINE NEWS.

The Department of Marine and Fisheries is experimenting with asbestus as a material for portable lighthouses.

The dredge Ottomac, of Preston, Ont., was burned to the water line last month at Quebec, where she was working on the breakwater extension.

The Public Works Department has awarded to the Bertram Engine Works Co., a contract for a "snag boat" for clearing the rivers of Manitoba.

Through the refusal of the men at Yarrow's, the London shipbuilding firm, to work overtime at a rate and a quarter of pay, an order for several torpedo boats was lost to England, and will be executed by a firm at Trieste, Austria.

J. J. Roy, C.E., of the Department of Public Works, is investigating the feasibility of relieving the overflow water of the Assiniboine by diverting it into Lake Manitoba by a channel 15 miles long. One purpose is to prevent the flooding of farm lands, and another is to improve navigation.

A new steamship line is to be established between British Columbia and Mexican ports, the principal owners being Andrew Weir & Co., of Scotland. It is planned to make San Diego a calling port. The company will run modern steamers with capacity of 4,500 tons freight, 50 first-class passengers and 300 to 400 steerage, boats to run semi-monthly. The service will begin in January.

The Champlain, the first of the two ice-breaker steamers ordered by the Department of Marine and Fisheries from Messrs. Flemming & Ferguson, of Paisley, Scotland, arrived at Quebec on October 25th. She will run in connection with the Intercolonial Railway at St. Denis, County of Kamouraska, to points on the North Shore. The Champlain is a steel sea-going passenger steamer, length 120 feet, beam 30 feet, depth of hold 17.6 ft., tonnage, register, 225; gross, 522; draft, 11 ft. The second boat, the Montcalm, was recently launched by the same builders, and will soon leave for Canada. The Montcalm is 250 feet in length, and is designed especially to attempt the breaking of the Cap Rouge ice bridge. She will reach Canada not later than December 1st. In summer she will be used as a lighthouse and buoy tender.

The court investigating the collision between the R. and O. Navigation Co.'s steamer Canada and the steamer Cape Breton, near Sorel on June 12th last, has concluded its sittings and has handed out its report. It finds that the Canada was running in contravention of collision regulations, and thus caused the accident. Elie Bouille, the man in charge of the Canada a the time, was fined $50, and the R. and O. Navigation Co. was ordered to pay the remainder of the cost of the investigation. The company was severely censured for the navigation of its vessels between Montreal and Quebec, which is left in the hands of wheelmen, certificated officers being merely figureheads. Further, no person is detailed to keep a lookout at night; the crew are not in uniform, and have no discipline or fire drill. The certificate of Louis St. Louis, the master, was cancelled, and that of Peter Kane, the mate, was suspended for a year.

PERSONAL.

Talbot Strong, of Toronto, has returned to Galt to take an interest in the James Warnock Co., and will be associated with Byard Warnock in its management.

Dr. Hans Goldschmidt, the eminent chemical scientist of Essen Ruhr, Germany, while in Montreal last month as the guest of William Abbott, his representative in Canada, delivered a lecture, illustrated by lantern slides, at McGill University, on the Alumino-thermit process of welding, as well as on its use in metallurgy and its use in the foundry.

Felix Gouin, civil engineer, for several years in the Department of Public Works in Manitoba, under the Dominion Government, died last month at the age of 42.

H. J. Fuller, manager for the Fairbanks Co. in Canada, was in Toronto in reference to matters connected with their new warehouse to be built on the north side of Front St. West.

Stephen A. Ferguson, assistant city engineer of Detroit, died last month, aged 62. He was a native of Canada, having been born at Woodville, Ont. For several years he was on lake surveys, and was a civil engineer on the Wabash Railway.

John S. Fielding, C.E. & M.E., consulting engineer, has moved from the National Trust Building to 15 Toronto Street, in the Toronto Mortgage Company's building, where he will have greater accommodation for his increasing business.

W. G. Ross, managing director of the Montreal Street Railway has been elected president of the Street Railway Accountants' Association of America. The standard set of forms adopted and used by the Association were devised by Mr. Ross.

J. F. Birchard, travelling representative of J. T. Wing & Co., Detroit, Mich., was in Toronto last week and his many friends in the trade will be pleased to learn that he has fully recovered from the attack of typhoid fever in Los Angeles, Cal., in which city he was confined for six weeks.

Eugene Poisson and M. E. Parrot, engineers representing large construction and engineering firms in France, are now visiting Canada to learn something of the machinery and methods employed in this country, and incidentally to see what openings there are for French machinery.

MINING MATTERS.

The output of the Crow's Nest Pass Coal Co. now averages 3,000 tons a day, or a third more than the average of last year.

The Canadian smelting works at Trail have installed a plant for the manufacturing of lead pipes. The new department is very successful.

The coal mine at Joggins, N.S., is producing 200 tons per day. In two months' time, when the workings stopped by the fire are reached, the output will be about 500 tons daily.

A. D. Griffin, who has been surveying for the Ontario Government west of Lake Abitibi, reports indications of an extensive iron deposit in the newly surveyed township of McCaul and Dundonald.

The Kootenay Ore Co. are erecting a zinc separator in connection with their sampler works at Kaslo. The building will be 80 by 100, and will be fitted with the latest magnetic zinc separators. It is expected that the plant will be in operation early in the spring.

The Carter White Lead Company, of Chicago, has made arrangements to etablish a large lead corroding industry in Montreal. The old shops of the Canadian Pacific on Delorimier avenue have been secured as premises for the new works. It is understood that the metal used will be electrolytic lead from the refinery at Trail, B.C.

The Amalgamated McKee Creek Mining Co. and the McKee Consolidated Mining Co., operating at Atlin, B.C., will be consolidated shortly. The shareholders of the two companies are almost identical, and C. M. Hamshaw is president of both. The consolidation will give an authorized capital of $20,000,000. The shareholders are New York capitalists.

The control of the Cape Breton Coal, Iron and Railway Co. has been taken over by an English syndicate, headed by Horace Mayhew and Coates, Sons & Co., London. The new directors are: H. Mayhew, president; T. Lancaster, vice-president, and Wm. Hanson (Hanson Bros., Montreal), treasurer; E. W. Molsley, secretary, and Messrs. Gladstone, Thompson, C. H. Hanson, of London; N. Ferguson and Crowe, of Sydney. Plans are now being prepared in England for extensions, and equipment will be ordered as soon as the plans are completed.

Mr. McKenzie, of Montreal, who has made the recent mineral discoveries west of Lake St. John, has brought in magnificent samples of asbestus in veins of two, three and four inches in thickness, and also samples of copper, gold and magnetic iron. It appears that these deposits exist in very great quantities at the head waters of the Nottoway river, about 190 miles from Roberval, and if appearances are realized, we may look for a repetition of Sudbury and Thetford in the northern part of the province. It is said that J. Obalski, the geologist of the province, confirms the value of these discoveries.—Quebec Chronicle.

Coleman, Alta., where the colliery of the International Coal and Coke Co. is located in the Crow's Nest region, is a mining town only a year old, and already has a population of 850. It is in the valley of the Old Man River, 16 miles east of the summit of the pass. An electric lighting system is being installed in the town. The mines have an output of 500 tons a day, which is to be increased to 1,000 tons by January next, the ultimate capacity of the present plant being 2,000 tons. Over 100 out of the 400 coke ovens to be installed are now in operation. The areas owned by the company are estimated by one mining engineer to contain over 60,000,000 tons of coal.

W. H. Aldridge, manager of the C.P.R. smelter at Trail, reports that 200 tons daily of nut and larger sizes of hard coal are being mined at Banff, and another hundred tons of the smaller sizes. This is marketed west of Virden at present. There are between four and five hundred men working, the majority being employed on construction. It will require another year to complete the work under consideration. Development work is being done on the soft coal seams as well as the hard seams, but it will be some time before shipments of soft will be started. The total investment in plant, buildings, miners' cottages, water-works, etc., may reach $1,000,000. At present the hard coal smaller than buckwheat No. 1 is being wasted, but experiments are in progress for briquetting.

THE WORLD'S LONGEST TRUSS SPAN.

The new bridge over the Whitewater River at Elizabethtown, Ohio, is the longest single span truss in existence. It is now under construction in the shops of The Brackett Bridge Co., of which H. G. Tyrrell, a native of Canada, is chief engineer. It will require upwards of a year to have it completed and open for travel. The span is 586 feet

H. G. Tyrrell, C.E.

centre to centre of end pins, and the clear distance between trusses is 30 feet. A new feature has been introduced, in the design of the trusses, which gives at the same time an economical arrangement of truss members, and the minimum cost of floor system. The rebuilding of the piers in reinforced concrete is now under way, and it is expected to have them completed before the spring floods.

Mr. Tyrrell is the compiler of the following formulae for the weight of bridges.

Railroad Bridges.

All weights are per lineal foot of single track bridge. Steel only.

Live loads, two engines, 100 tons each, and 4,000 lbs. per lineal foot of track, units 10,000 lbs. and 12,000 lbs. per square inch.

Deck-plate girder bridge	100 + 9 l
Deck-lattice girder bridge	100 + 8 l
Half through plate girder bridge	300 + 12 l
Half through plate girder bridge, ties on shelf angle	200 + 8½ l
Half through plate girder bridge with solid steel floor	600 + 10 l
Riveted through truss bridge	400 + 6 l
Riveted deck truss bridge, ties on top chord	200 + 7 l
Through pin bridge	400 + 5½ l
Deck pin bridge with stringers	400 + 6 l
Deck pin bridge, ties of top chord	300 + 6 l

Railroad Trestles.

Loads as above.

Weight of spans as above.

Weight of bents and bracing = 9 lbs. per square foot of side profile from ground to base of rail.

Electric Railroad Bridges.

To carry 25-ton cars, or 2,000 lbs. per lineal foot of track, units 10,000 lbs. and 12,000 lbs. per square inch.

Weight of steel per lineal foot of single track bridge are for	l
Beam bridges	50 + 5 l
Deck-plate girder bridges	50 + 4½ l
Pony truss bridges	250 + 1.5 l
Through truss bridges	250 + 1.3 l

Electric Railroad Trestles.

Weight of spans as above.

Weight of bents and bracing = 6 lbs. per square foot on side profile from ground to base of rail.

Highway Bridges, with Wood Floors.

Dead weight of floor = 40 lbs. per square foot. Live loads, 100 lbs. per square foot, and units 10,000 lbs. and 12,000 lbs. per square inch.

Weights are per square foot of floor, and include steel only, without joists.

Girder bridge with sidewalks	$3 + \frac{l}{4.4}$
Girder bridge without sidewalks	$3 + \frac{l}{3.4}$
Truss bridge with sidewalks	$3 + \frac{l}{8}$
Truss bridge without sidewalks	$5 + \frac{l}{7}$

Highway Bridges with Solid Floors.

Dead weight of floor = 150 lbs. per sq. foot.

Deck-plate girder bridges	$3 + \frac{l}{2.6}$
Half through bridges	$3 + \frac{l}{2.4}$
Truss bridge	$3 + \frac{l}{4}$

In the above l represents the length of span in feet, centre to centre of bearings.

NEW METHOD OF MANUFACTURING STEEL.

It is reported that successful experiments have just been made by the Iron, Steel and Metals Manufacturing Company, at Melbourne, Victoria, for the purpose of proving the value of certain patent rights for the direct production of wrought iron and steel without first producing pig iron. Only a rough idea of the process may at present be had, though trial runs with New Zealand magnetic iron sand are now being made on a somewhat larger scale than hitherto. The sand is first separated from its gangue by electro-magnetic separators, this treatment leaving a pure magnetic iron oxide. The sand is then fed from a bin into the furnace, which is entirely novel in its features, being chiefly mechanical and automatic in its operation.

The ore drops from the bin into a slowly revolving cylinder placed at such an angle that the ore travels forward continuously in it. As it does so it is heated to a dull red by the waste gases from subsequent operations. From this cylinder the ore drops into a second revolving cylinder, where the fine particles are subjected to the action of reducing gases which reduce the magnetic oxide of iron to the metallic form, at the same time permitting the particles to retain their individuality. From this second cylinder the reduced ore drops into a smelting bath at the bottom of the revolving cylinders, and the molten steel or malleable iron, as the case may be, is tapped from this whenever that operation is necessary. It will thus be realized that the process is one of great simplicity and yet of much ingenuity. Not the least interesting part of it is the use of fuel oil for heating purposes. This is employed to secure concentration of heat and direct application in the furnace work. It is found that the fuel oil possesses many advantages over producer gas as used in existing smelting practice. The work done so far has demonstrated that not only is oil a cheap fuel, quite irrespective of the capital outlay that would be required if it was decided to utilize producer gas, but it is so thoroughly under control as to insure the best service.

The temperature at which iron ore melts is given variously at from 1,500 deg. to 2,000 deg. C., according to its purity.

The accurate gauging of temperature in the furnaces plays a very important part in the company's work, and accordingly an installation of thermo-electric thermometers has been made at the company's works. The apparatus consists of a "couple" consisting of a platinum-iridium junction enclosed in a metal tube fully three feet long, which is placed in the centre of the furnace, and the temperature is then recorded on the dial of a special form of voltmeter, each division on which represents 25 deg. C. This voltmeter reads up to 1,600 deg., and is placed at any convenient distance from the furnaces. The various thermometers are connected with a switchboard, which is again connected with the "couples" or tubes in the furnace. In the installation under notice four "couples" will be used, inserted in different parts of the furnace, and separately connected with the board, so that the reading of any thermometer can be taken and any discrepancy in the heat of different points of the furnace can be quickly remedied. It is interesting to notice that the voltmeter is so extremely sensitive that variations of heat down to 0.5 deg. were easily noticeable in the trial test. The greatest temperature recorded was 1,300 deg. C., equal to 2,372 deg. F.—John P. Bray, United States Consul-General.

HIGH PLANER SPEEDS.

With the introduction of high-speed steels greatly increased cutting speeds were at once made possible on lathes and other tools where the work was constantly revolving in one direction, but the planing machine stood out as being the one tool where full advantage of these steels could not be taken, consequent upon the increased strain thrown upon the driving gears at the moment of reversing, when running at accelerated speeds. A patented invention of Smith & Coventry, Ltd., Manchester, England, does away with this difficulty by allowing the momentum of the table to spend itself before calling upon the gearing to bring about the return. Further, the energy created by this momentum is stored up in a powerful spring, which, as soon as the table gets to the end of the stroke, assists the gearing to start it off again in the opposite direction. In small machines this spring will start the table without the assistance of the belt. Having overcome the question of the reverse, the cutting speed depends somewhat upon the class of work to be done, but both it and the ratio of the return can be regulated to the wants of the purchaser. Stock machines up to 3 feet wide are built with a return of 4 to 1, and above this size 3 to 1, but, as stated, these ratios can readily be altered even in machines in stock. For sizes up to 3 feet, a cutting speed of 40 feet per minute, and a return of 160 feet a minute is recommended. Above 3 feet size, 30 feet cutting speed and 90 feet return. The table is driven by rack and pinion, and slides on flat surfaces, friction is thus greatly decreased, and the tendency to lift when side planing entirely done away with. Both horizontal and vertical surfaces are oiled by a self-acting device. The tables are of very deep section. The cross slide in the smaller machines is raised and lowered by hand, and can be manipulated from either side of the machine. In the larger machines it is raised by power. The tool box is self-acting in the horizontal, vertical and angular cuts, and includes a device which lifts the tool off the work during the return stroke. It can be controlled from either end of the cross slide. Driving.—All gears, including the rack, are cut from the solid, the driving belts are shifted one after the other, preventing noise and jar. The machine can be started or stopped from either side of the bed. The Canadian representatives, Peacock Brothers, Canada Life Building, Montreal, will be pleased to give further particulars of this efficient tool.

CARBON VS. METAL BRUSHES FOR DYNAMOS.

A writer in the Electrical Review (London), asserts that the one redeeming feature of the carbon brush for dynamos is its non-sparking tendency, which, in his opinion, does not compensate for its bad features. The carbon brush practically necessitates large commutators and extra expense of brush gear, large shafts and longer machines, and therefore, must increase the cost of production by a large amount. Especially is this the case where large currents have to be dealt with. This practice results from the designer's doubt of the efficacy of metal brushes. Carbon brushes not only increase the first cost, but lower the efficiency, so that it frequently happens that this might be increased 2 or 3 per cent. by the use of metal brushes. Consulting engineers demand carbon brushes, unmindful of the fact that so long as sparkless commutation is secured it is immaterial of what the brush be made. Comparing the design of a commutator for a six-pole 88-kilowatt parallel-wound armature for carbon and for metal brushes it is found that the use of carbon necessitates three times as many brushes as the metal. For the former the commutator must be 17 inches long, and for the latter only 6. The watts lost, due to the friction of the carbon brush, number 1,025, as against 205 for metal. The watts lost, due to the resistance of contact of the former, are 1,260, as against 434, making the total loss 2,285 watts for carbon and 639 for metal. The watts lost per square inch are 2.51 for carbon and 2 for metal. The commercial efficiency with the carbon brush is 91.8 per cent.; with metal, 93.4 per cent. The chief virtue of the carbon brush is its high specific resistance, which facilitates sparkless commutation. To secure a similar condition with metal brushes they may be subdivided with an insulating partition between the portions; or the central layers of metal may have a higher specific resistance. Where a reversible motor is employed a radial brush is necessary, but it would not be impossible to construct a satisfactory brush of this type out of metal.

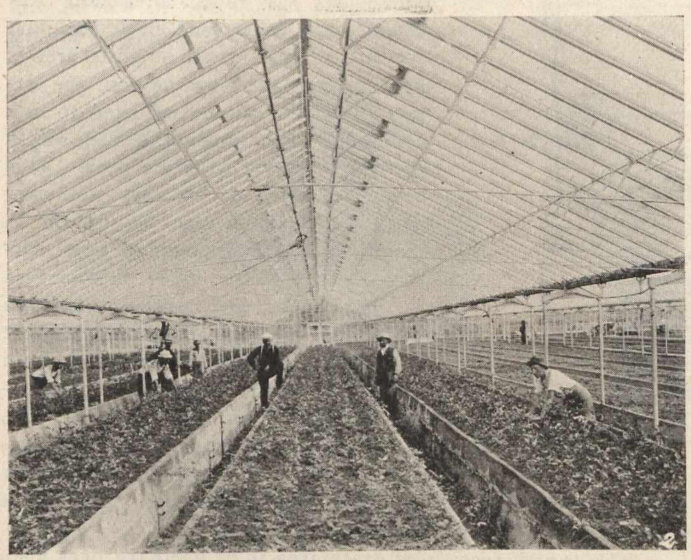
—The business district of Hague, a village twelve miles south of Rosthern, N.W.T., was destroyed by fire on October 24th. Loss, $40,000; some insurance.

—An extensive deposit of high-grade limonite iron ore has been located about one hundred miles east of Edmonton. E. McAdam and A. Johnson, of Edmonton, are the owners.

ENGINEERING APPLIED TO HORTICULTURE.

There are few, if any, industries in late years that have made greater strides on this continent than that of the growing under glass of cut flowers.

Until recently this trade was mostly in the hands of small local growers supplying their immediate neighborhood—whose methods were taken from old country practice of many years ago. With the extension of our towns and cities, together with the increased wealth of their inhabitants the demand for fresh flowers has commonly exceeded such a supply, with the result that this business has been getting more into the hands of larger growers, or of companies specially formed to operate on an extensive scale. Thus the construction of greenhouses has become a special architectural and engineering question. Amongst the many



As will be seen the root is of a single span, now made up to 30 ft. in width. This leaves the beds clear of the usual posts that interfere with the work and cast shadows on the flowers. The principals placed every 12 ft. 6 in, are of truss construction, the truss rod being only ¼ in. diameter, which casts practically no shadow. The purlins are also of a skeleton truss formation, the truss rods being wire 3/16 in. diameter, and the compression member ⅜ in. diameter of round iron. The complete distribution of light will be seen in the view. The drainage of the roof is accomplished by carrying the water through hollow roof supports shown as arches to large drains placed under the walks. These serve the double purpose of keeping the walks dry and providing escape for roof-water, thus doing away with the heavy shadows of gutters of ordinary construction. This method is important when it is considered that the new green houses are frequently a thousand feet long.

engineering firms that make a specialty of this work on the American continent, the King Construction Co., of 32 Church St., Toronto; Robert W. King & Co., being their engineers, may, we think, be fairly mentioned as having brought out the greatest number of improvements in this line.

This company has a branch in North Tonawanda, N.Y., to supply the demand for their improvements in the United States. Amongst their specialties are an iron skeleton construction of the greenhouses themselves, set in concrete foundation, the effect being to obtain permanency and rigidness with the least possible obstruction to light. Views and description of their more recent structures are here given.

Their machine for the automatic regulation of the temperature of the houses has already been described in these columns.

Part of one of five sections of the U. S. Cut Flower Co's green houses at Elmira. When completed these green houses will contain over a million sq. ft. of glass.

From Mr. King we have obtained an account of more recent improvements in the heating of greenhouses, including a description of his company's steam boiler, automatic stoker, and economiser system.

Owing to the greatly extended dimensions called for in greenhouse construction, it has become necessary to increase the size of the boiler units, and to use steam more largely as compared with hot water.

The larger plants no longer place their boilers in a cellar in order to obtain a gravity return of the condensed water. While boilers had to be in a cellar seldom more than 10 feet deep, and often not that, owing to lack of height they could only be made in comparatively small units covering a proportionately larger area of surface to obtain the necessary power. Hence we supplied only units of from 10 to 40 h.-p. This went very well while the average demand for any one plant did not exceed twenty thousand square feet of glass, while the majority would be far below that amount. The company's last set of plans made for the United States Cut-flower Co., of Elmira, New York, embrace in one plant heated from a single station one million square feet of glass, probably the largest single plant in the world. The power used is 2,400 horse-power. The purport of this plant is to supply the wholesale dealers mainly for New York market. The ground purchased for the purpose of this plant is 68 acres, the power station contains four batteries each of six units of 100-h.-p. per unit. Each unit is provided independently with its own economiser. Though some experimenting has already been done by us in Canada with economisers in greenhouse heating, it has been met with considerable opposition and prejudice on the part of proprietors lacking in that patience, perseverance, and we might add confidence, necessary for success. The result is that the lead in greenhouse engineering, of which the Canadian florists were once so justly proud, is as far as this item is concerned, passing to the United States. The company mentioned will probably be the first florists on record to install and operate a complete economiser system in connection with a greenhouse heating plant.

The Boilers.

Figs. 1 and 2 are from the King Construction Co.'s working drawings of boilers being erected. Each unit or pair of shells contain 10,000 square feet of fire surface over one fire—and are of the water-tube type, so as to give a quicker response to the firing. The shells have some fall to the back, which is increased again in the tubes by the extension nipples between the back head and water boxes. The circulation in the two upper horizontal rows of tubes is assisted by circulating plates shown in the front water boxes. Each water box contains two upright rows of tubes. This enables a much larger circulating connection from the water boxes to the shell than where only one row is used, so that as great a slant of the tubes is not required to enforce circulation. This gives room at the back end under the tubes for the introduction of economiser surface.

A baffle plate is inserted between the economiser and the boiler, which plate is easily removed in case of repairs.

The Economisers

Are of novel construction; they are formed of horizontal 4½ inch diameter cast iron tubes, mounted on a car that can be run out from under the boiler for convenience in internal cleaning or repairs. These tubes are set practically level, the circulation being made as follows:—Inside of each tube is a light circulating tube connected to the pipe where the water enters. This passes along the inside of the tube with an upward grade, conducting the water to the further end; the water then works back along the 4½ inch tube to the exit leading to the entrance of the tube above, eventually passing through pipes at the sides of the furnace to enter at the front end of the boiler shells. The outside surfaces of the economisers are cleaned by a hand brush from the back end much in the same way as the tubes in fire-tube boilers are cleaned. The tubes being water-tubes, of course, have the same advantage as other water tubes of being partially self-cleaning.

The inside of the tubes is easy of access for removing scale. The slackening of set-screw in yolk enables the tube cover to be removed; the inner circulating tube is also removable. No economiser can have full effect unless cold feed water is used, and the heat given off by the cooling utilized to good effect. To obtain this object the condensed water of the heating system is distributed in piping, along with the steam pipes; the sizes of the water and steam pipes being so graded as to obtain uniform radiation through their length.

The Stokers.

Ordinary grate bars are shown in the plans. The boilers are fitted so either ordinary grates or automatic stokers can be used. The stoker used is illustrated in figure 3. When stokers are installed a water-front will be placed above the fire doors, from which will extend loops of tubes which will support the fire crown. Removable covers on the water front will enable the inside of tubes to be cleaned of scale. Water will circulate through the tubes—by this arrangement a fire crown of any width can be supported.

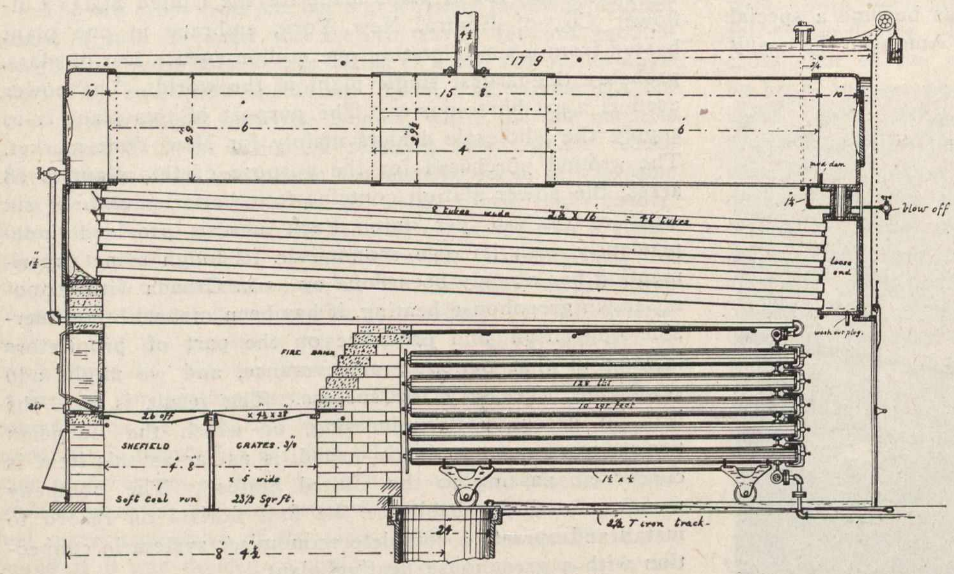


Fig. 1. The King Water Tube Boiler.

The stoker herein shown is one that has been under experiment for a number of years, and has been fairly well perfected for smaller units. Some 60 of them are in operation in various stages of perfection, but owing to the pressure of other business Mr. King has been unable to give the matter of design for the larger units his attention this season, but considers the success that has been attained quite warrants a continuation of his work and the carrying of the stoker into general use. The design is patented in Canada, United States, Great Britain and France.

The operation and construction of the stoker may be explained as follows:—

The process consists in feeding in the fuel in an even layer the full width of the furnace with a constant feed. After leaving the mouth of the feed, the fuel runs down the first section of the grate area of its own gravity, assisted with pressure from behind, and covers evenly this section of grate, where it remains for a time in a stationary condition. The gases are extracted from it by the heat of the fire, which is thrown forward so as to pass over and near to the incoming fuel, and the fuel then cokes or welds together. So that the fuel may not escape through the grate, the air spaces of grates are made to enter horizontally. When the fuel has become coked, a series of pokers advance through the horizontal air spaces and push the coked fuel forward, dislodging it so it may pass on to the second section of grate area. On the withdrawal of the pokers, another lot of fuel passes on to the coking plate, or first section of grate area.

The second section of grate area is composed of alternately moving grates placed side by side and in a slightly inclined position. These act as rams, alternately relieving each other, and push the fuel forward. This section of grate area is kept in constant slow motion, the extent of which can be adjusted to suit conditions, and forces the fuel on to the third section of grate area. This section is made of ordinary stationary grate bars, which can be varied in length to suit the amount of grate surface desired to be used; this surface is horizontal, and presents enough friction to the fuel at this part so that the openings that otherwise might burn through are kept closed up by the constantly advancing and pushing fuel, thus keeping a compact bed and preventing any undue amount of draft or air from passing through the almost exhausted fuel.

The fourth section of grate area is of ordinary bars also, but so arranged that it can be dropped into the dotted position by a lever passing to the front; the clinkers and other burned parts of fuel too coarse to go through the grates are pushed on to this drop grate, which is occasionally dumped, throwing them into the ash-pit. The drawing shows the mechanism by which the above is accomplished. A hopper is shown in outline above the feed, but is not required when the feed is fed from a spout. The feed consists of a series of screws placed side by side near to each other, but covering the whole width of the grate surface. There is, however, preferably a space and partition between the screws, causing weak places or cuts in the coking fuel, enabling it to more easily break into pieces. The coking plate sets at an angle of about 45 degrees. It has bars or solid portions connecting the shelves. The pokers are advanced in upright sets alternately, one set being retired when the other is in action.

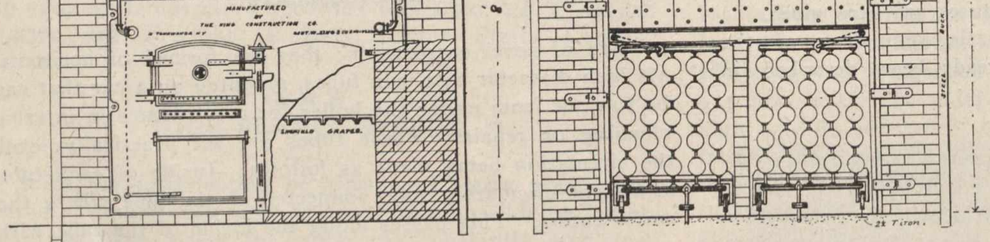


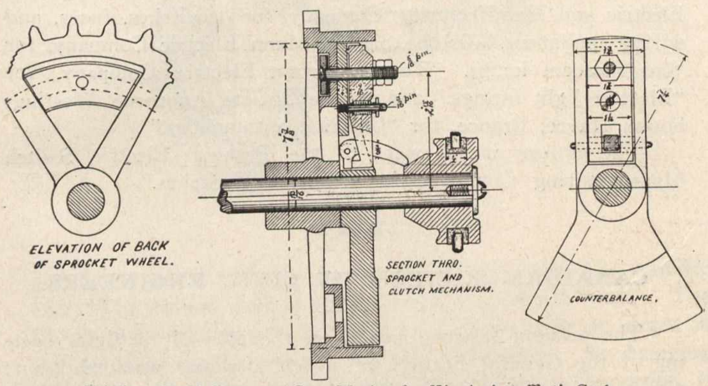
Fig. 2. Front View. Twin Setting. Back view door removed.

The second section of grate area consists of bars easily replaceable for repairs, resting on reciprocating carriages, and preferably in order to simplify the mechanism required, the same action that reciprocates the grate carriages operates the pokers also, the poker drivers being attached to the grate carriages.

The reciprocating action is preferably accomplished by connecting the grate carriages to crank, each pair of cranks (reversed to one another) are set on a short connecting shaft with its driving wheel in the centre. A counter-shaft with pinions engaging in each gear drives them; this counter-shaft is driven by a ratchet wheel operated by a paul and lever connected to the main shaft of machinery by an adjustable crank and pin, by which the number of notches the paul will take can be regulated. Worms on this main machine shaft operate into worm wheels, as shown driving the feed screws.

It will be noted from the drawing that the coking plate is arranged so as to be partitioned off from the ash-pit proper, and has a separate door or damper from the ash-pit door, so the draft to it can be independently regulated. The fire door is shown immediately back of the hopper, and is raised bodily out of position by chains and a lever. A ratchet wheel on lever shaft and paul, not shown, holds it in elevated position when required. The door is hollow, with partitions at close intervals joining the inner to the outer plate. The upper part of door has an air-admitting damper, which when open allows air to pass through the door between the partitions in a direction to impinge on the entering fuel, and is heated on its way.

The heated products of combustion pass from the furnace and exhaust themselves first in contact with the fire surfaces of the boiler. Before they can reach the exit flue (which in this design passes downwards into an underground tunnel, connected with smokestack), they are made



Friction Clutch Start and Stop Motion for King's Automatic Stoker.

to pass the economiser which has 50 per cent. of fire surface in addition to the boiler proper, thus abstracting additional heat from fuel. In experiments conducted by Mr. King last winter, no difficulty was found in reducing the temperature of the water of condensation from 212° to 60° even though the houses were heated to 68° or 70°. The condensation first flows through a syphon or trap that separates it from the steam to a pump which forces it back to the boilers. On its way from pump to boilers it is forced through a number of small pipes dispersed in the lower and colder portion of the houses, thus reducing its temperature to the degree mentioned, at the same time that its heat so dissipated is usefully employed in the heating of the houses. It is a simple matter for engineers to calculate the amount of saving in fuel that can be so effected.

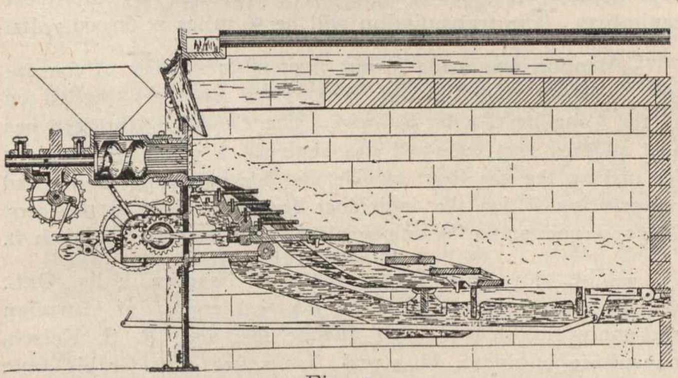


Fig. 3.

Section of King Automatic Stoker showing also bottom row of Boiler Tubes.

In the growing of cut-flowers in winter the fuel required to keep the glass houses warm is the main item of expense. For this reason, and as the addition of large establishments increase competition, advantage will have to be taken, as in other businesses, of the skill of the engineer, and the power plants will have to be designed and operated on special up-to-date engineering lines. It has been estimated that in locations where winters are severe and fuel expensive, the saving that can be effected in the boiler room or power station by special engineering as compared with ordinary practice will itself pay a fair dividend on the whole investment.

WINNIPEG NOTES.

CORRESPONDENCE OF THE CANADIAN ENGINEER.

Many people in Eastern Canada have been disturbed regarding the character and consequences of the movement of population from the Northwestern States, which has set in so strongly towards Manitoba and the North-West Territories. Will these immigrants become good Canadians, or will they make trouble when they become more numerous by inviting some kind of Jameson raid from the border states? Your correspondent has talked with a great many people, some of whom are neighbors of the new settlers from the States, or are intimately connected with them in business, and the facts and opinions gathered justify the prediction that no anxiety need be harbored on this score. It is quite true that in certain localities groups of United States settlers of the older type have planted themselves in solid colonies, and give offense to their Canadian neighbors by flaunting the Stars and Stripes on frequent occasions, and make it evident by their conversation that they have yet to learn there are other nations besides the United States. These people, who would be classed among the noisy jingoes at home, will probably, many of them live and die in their national prejudices, which they have imbibed from their old school books, but their prejudices will not outlast their own lives. Their children will be educated in Canadian schools, with Canadian text books which will throw a different light upon the history of "the continent to which we belong." These children will grow up to regard Canada as their home, and will love their playmates of Canadian descent as if the American Revolution had not estranged their great grandfathers. Meantime, the spread-eagle talk of this class of United States immigrants is, as a rule, wisely treated with good-natured tolerance, which will sooner or later show that Canadians have a broader conception of the word "liberty" than they who make it their boast without possessing the spirit of it so deeply. The class just referred to is happily not the majority of the new-comers from the States. There is another and quite as numerous a class of American-born settlers, who have been quick to learn since they came here that in all that makes for true liberty the Canadian constitution is on the same high level as that of the United States, both having their base upon the conceptions of liberty and law derived from the common mother constitution. They also recognize that generally speaking, the administration of law is better carried on than in their own country; and as they have no disabilities, but are treated as our own people, there will never be any grievance upon which to base a Jameson raid. But apart from these considerations, it appears that fully half—some say two-thirds—of the settlers from the United States during the last two years, turn out to be returned Canadians—men who moved from Ontario, Quebec, and the Maritime Provinces ten, twenty and even thirty years ago, and settled in the Western States, but who either to better their own individual condition, or desiring to end their days in their native land, return to where the old flag is flying. Leaving out of account this large proportion of repatriated Canadians, a considerable proportion of the remainder is composed of people of European birth, who not being born to United States institutions, will be no more wedded to them than to Canadian institutions. From all these considerations, there need be no fear as to the political future of the United States immigrants into the Canadian West.

As mentioned in last letter, Winnipeg has arrived at that stage of development when make-shift structures give place to works of a more permanent kind, and when, along with the continued development of the wholesale trade, local manufactures on a larger scale are called into existence. There has been a large demand for machinery and structural material of a varied character, and United States firms are keenly after orders. Eastern Canadian firms are more in evidence here now but have, in too many cases, been very slow in taking in the situation. Between foreign and Canadian firms, not a week passes but some new warehouse, or branch warehouse, is opened for business or some branch factory started.

The conditions are not yet favorable for small factories, owing to the lack of cheap fuel or cheap electric power, but electric power is likely soon to be supplied. If it can be brought in under civic ownership, or at least under effective civic control, it will be well for the industrial development of the city.

The Winnipeg Electric Street Railway, which still uses coal, develops rapidly, notwithstanding the high cost of its fuel. Coal can be bought at the Crow's Nest Pass at $2.50 per ton, but it costs $5 a ton for freight, so that it costs $7.50 before it can be laid down in Winnipeg. Eastern coal costs 50 cents a ton less, so that Pennsylvania holds the trade in the anthracite variety. With coal for manufacturing purposes at such prices, any project for transmitting power to the city is of great interest. The proposition which appears most likely to materialize is that now on foot by the Winnipeg General Power Co.—a corporation closely associated with the Street Railway Company—which proposes to bring power from Lac du Bonnet, seventy miles distant. The power house and dam are under construction this year, and are to be finished in 1905. The ultimate power available is 30,000-h.p. Meantime the Street Railway Company which has thirty miles of track in operation, and is steadily extending its lines as the area of the city expands, is providing for its needs by building new repair shops and car shops. These shops are 100 by 250 ft., exclusive of boiler room and heating plant, and here the company will make its own repairs, and build all its open cars in the future. The shops are to be finished before the close of the year. This company does the commercial lighting and furnishes electric power, and also operates the gas plant, which is being extended by a new coal gas plant of a capacity of a million feet a day. The gas plant will also be finished before the close of the year. The company now has 60,000 incandescent lights on its circuits, but the power is chiefly confined to elevator work, the elevators being nearly all operated electrically.

Other power for Winnipeg is that which will be available when the Government dam at St. Andrew's Rapids is completed.

As may be imagined, the remarkable growth of Winnipeg's population entails heavy responsibility as well as prodigious work upon the city engineer's department, but under C. H. Ruttan this work is being carried on to the great credit of himself and his staff. A pumping station and plant is now being constructed at a cost of $80,000, and new water mains are being laid to cost over $90,000. Asphalt is now being favored as a paving material, the asphalt paving now in hand amounting to $273,000, compared with $240,000 of macadam, and only $6,000 of cedar blocks. Granolithic sidewalks are being put down to the value of $71,000, and wooden walks to the value of $15,000. Sewers to the value of $390,000, and other works will make a total of a million dollars now being spent in the engineer's department. The situation of Winnipeg on a dead level plain makes the problem of perfect sanitation of the city a difficult one, and if Mr. Ruttan and his staff works out this problem right, they will leave a worthy memorial to their names.

WESTINGHOUSE AWARDS.

The various Westinghouse companies represented at the Louisiana Purchase Exposition have received in all twelve grand prizes, eight gold medals, four silver medals, and one bronze medal. They received the special award in the department of machinery for "the best, most complete, and most attractive installation."

The following were the twelve grand prizes: Westinghouse Electric and Manufacturing Company, for "Alternating current generators and motors, alternating current turbo-generator installation, static transformers, and rotary converters." Westinghouse Electric and Manufacturing Company, for "Direct current generators and motors." Westinghouse Electric and Manufacturing Company, for "Electric railway motors, alternating current and direct current, and control systems for single and multiple unit operation and for mining and industrial locomotives." Westinghouse Machine Company, for "Horizontal gas engines and steam turbines." Westinghouse Air Brake Company, for "Air brakes and friction draft gears." Westinghouse Traction Brake Company, for "Brakes for electric cars." American Brake Company, for "Driver brakes." Westinghouse Automatic Air and Steam Coupler Company, for "Air and steam couplers." Westinghouse Brake Co., Limited, London, England, for "Air brakes and accessories." Westinghouse Company, Limited, of St. Petersburg, Russia, for "Air brakes and accessories." Union Switch and Signal Company, for "Signal system." Cooper-Hewitt Electric Company, for "The development of the mercury vapor arc lamp."

The eight gold medals awarded were as follows: Westinghouse Electric and Manufacturing Company, for "Complete switchboards and controlling apparatus, and the application of electric motors for mechanical purposes." Westinghouse Electric and Manufacturing Company, for "Alternating current, direct current, and Bremer arc lamps and arc lighting systems." Westinghouse Electric and Manufacturing Company, for "Electric measuring instruments." Nernst Lamp Company, for "Nernst lamps." Cooper Hewitt Electric Company, for "Vapor lamps for photo-engraving." Pittsburg Meter Company, for "Water and gas meters." Westinghouse Electric and Manufacturing Company, for "Industrial betterment work." Westinghouse Air Brake Company, for "The housing of the working-classes."

The four silver medals were given to the Westinghouse Electric and Manufacturing Company, for "Switches, fuses, and wiring appliances." To the Sawyer-Mann Electric Company, for "Incandescent lamps." To the Bryant Electric Company, for "Electric light fittings," and to the Societe Anonyme Westinghouse, Havre, France, for "Gasoline automobiles."

The bronze medal went to the Perkins' Electric Switch Manufacturing Company, for "Electric Switches."

CANADIAN SOCIETY OF CIVIL ENGINEERS.

The autumn session opened on the 20th ult. with a meeting of the General Section, at which a paper was read on: "Loss of Heat from Iron Pipes," by R. W. Leonard. Duncan Macpherson, president of the section, occupied the chair. J. M. Nelson was appointed secretary of the section. A short discussion followed, Messrs. Durley, Kerry, Rhys, Roberts and Ross taking part.

A high-grade galena ore was struck recently at the Foghorn mine, near Ymir, B.C.

—The corporation of Napanee, Ont., have retained the services of R. S. Kelsch, consulting engineer, Montreal, in connection with the new electric light plant and water-works to be installed by the corporation.

—R. S. Kelsch, consulting engineer, Montreal, has returned from Vancouver Island, B.C., which place he visited in connection with a hydro-electric development to cost $2,000,000. The property is controlled by Montreal capitalists. The transmission will be 56 miles at 60,000 volts.

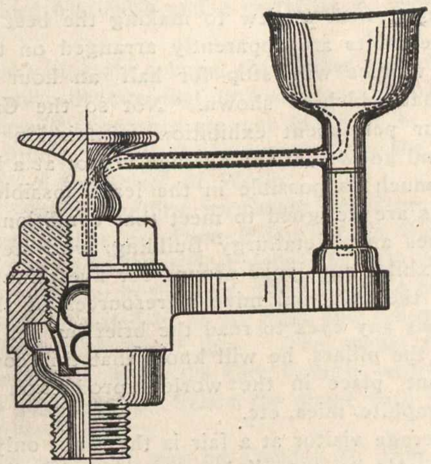
—Mention was made in our September number of the extent to which train lighting by acetylene had been carried on by the Canadian Pacific Railway. The Canadian Northern has also adopted acetylene and has equipped a plant at Winnipeg for making the gas from carbide and for purifying, drying and compressing it for the individual tanks attached to the cars. The reservoir at the Winnipeg plant has a capacity of 30,000 ft.

—The new water-power plant at Niagara Falls, Ont., will have to contend with the greatest enemy of Canadian water-powers, floating and anchor ice, and R. S. Kelsch, consulting engineer, Montreal, has spent considerable time at the Falls recently, studying this matter. Mr. Kelsch's experience at Lachine Rapids, and the successful means employed to overcome the great difficulty experienced by the Lachine Company will be of great assistance in formulating successful plans for handling ice at Niagara Falls.

—R. S. Kelsch, consulting engineer, Montreal, was selected as arbitrator to adjust the differences between the Canadian Electric Light Company and the Levis County Railway Company, consisting of the interpretation of an existing power contract, four suits and one damage claim for $10,000, and to draw a new contract for power for the railway company, the companies signing a bond of $5,000 to abide by the decision of the arbitration. The award has been made and the companies have complied with same.

GAS ENGINE STARTER.

The accompanying sketch from the Electrical Engineer shows a starting apparatus for gas and oil engines. The construction is simple, the only internal working part being a steel ball valve. To start the engine, the crank is placed in such a position that all the valves are closed; the screw plug on the top of the starter is then removed, and the ball pressed down with a prober, which is supplied with the starter. The required quantity of gasoline is then poured into the funnel-shaped reservoir,



Gas Engine Starter.

and by it passed through the projecting pipe into the cylinder end. The funnel pipe is then twisted out of the way. The fly-wheel is then moved a little forward in order to draw in the requisite amount of air through the starter. By bringing the crank nearly back to its original position, compression is obtained and the ball is forced back on to its seating. The prober is again used to press down the ball until it falls by its own weight, then by placing a lighted match over the hole in the starter the engine is started without further manipulation. The screw-plug is then replaced. The quantity of benzine required is small, being, it is said, about a thimbleful to start a 50-horse-power engine and about half this quantity for a 10-horse-power engine.

CANADIAN WOOLEN MANUFACTURERS.

(Canadian Journal of Fabrics).

What are the causes of the difference in the cost of producing woolen goods here and in Great Britain?

1. Higher rate of interest on capital invested in Canada.

2. Increased cost of equipping a mill in Canada, this difference being estimated at 30 to 40 per cent. The Canadian manufacturer pays a duty on all his machinery, though by this duty on spinning, weaving and finishing machinery no home industry is protected, since none of that class of machinery is made in Canada. If the Government really desired to give a "preference" to British goods without injuring any established Canadian industry it would make such machinery free.

3. Higher rate of wages in Canadian mills. The wages of skilled operatives are estimated to be on the average, 50 per cent. more than those paid for corresponding work in Great Britain, and in every branch, skilled or unskilled, the cost of labor is higher in Canadian mills. The Canadian mill hand lives in greater comfort than his British contemporary, and it is a question whether our politicians or manufacturers would have it otherwise if they could.

In these considerations we are excluding from view the custom mills of this country, many of which have carding and other machines of a kind unsuited to cope successfully with trade orders under present day conditions. But it ought to be known to those having only a moderate acquaintance with the textile trades that as a rule these mills were never designed to live upon orders from the trade as all mills in the Old Country are. Their very name of "custom mill" implies that. When the country was younger, and every farmer raised sheep, while every farmer's wife and daughter could spin, weave and knit, the custom mill throve; but, regrettable as it may appear to many who have watched the change in our domestic conditions, the custom woolen mill along with the hand-loom and the spinning-wheel is doomed to extinction, no matter what the duties on imported goods or what the preference to British goods.

CAMPBELL SWINTON CORRECTED.

Editor Canadian Engineer:—

Sir,—I would like you to publish this letter as a correction of one of the statements made in the excellent article on "Electricity from Water Power," by A. A. Campbell Swinton, M.I.C.E., M.I.E.E., appearing on page 307 of your October number, particularly as the information given purports to have been given by me.

I wish to state positively that none of the plants given in table in the first column of page 307 was installed by the Stanley Electric Manufacturing Company. Immediately on the receipt of advance proof of that paper from Mr. Swinton I wrote him, asking that this be corrected, and had hoped that it would be before appearing in the press, as I received a letter from his office stating that the matter would have his early attention.

I regret the publication of this information before Mr. Swinton had had the opportunity to make the correction, as it ascribes to the Stanley Electric Manufacturing Company the credit for installing plants which it had not, and which it had no intention or desire to claim.

Trusting that you will publish this letter, and that it may correct the error so unwittingly made, I am,

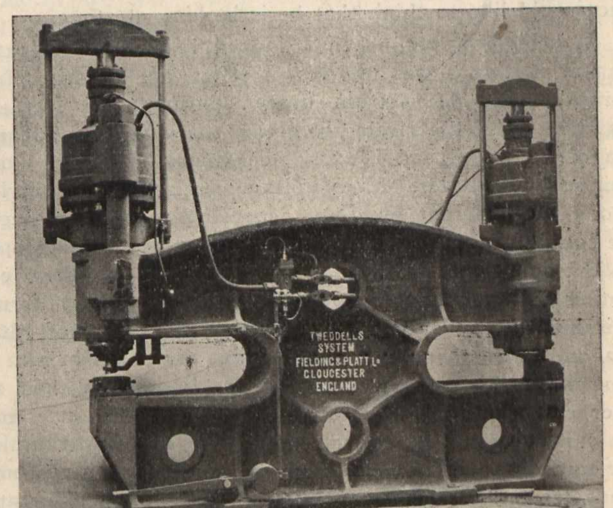
Respectfully yours,

C. C. CHESNEY.

Pittsfield, Mass., Oct. 11th.

HYDRAULIC PUNCH AND SHEAR.

Amongst the heavy tools ordered by the Canadian Pacific Railway Co. for their new shops is a Hydraulic Punch and Shear, here illustrated, made by Fielding & Platt, Ltd., of Gloucester, England. This machine has gaps 48 inches deep, being powerful enough to punch 4 inch holes through 1 inch



Hydraulic Punch and Shear.

plate, and shear 1¼ inch plate. The body is cast steel with loose cast steel cylinders lined with gunmetal, rams of close grained cast iron. Fielding's patent balanced piston valves are used for operating the machine and can be worked either by hand or foot. Although this machine was only lately made, the Canadian Pacific Railway Co. have given an order for a duplicate machine to Fielding & Platt.

The Canadian representatives of this firm are Peacock Brothers, Canada Life Building, Montreal, who have been for some years practically the only firm making a specialty of importing heavy and special British tools.

A VISIT TO THE WORLD'S FAIR.

An ideal time to visit the World's Fair at St. Louis is during the period indefinitely known as Indian Summer. Your representative spent the first week of October on the grounds, and found the weather ideal. After leaving a frost-bitten country where most of the out-door floral decorations have disappeared, and the woods are donning their autumn tints, it is a delightful surprise to find one's self in a latitude where it is still summer. On the fair grounds, the lawns and flower-beds are in their prime, and their luxuriant colors together with the light summer garments so common among the crowds, lead one to imagine that it must be August instead of October.

My route lay by the Grand Trunk Railway to Chicago, and thence by the Illinois Central. With all the luxuries of modern travel we sped through Western Ontario with its rolling farms and woodlands, and past the oil district where the rigs dotted the landscape like trees. Passing through the Sarnia tunnel is a unique experience, since one travels under a river without ever seeing the water. It is to be hoped that electric traction will soon be substituted for steam, through the tube, both for comfort and for safety. Gas is unpleasantly noticeable as a train passes through, and how dangerous it can be, has very recently and grimly been brought to public notice. Over the Grand Trunk Western from Port Huron to Chicago the ride was most delightful, and there our car was attached to the Illinois Central train which carried us straight south during the night, and showed us the cornfields and mules in the morning.

The Fair is certainly a great show and well worth a visit. It is large and it is impressive, but naturally it impresses different minds in different ways. Your correspondent confesses that he was not as much struck with the first view of the grounds and buildings as he might have desired. While the advancing season has probably improved the appearance of the natural decorations of the grounds, it is an undeniable fact that age does not improve plaster and staff. Things are not looking shabby yet, by any means, and the best possible care is being taken of the buildings, but an occasional patch in the plaster disillusionizes the onlooker, who would like to think that he is looking at stone.

It was, however, when I looked into the Fair rather than at it, that I was impressed. Here are countries from Europe, from Asia,—from every continent, in fact,—engaged in a friendly rivalry in giving the visitor an adequate idea of the social and industrial conditions prevailing among their several peoples. As exhibits were classified and divided among the different buildings according to their character, one could not find the various sides of any particular people's life exemplified in any one place. Here you see them conducting railroads, there you are shown how they furnish their homes, yonder you may examine their form of education, and in another place, they exhibit their skill in art. In some ways this arrangement is more impressive than any other could be. For instance, no matter where one goes, one cannot travel far before coming on a German exhibit. The same way with Japan; whether you go to manufactures, mines, transportation, agriculture, or what not, even sauntering down the Pike, you will meet Japan. The same thing is doubtless true in large measure of other countries, but Germany and Japan impressed me more than the others.

The exhibits of Great Britain and Ireland are prominent in nearly all the buildings, and other parts of the Empire show up very well. France and Germany for the most part show exhibits from their colonies in close proximity to the motherland; but the members of the British Empire are quite separate and distinct from each other. Perhaps that fact is an indication of a fundamental distinction between our Empire and others.

New Zealand has two or three exhibits, and does some aggressive advertising; Egypt has displays in two or three places; Rhodesia has a stand; India and Ceylon are prominent; and there are probably other exhibits from outlying members. Australia, however, is a disappointment. Possibly I missed their main exhibit, but all I saw was a booth from New South Wales.

Canada has exhibits in nearly all the large buildings, besides two buildings of her own,—the Government building, and a special forestry building. The exhibits are all tastefully arranged with a view to making the best impression.

Some exhibits are apparently arranged on the assumption that visitors will stop for half an hour or so and examine that which is shown. Not so the Canadian exhibits. Our permanent exhibition commission know their business, and know that the average visitor at a fair is there to see as much as possible in the least possible time, and our exhibits are designed to meet that condition. A visitor in the Mines and Metallurgy Building, who steps into the Canadian exhibit and looks around for five minutes will get an idea of the principal mineral resources of the country, and if he has any eyes to read the brief but telling legends that adorn the pillars, he will know that this country takes an important place in the world's production of nickel, asbestus, graphite, mica, etc.

The average visitor at a fair is there not only to see all he can but also to get all he can. Nearly all exhibitors issue some sort of circular or souvenir for distribution, and a visitor, picking up such things for a few days, is subject to a sort of kleptomania, and will seize anything of convenient size which is lying loose. The Canadian Commissioners met this condition exactly when they issued a series of handbooks to be distributed at the various exhibits. These books are got up neatly and tastefully and deal with various topics, one with agriculture, another with the economic minerals of this country, another with the forest wealth of Canada, etc. Besides these there is issued a larger book, in very durable and attractive binding, giving general information about the country, which is distributed free at the Canadian Building.

Other displays which help to advertise Canada are the Intercolonial Railway display, which points to Canada as the sportsman's paradise, and the Grand Trunk Railway booth, which advertises the Kawartha district by paintings and moving pictures.

PAVING A CANADIAN CITY.

FROM A PAPER READ BEFORE THE UNION OF CANADIAN MUNICIPALITIES, BY A. O. GRAYDON, CITY ENGINEER OF LONDON, ONT.

I must preface this report by stating that I became an official of the city in 1888, as assistant City Engineer, and assumed my present office in 1891. Quite a number of pavements were, of course, laid previous to those years. I would also observe that the Board of Works, under whose control the expenditure on the streets is made have had their estimates so cut down by the council each year that it has prevented them from carrying out improvements which they otherwise would have done.

The City of London has 133 miles of streets of which the greater portion are surfaced with pit or river gravel. Fortunately the city abounds with the best gravel, and until within the past four years, these streets were fairly well made at a small expenditure, but since then the contractors and teamsters supplying gravel have so increased their prices that it is nearly as cheap to buy broken stone, and certainly in the end it is much more economical. The reason why gravel has increased in price is due to the large quantity used by the contractors for cement walks.

The soils we encounter in constructing roads and pavements throughout the city are, as a general rule, of an excellent character and form a good foundation and seldom require under-drainage, except in what is known as London South, and the south-western portion, chiefly occupied by the business portion of the city. The formation underlying the remaining portion of the city is composed of red sand and gravel.

The city in 1896 purchased a 12½ (long) ton roller from the Harrisburg, Pa., Engine Company, and it has been of the greatest benefit. If a good coat of gravel about 10 inches in depth is laid on a sub-grade properly prepared, the road given a crown of 9 or 10 inches, and a cement curb laid on each side and then thoroughly wetted and rolled, you have an excellent road for residential streets, but it is not a permanent road, and requires frequent repairs to keep it in anything like a satisfactory condition. A road of this class made with unscreened pit gravel will cost, here, about 60 cents per square yard. The cement curb (6-in.) costs 25 cents a lineal foot, and a combined 6-in. curb and a gutter 15-in. wide costs 50c. a lineal foot.

I have very strongly opposed the further use of gravel for our streets and advocate that broken stone be used entirely where permanent pavements are not likely to be constructed in the near future. In this I am supported by the Mayor and the Chairman of the Board of Works.

Coming down to the first permanent pavements laid in the city, we have Dundas St. from Ridout St. to Richmond St., a length of 1,166 feet by 46 feet wide laid with cedar blocks on a stone foundation in the year 1881. The life of this pavement was then estimated to be 20 years and debentures issued to mature in that length of time. The annual frontage tax was paid until 1895, when the City Council cancelled the remaining six payments and relaid the street with the present sheet asphalt pavement.

The next pavement was on Dundas St. from Wellington St. to Richmond St., laid in 1883, in the same manner, with 20 years as the life of it. These payments were also cancelled in 1895 or eight years before the final payment came due.

Richmond St. from the G.T.R. to Fullarton St. was laid in 1883 and the payments cancelled in 1895, and the street repaved with the present sheet asphalt. The city had of course to assume all the cancelled payments on the cedar block pavements; the average cost of the above-named cedar block pavements to the ratepayers was 22 cents per foot frontage, for a term of 20 years

I need hardly tell you these pavements were worn out long before 1895, when the payments were cancelled with from six to eight years yet to run.

Dundas St. from Wellington St. to Waterloo St., 660 feet, was laid with cedar blocks in 1888, under a ten-year life. This block has been completely worn out for several years.

Dundas St. from Waterloo St. to the Western Fair grounds, a length of some 6,000 feet, was laid with cedar blocks, laid on 8 inches of gravel, in 1892, with an estimated life of ten years. This pavement is also worn out, and will in all probability be replaced with a better class of pavement next year.

King St. from Ridout St. to Maitland St., a distance of 5,200 feet, was laid in different sections in 1891 and 1892, with a ten-year life.

The above mentioned cedar block pavements comprise the great bulk of that class of pavement laid here, there were four short blocks laid about 1892, all of which are worn out. The total length of cedar block pavement laid in this city was about six miles.

The next class of pavement laid was sheet asphalt on Dundas St. and Richmond St., constructed in 1896, with an estimated life of fifteen years, with a five-year guarantee. This pavement is laid on a 6-in. concrete foundation with 1-in. binder and 2-in. surface of Trinidad pitch lake asphalt, and cost $2.65 per superficial square yard. The contractors were called upon to repair in 1900, and they again had to repair in 1901, the year their guarantee expired, since then the city have had to repair each year at a cost of from $900 to $1,200 annually, this is exclusive of street railway portion, which has to be maintained by the company, and their repairs, I am informed, cost as much as the city's portion. The Street Railway Co. occupy 17 ft. ½ in., or that portion occupied by the tracks and 18 inches outside the outer rail. Under their agreement with the city they are compelled to pave or repave with like material to that used on the adjoining portion of the street at their own expense.

In the Street Railway portion 12-in. by 12-in. longitudinal beams of concrete are constructed upon which the rails are placed, the rails are tied together every 6 feet with an iron rod and then the whole is imbedded in concrete. The rail is 6½ inches deep and weighs 70 lbs. to the yard. This construction has not been successful and the rail is too light in weight and not of sufficient depth. The length of this pavement is 2,600 feet on Dundas St. and 1,800 on Richmond St. by 46 ft. wide, and cost (by contract under tenders), $1,200 to clean it from the 1st April to the 1st December, and the remaining four months of winter it usually costs about $150, which is equal to $1,350 annually.

The next class of pavement laid was the Warren's bitulithic, laid in 1902 on Talbot St. from Fullarton St. to Oxford St., a length of 3,900 feet and 26 feet wide with returns at street intersections of 25 feet. This pavement is constructed by laying a foundation of 6 inches of broken stone passing a 3-inch ring and caught on a 1-inch ring, flushed with bitumen and well rolled, then ¾ of an inch of small crushed stone is swept over it to fill voids and then a coat of their patent cement. The wearing surface is 2 inches thick and is composed of 1¾-in. to minutest particles of hard crushed stone mixed with bitumen and heated to 250 degrees Fahr. and passed through a "twin pug" mixer and afterwards brought on the ground while hot, and spread with rakes, similar to asphalt, and then rolled solid. On this surface is spread another flushing coat of bitumen and then a thin layer of stone chips is rolled into it to give it a gritty surface that will not be slippery, and which gives horses a firmer foothold. The cost of this pavement was $2.40 per yard, and the combined curb and gutter was 50 cents a lineal foot with a ten-year guarantee.

Warren's bitulithic pavement was also laid on King St. from Maitland St. to William St. some 700 feet by 25 feet wide at the same cost per yard, and also on York St. from Wellington St. to Talbot St., a length of 2,000 feet by 40 feet, at a cost of $2.20 per square yard, the westerly block on York St. is traversed by the London St. Railway, and they paved (with the consent of the City Council by by-law), their track allowance with vitrified brick. The brick are of a very inferior quality, but I am of opinion that scoria block, vitrified brick or asphalt blocks are the best material for paving street railway track allowances on account of the vibration of the rail and also it is so much easier to get at their rail joints for repairs, etc. Sheet pavements are not calculated to stand the vibration of street car traffic and have proven unsatisfactory. Peter St. from Queen's Ave. to Dufferin Ave. was also laid with bitulithic in 1902 at $2.10 per yard, it is 25 feet wide by 500 feet long. This year the city awarded a contract for paving Wellington St. from Dundas St. to the G.T.R., 1,250 feet by 40 feet wide, 3-inch asphalt blocks. These blocks are laid on 5-in. of concrete, on this is ½-in. of cement mortar on which the blocks are laid. The interstices between the blocks are filled with a mixture of dry sand and cement, one to one, which is swept into all the spaces and afterward a coat of liquid cement is swept all over the pavement and when dry a layer of sand is swept over the entire pavement and allowed to remain two or three days, and afterwards swept off. The cost of this pavement was $2.60 per yard with a ten-year guarantee.

In the year 1900, the city awarded a contract for laying a tar macadam road on Queen's Ave. from Adelaide St. to Maitland St.; this was constructed with a 12-inch foundation being 4 inches of very coarse gravel and 8 inches of broken stone. The broken stone was heated in pans to a temperature of 240 degrees Fahr. and thoroughly coated with bitumen at the same temperature, this bitumen was composed of 10 gallons of coal tar to one gallon pitch and a small quantity of asphalt and sufficient was used to cover all the exposed surface of the stone. The stone was then teamed into the street while hot and immediately rolled into place. This 8-inch depth of stone was laid in two layers of 6-in. and 2-in., the lower layer being 2½-in. stone and the upper having stones of 1½-in. and under. The surface was finished with a coat of sand and bitumen of a thickness of ¾ of an inch and then rolled down. The easterly block between William and Adelaide St. was laid in warm weather, and now it is in first-class condition, but the westerly block to Maitland St. was completed under less favorable conditions, the cold weather having come on and on several occasions the snow had to be swept off the lower layer in order to put on the surface, the result being that this block required resurfacing. The cost of this pavement was $1.10 per yard, which includes cement curb and gutter.

Macadam Pavements.

The following macadam pavements have been laid in this city by me by day work: Dufferin Ave. Wellington to Waterloo, in 1897; Dufferin Ave. Waterloo St. to Cartwright, in 1898; Wellington St. Dufferin to Central, in 1898; Wolfe St. Wellington to Waterloo, in 1898; Princess Ave. Wellington to Waterloo, in 1898; Princess Ave. Waterloo to Colborne, in 1899. These pavements have all a stone curb 4 by 18-in. with the exception of Dufferin Ave. from Wellington to Waterloo. They were constructed in the following manner: The road was excavated to the depth of 12 inches and made to conform to the required cross-section and then 12 inches of broken stone was laid on the sub-grade and thoroughly wetted and rolled and then one inch of crushed stone dust was spread on it and this was thoroughly rolled in. The cost of these pavements was about $1.05 per square yard, the stone curb was 43 cents per lineal foot in place. There is always a feeling in the minds of laymen that there is nothing like the macadam roads, and while I think they are very suitable for residential streets, yet they require continuous and systematic repairs in order to prevent the disintegration caused by traffic and water. Broken stone in available quantities should be kept on hand to repair these roads wherever a weak or defective spot appears in the surface in the same manner as these roads are cared for in England or the sections of a steam railway are cared for in the country.

This city has no brick pavements; the council has decided to initiate one on King St. from Wellington St. to Ridout St. one of the main business streets. Whether the property owners will ratify the council's action or not remains to be seen. I estimate this pavement laid on 5-in. concrete base will cost about $2.25 per yard.

General Remarks.

In considering the paving question of this or any other city, one must familiarize himself with the general conditions as they exist, by this I mean the nature of the street, its environment, its width, its levels for carrying the water off, its residents, or the nature of the business on it, etc., etc., also the capability of the property owners as to what frontage tax they are able to bear without being a burden. Then, again, you must consider the money available for keeping the pavements clean, for, as I have already informed you, it costs $1,350 a year to keep three-quarters of a mile of asphalt clean. For instance on a great many streets in this city which require to be paved in the near future the properties consist of wide frontages with comparatively inexpensive houses, and thus if costly pavements were put down it would practically be putting a mortgage on the properties; for instance, if a man has a frontage of 100 feet, and has a $1,200 dwelling on it, and you construct a 27-ft. roadway at a cost of say $2 a yard, means $35 a year or a mortgage (by the way of frontage tax), of $350. I use this illustration, as a great number of such cases (and many with greater frontages), exist throughout the city, as owing to its large area (4,478 acres), London is a city of wide frontages, and the population has not reached that stage which requires the utilization of all the frontage with revenue-producing buildings; more especially is this the case where the great majority of the mechanics and wage earners own their own homes, and where we have a large amount of available land not yet built on, although each day this is being quickly taken up and the city rapidly increasing in all directions. I desire here to say that I consider that much harm is done and the construction of many pavements defeated by too much zeal on the part of agents representing different classes of pavements and the property owners greatly confused and annoyed by the representation and requests made to them to sign petitions and contra petitions. I might instance that we have had in this city within the past two years at least three streets unpaved which without the action of such agents would now be paved, and to avoid and do away with this detriment to paving I think that the city council by a two-thirds vote should have the right to lay any class of pavement on any street on the recommendation of the City Engineer and from this decision from the city council the property owners should have no appeal. I would urgently suggest that your association take steps to have an act passed in the Local Legislature to that effect, and I would also suggest that you use your influence to have an Act passed in all the Provincial Legislatures compelling the use of wide tires.

I think you might discuss the question whether all horse and vehicle owners be charged a yearly license by which a fund could be created for the purpose of supplementing the yearly appropriation made to No. 2 Committee for street repairs. The appropriation for 1904 for grading, gravelling and repairing 133 miles of streets in this city, besides laying crossings and repairing plank sidewalks is $16,500, a sum quite insufficient for the work to be done.

We have a peculiar case on Dundas St. between Wellington and Waterloo streets which, as stated, was paved with cedar blocks long since worn out. This street has shops on the north side and the sidewalk is laid directly along the street line; on the south side is a factory, and the rest of the buildings are private dwellings and the sidewalk is put out 33 ft. from the property having a boulevard. The property owners on the north side want the pavement extended to the sidewalk, and they want the owners on the south side to pay one-half of this extra width of pavement on the north side, which they refuse to do, and the result is a deadlock and a disgraceful pavement in nearly the heart of the city. The owners on the south side petitioned for a pavement on their side, but the City Solicitor said it could not be constructed, and the City Council is helpless to act and their attempts at mediation have thus far failed. Under these circumstances, what would you suggest?

Cement Walks.

The city has about 100 miles of these walks already laid. They are constructed with 7 inches of coarse gravel well rammed for a foundation, then 5 inches of base concrete made 7 to 1 and 1-inch surface ½ to 1. The cost this year is nine cents per square foot. They are paid for by debenture, one-half the cost of the property frontage is paid by the owners and the other half and the street intersections paid by the city, where there is a corner lot and a sidewalk on both streets the city pays one-third of the depth of the lot. Cement curbs and combined cement curbs and gutters are paid for in exactly the same manner as the sidewalks. The contract prices for 1904 are as follows:

	Per Lineal Foot.
6-in. cement curb	24½c.
6-in. curb, 15-in. gutter	47½c.
6-in. curb, 18-in. gutter	29½c.
6-in. curb, 24-in. gutter	53½c.

Payment of Pavements.

The city pay the street intersections only, except where a corner lot has a pavement laid on both streets and in such case the city pay one-third of the depth of the lot. Owing to the great width of most of our streets (132 ft.). the cost to the city is about one-third the total cost.

* * *

ELECTRICITY AND ACETYLENE.

As noted last month, the first instance on record of the amalgamation of an acetylene lighting plant and an electric lighting plant is furnished at North Bay, Ont., where the North Bay Light, Heat and Power Company, Limited, has taken over the business of the North Bay Gas Company, and the electric plant owned by John Bourke. Extended notice was given in this publication in September concerning the North Bay Gas Company, which sells acetylene for lighting and cooking. The amalgamation was undertaken by A. F. Leggatt, president of the North Bay Gas Company. The new company has a capital of $50,000, and will spend $7,000 in the extension of the gas and electric businesses. The company begins with an income of $14,000 a year and net profits of about $6,000. All of the shares are owned by citizens of North Bay. The directors are: Thomas Wallace, president; John Blanchet, Wm. Martin, Sr.; Sam. Berry, J. T. Lovell, A. F. Leggatt, managing director. The secretary-treasurer is W. Martin, Jr. The company has a perpetual franchise for all kinds of gas and an exclusive franchise for ten years for electricity. The shareholders comprise most of the leading citizens.

UNIONS AND FLANGES: THEIR CONSTRUCTION AND MERITS.*

Union couplings have been in use almost as long as pipe. When pipe was first used, it became necessary to connect the ends in some way, and for this purpose a plain tubular piece of metal was used of larger diameter than the pipe, threaded on the inside so that the threads on the end of the pipe could be screwed into it. This method was satisfactory when new work was put up, and where the end of the pipe was loose so that the coupling could be screwed on to it and the other pipe then screwed into the coupling. This was very objectionable, however, when it became necessary to disconnect any length of pipe, as it was necessary to tear down the whole line to make or repair any part of it. Therefore some one devised the use of the union coupling, consisting of two hubs, each threaded to fit the pipe ends, one end being loose on the nut and the other having an outside thread on which to screw this nut, so that the two ends could be drawn together forming a seat by the connection of the two ends of the coupling, and in this manner making it a joint. It was found, however, that a tight joint could not be made unless some softer material were used between the seats, consequently we have the various forms of union coupling.

Union couplings, and the many forms of their construction, have been and are agitating the public mind and at the present time, this well-known device is the most desirable form for the connecting of pipe ends.

We will, therefore, attempt to discuss their various constructions, with the view to determining the best design. It will be understood that this article is not written with the idea of decrying any make of unions, and we will, therefore, not mention them by name, but that we may fully discuss this matter, and be in a position to judge as to their merits, the writer will attempt to describe them without any partiality, even though his own mind is fully made up as to what he considers the best mode or method of construction.

The first will be the old-style form of union coupling, and will be known as No. 1. The ends of No. 1 are usually malleable iron, as is also the nut, but as we have said before, it was necessary to insert something between the hubs to make a tight joint; therefore, a leather, rubber or even paper washer was inserted between the two hubs, and then the nut drawn tight, binding the two ends together and holding the washer in place. This method was not entirely satisfactory, because this washer would not stand the pressure and wear of the water, steam, air, or whatever the substance flowing through it, owing to its decay or its destruction by the elements with which it came in contact; and also by the fact that the nature of the material prevented the making of a tight joint, it being impossible to obtain a uniform pressure on all parts of the washer due to inaccuracies in pipe alignment.

This method of connecting pipes is used, however, more often than any other because of its cheapness; and price, with some users of material covers a multitude of evils. Some of these are as follows: Constant changing of washers under pressure; loss of same when disconnecting the couplings, and having no others to replace; and lastly, when used on heavy pressure the light weight of the regular coupling necessitates the use of an extra heavy coupling of heavy type at largely increased price.

After a while, we had the brass, or No. 2, union. This was brought out to cover the defects in the malleable iron union and also in connection with the use of brass pipe.

The general construction of this union, aside from its being all brass, was the same as in the former one, except that instead of using a washer to keep the joint tight, the two faces of the union were ground together, thus forming a perfect seat when drawn tight with the nut, and from this we get the name "ground joint union." This method was a great improvement, owing to the fact that the troublesome washer, or packing, was done away with, but there are some objections to its use, viz.: Its increased cost, and when used with iron pipe the difference in the materials of the unions and the pipe ends. This causes trouble, as brass expands much faster than iron, under a temperature, and this causes the hubs to expand and become loose; also because brass, being so much softer than iron, in screwing off or on, in making or breaking joints, the hubs stretch or become so loose on the pipe as to be worthless, and have to be thrown away, and thus we have an expensive joint. The ends, or faces, of all brass unions, are supposed to be ground or fitted in pairs, but it is a deplorable fact that a great many of the manufacturers do not do this, because of the expense of this operation. If you will examine the seats of some of these unions, you will find the tool marks on the brass showing no grinding whatever. Thus you fail to get the desired results, namely, ground seats, perfectly tight, but instead, unions forced together, depending on the softness of the metal to make the proper contact.

No. 3 Type—This type is represented by two styles of union, and are what we may call "the soft seat union." The first of them has the malleable iron nuts and ends, but has a flat seat of malleable iron in which is inserted a thin ring of lead or babbitt metal projecting over the seat about 1-16-in. and about ⅛-in. wide. Its chief trouble arises from the fact that this little ring is often abraded before it can be made tight, or is cut by dirt or chips coming in contact with it, defacing or cutting it, and if this is the case, the joints are spoiled, and once the coupling is broken, you have a leaky fitting.

The other style of No. 3 type, instead of one soft seat, has both sides soft, with the same construction of seat as in the ground joint union. This is also liable to destruction through the same causes as the former, and in addition thereto, in making the joint tight, the two seats are mashed together when tightened, and thus, when opening the coupling and replacing upon the pipe, we do not bring these two points exactly together, and consequently have a leaky union.

The next union in use will be known as No. 4, or "Dart-Union," but we will defer this description until later, as we desire to discuss some of the others before we take up this.

No. 5 type of union is made with one end entirely of brass, and the other end of malleable iron, with a malleable iron nut. The brass end of the union is the female end, while the iron end is the male. These two ends are supposed to make a perfect joint, and to be so, they must be ground in pairs. Unfortunately, however, we have found a number of these unions showing no attempt to grind in this way. Consequently, we have the same failure to make a perfect joint as in the other union.

Then, too, there are the objections to its construction. On the brass end we have the same trouble as with the brass or No. 2 union, that of unequal expansion and also of stretching. This expansion also takes place between the hub and the nut, often causing trouble. The iron face will corrode or rust and this being the case, we have an imperfect joint. You will often find this union with the iron end covered with oil or grease to prevent its rusting before it is put in use through lying in stock or through lying about a building waiting to be used.

No. 6 type of union has the ends of malleable iron and also the nut, but it has but one brass seat inserted in the malleable iron end. We have here the same trouble of grinding and forcing to a seat, and also the corrosion of the male end, and in addition to this, the hubs are hexagon, and in using a Stilson wrench, which a fitter invariably uses, the sharp ends are torn off when tightened.

If you will compare both of these unions, Nos. 5 and 6, with the No. 4, you will see many points of advantage in favor of the Dart union.

Type No. 7—This is the latest union which it has been the writer's privilege to see. It is all malleable iron, with the exception of the seat. It has two iron faces, male and female, on each of the hubs, into which fits a loose brass washer, thus making four surfaces to constitute a joint. In this manner we see that this union has twice the chances for corrosion that have the two former types, having both sides of the union iron; in addition, the brass washer is liable to be lost or to be jammed in tightening up.

Now that we have fully described all of the makes of patent unions or types of these, we will take up the No. 4, or Dart union. It is constructed with malleable iron hubs and nut, and so built that the wrench will not scar or mar the hubs in screw-

*From a paper prepared for the Association of Steam Engineers.

ing on the pipe. The nut is heavy and strong to draw the parts tightly together for very heavy pressure. This union has been tested in the 1-in. size up to 2,000 lbs.' pressure, while the other makes of unions, unless of the extra heavy pattern, will not stand one-half of this test. The seats of this union are of brass composition, and the male and female ends are absolutely ground in pairs, so that we have a perfect ground seat. The seat is in the shape of a ball and socket, which is the most approved type of joint, and is tight whether the pipe is in or out of alignment. The brass faces are forced, under heavy pressure, into a recess made for them in the hub. They are then turned up true to each other, and then ground to a perfect seat. We see, therefore, that we have all the advantages of the brass ground joint union with the disadvantages eliminated. We have an absolutely tight joint, no corrosion on either end of the face of the seat, and no unequal expansion and contraction of the hub or end and no stretching of the threads in taking off the union. This type of union, therefore, appears to combine all the best features of all the types, and consequently should give the best satisfaction.

Reasoning from the facts shown, are not two parts, forming the seats of any union, each non-corrosive, better than a seat formed by one part corrosive and the other non-corrosive? And if it is better to have the strength of iron in one end, is it not better when both ends are of iron? If a union made wholly of iron is undesirable on account of rusting, is not a union made with one end of iron liable to the same trouble? If a union made entirely of brass is also undesirable on account of expansion and stretching, is not one made of iron combining the ground joint seat and non-corrosive, much better?

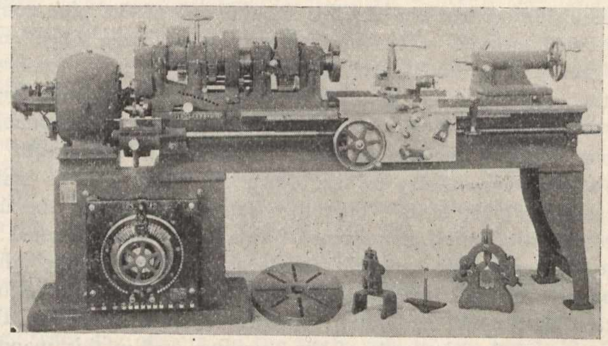
The use of flange unions is not quite as frequent as the union couplings, but in large joints, and in a number of places, union couplings cannot be used to an advantage. Consequently we have the use of the flange joint. As we all know, the flange joint consists of two plates of cast iron, with the hubs of each threaded to correspond with the pipe ends, and with bolt holes on the outside circle of the flange to draw the two parts together. In the flange is inserted any style of packing that may seem desirable to the user of this style of joint. In the first place, it is necessary that the pipes be in perfect alignment to get a perfectly tight flange, and second, it is necessary to draw together the two halves of the flanges exactly equal at all points; otherwise the point that there is least contact on will have a tendency to blow out. Engineers have had so much trouble with blowing out of packing, owing to high temperatures or peculiar conditions, that a number of engineers are sceptical in regard to flange unions except for large size work. After a certain pressure has been reached, it is necessary to use what is known as an extra heavy flange faced and drilled. The flange is the same as the other, except that it is heavier and is trued up so that both sides make a perfect fit; packing is used also in this flange, and the same care must be used in the putting up of the extra heavy type of flange. We will compare both of these types with the Dart patent flange; but first we will state that in addition to packing, all kinds of numerous gaskets of metal, etc., have been devised for the making of tight joints and the preventing of the blowing out of such joints. The Dart flange union is made in sizes from ½-in. to 12-in. and has practically no competitor or no imitator. The union is constructed in the same manner as the ordinary flange, with the exception that it is heavier and is braced where it receives the bolt, but has in addition the brass ring forced into it the same as in the union coupling. These brass rings are screwed up to match each other, and are then ground, the same as in the union coupling; but you will also note that this flange is tight absolutely in or out of alignment. It makes no difference whether it is bolted perfectly true or not, as the seat is ball and socket, and tight in any position in which you may desire to bolt it. It may be clamped tight at the bottom, and stand open ½-in. at the top, and remain perfectly tight. This flange will stand a pressure of at least 5,000 lbs. without leaking, on an 1½-inch size. Probably the larger sizes, which are made heavier, would stand even more.

* * *

The Western Electric Co. is installing light and telephone systems in Red Deer, Alta. The lights are expected to be in operation this month.

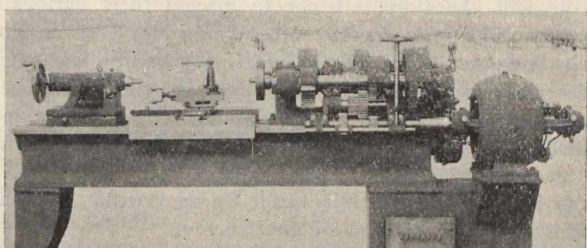
ELECTRICALLY DRIVEN LATHE.

The accompanying illustrations show a front and back view of an electrically driven lathe made by the Lodge & Shipley Machine Tool Co., of Cincinnati, Ohio. The motor is a 2 to 1. The patent head shown gives three changes—the two mechanical



Electrically Driven Lathe—Front View.

changes on the driving shaft make six mechanical changes; this, with the 2 to 1 motor gives a very great range. As ordinarily made, the controller is operated from the carriage, but this arrangement is simpler. This lathe can be furnished with a pulley suitably supported in place of the motor, so that the lathe may be operated directly from the line shaft, with six



Electrically Driven Lathe—Back View.

changes of spindle speed. The makers say: "The great claims we make for this are especially its mechanical simplicity and its neatness of appearance. We also have in this all the benefits of our recently patented lathe head, by which high speeds with heavy cuts, heretofore impossible, are easily obtained."

* * *

SIR SANDFORD FLEMING ON CANADIAN RAILWAY ENGINEERS.

The Ottawa correspondent of the Toronto News has obtained a copy of Sir Sandford Fleming's statement before Judge Winchester concerning the employment of United States engineers on the Grand Trunk Pacific, and he writes of it as follows:—

The Grand Trunk Pacific has elected to employ American engineers to locate and build its line. One of these engineers has remarked that "American brains" are needed to make this Canadian enterprise a success. It is not necessary to make a political issue of this line of policy, still less of the rash and ill-informed utterance of an individual. It is not desirable to rush into legislation and enact an anti-engineer alien labour law which will out-Herod the extravagances of American legislation. Rather, an appeal may be addressed to the railway authorities themselves. The best appeal in this case is a recitation of facts. Canadian engineers have been building Canadian railways for forty years, and have done good work. In one notable instance American engineers superseded Canadian engineers, and achieved the most colossal engineering blunder which so far has hampered the progress of Canada.

Sir Sandford Fleming, the dean of the Canadian engineering profession, communicated his views on this subject to Judge Winchester during the recent enquiry. It has proved possible to make public the substance of his statement. Sir Sandford, it may be interjected, in 1863 located the railway line between Toronto and Barrie, and explored the route to Collingwood and Penetanguishene. From 1863 onwards he was chief engineer on the Intercolonial. Later he surveyed a railway in Newfoundland. From 1871 to 1880 he was chief engineer of the National Transcontinental Railway of the day, the Canadian Pacific. It is to be observed that he wrote in terms of compliment of American engineers. "Canada and the United States are very near to each other, and they have many ties. We are on friendly relations with our neighbours, and give cordial welcome and employment in Canada to citizens of that country, or, indeed, skilled aliens from any land. We are the gainers eventually if they can teach us anything we do not know, or if they can do anything better than ourselves. All are placed much on the same footing as our own people. If aliens cannot do better work there is no justification for them receiving better pay and a preference to Canadians."

Sir Sandford Fleming's experience of Canadian engineers has been favorable: "All the engineers under me on the Intercolonial, the Newfoundland and the Canadian Pacific Railway explorations, location surveys, or construction were Canadian. Some were born in the United Kingdom, but all were British subjects, and all were residents in Canada or in some portion of British North America when they were engaged. Such engineers were quite equal in ability, and, generally speaking, were fully as capable in the performance of their duties as any engineers from the United States whom I have known. No difficulty was experienced in securing Canadian engineering talent forty years ago for the Intercolonial Railway, and since then for the Canadian Pacific Railway. A large number of men have gained good experience on these and other lines. The Military College at Kingston and the Canadian universities have long been training young men for engineering work, and many of them have for years been employed on the survey and construction of railways and other work, and are now quite ready to fill similar positions. I am perfectly satisfied that we have to-day in Canada an ample number of skilled men to carry on and complete the new national railway."

The work done by these Canadian engineers was excellent. Their chief was years ahead of his time as preacher of the need of easy gradient. In his report of 1879—twenty-five years ago—he used the following language: "The gradients and alignments of a railway have much to do with its capacity for business, and the cost of working it. It is well known that by attention to these features in locating a line, it is quite possible, in some cases, to double the transporting capacity of a railway, and very largely reduce the cost of conveying freight over it." As a result of his care, the eastward grades, between Winnipeg and Fort William, do not exceed 26 feet in the mile, or one-half of one per cent. The Intercolonial is a very carefully constructed railway, far superior to the Canadian Pacific Short Line to St. John. Mr. Blair a year ago gave a noteworthy example of the substantial advantages which the Government railway possesses. So, too, in the western portion of the Canadian Pacific the Canadian engineers did good work.

In sheer exploration the Canadian work was monumental. "At the beginning of the surveying operations in 1871 there was very little known respecting the country from the River Ottawa to the Pacific, comprising fifty or sixty degrees of longitude. At that period it was a prevailing belief that the construction of a continuous railway through it from ocean to ocean without crossing over to the United States was impracticable; indeed, it was so declared in emphatic terms by the highest known scientific authority of the day. The laborers of the Canadian engineering expeditions, however, set at rest all such views, and cleared away all pessimistic beliefs. Through their labors the vast territory ceased to be a terra incognita, the surveyors with their instruments of precision pierced the formidable barriers imposed by nature, and by such means solved every problem of practicability."

We are all talking to-day about the fertility of the Saskatchewan valley, about the splendid natural resources of Edmonton, and about the importance of easy grades. The Canadian engineers, working under Mr. Mackenzie's Government, and employed on strictly Governmental work, located a line for the Canadian Pacific which ran diagonally from Winnipeg to Edmonton, traversing the richest part of the North-West. They found through the Yellowhead Pass a splendid route, with easy and uniform grades. In 1880, however, the Canadian Chief Engineer was displaced. American engineers were called in. The road east of Winnipeg and west of Kamloops was already under construction, but in the prairie and Rocky Mountain sections they changed the plans formed by the Canadian engineer.

Two remarkable results followed. In the prairie, the rich Saskatchewan valley was abandoned, and the line was sent due west through the arid country. To-day, the Canadian Pacific as it spends its three millions in irrigation work possibly regrets its refusal to possess the "fertile belt." Possibly, also, Messrs. Mackenzie & Mann and the Grand Trunk Pacific, as they follow the Fleming route of thirty years ago, feel thankful to the American engineers who chose to go by way of Calgary.

Secondly, the American engineers of the Canadian Pacific abandoned the Yellowhead Pass and drove a line through the Rocky Mountains by the Kicking Horse and Rogers' Passes. In doing so they incurred great risks. It is a fact, recently brought to light, that the rails were laid to Calgary before the railway company had any assurance that a practicable route existed through the mountains opposite. When the road was built, it saved 45 miles in mere length, reducing the length from Montreal to Vancouver from 2,947 to 2,902 miles, at a cost of grades which are a permanent and irremovable obstacle to the success of the line as a freight route.

A diagram compiled not long ago by the late Marcus Smith, formerly assistant engineer to Sir Sandford Fleming, shows the profile of the Yellowhead Pass route located by Sir Sandford Fleming. Its highest point is 3,718 feet, and that involves a rise of only 1,210 feet. The rise to and descent from that summit are gradual. The Kicking Horse Pass route chosen by the American engineers has two summits, one of 5,330, the other of 4,344 feet; between them the line falls to a point only 2,458 feet high, a drop of 2,872 feet and a rise of 1,886 feet. As the Canadian Northern and the Grand Trunk Railways take the entire routes through the Yellowhead and still more northerly passes, they may again thank the men who diverted their competitor to the steep gradients of the Kicking Horse Pass.

Sir Sandford Fleming's conclusion is not unnatural. "I am firm in the conviction that the United States railway engineers have no qualifications superior to the qualifications of Canadian engineers, and that the Canadian engineers have special qualifications and methods for doing effective work under Canadian conditions which are not possessed in the same degree by alien engineers, whose training and experience have been gained under different conditions." He went on in this connection to urge strongly the employment of Canadians, if only because they would have their hearts in a work which means everything to the future of Canada. "I trust," he wrote to Judge Winchester, "that I have made it plain in the matter of the proposed undertaking, that there is great risk in placing it in the hands of men whose characters are unknown, that there is especial danger in employing alien engineers, who, for aught we know, may come under the influence of those who would profit most by the non-success of the Canadian line."

GAS ENGINE PROGRESS.

Editor Canadian Engineer:—

Sir,—The gas engine for the past five years has had a very steady and strong growth in general use.

It has reached a stage near perfection, for example; a 7½-h.p. engine has only about 5 or 6 pieces in the whole entire engine, it has no valves, no springs, no complications except for 2 or 3 small batteries for the sparking device. Four or five gallons of water for the purpose of cooling the cylinder, and has nearly a perfect balance in its construction for its vibration. It is one of the most independent powers that any man might purchase.

A French type of engine that will be made in Canada at an early date can be used for automobiles, yachts, direct connection of dynamos for lighting, etc., running pumps in place of wind mills, running centrifugal pumps for mining purposes, for general farm work, threshing and several other purposes. A 10 or 12-h.p. engine will weigh in the neighborhood of about 300 lbs. Gas engine plants can be installed for one-half of an electric plant, and 25 per cent. of a steam plant.

Respectfully yours,
F. C. BROOKS.

Niagara Falls, Ont.

DEVICE FOR PREVENTING EXPLOSIONS OF GASOLINE AND OTHER INFLAMMABLE LIQUIDS.

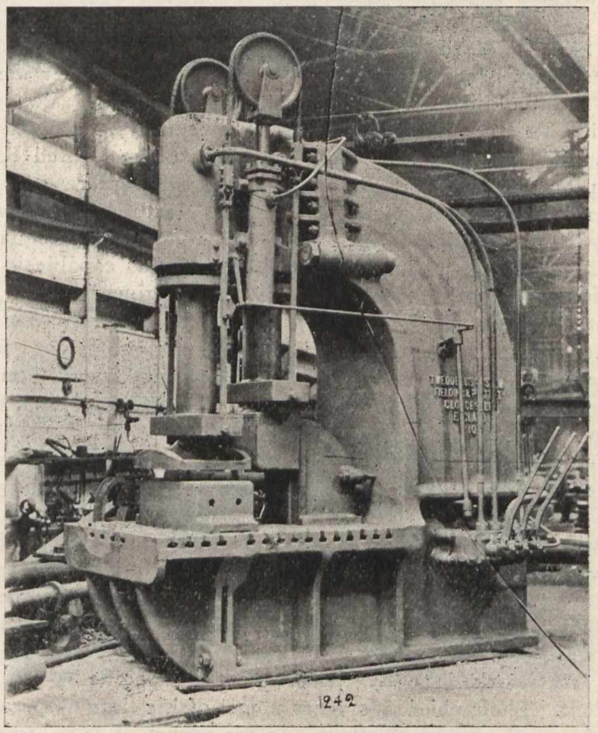
An invention in Birmingham, England, called "nonex," is a device for preventing the explosion of receptacles containing highly inflammable liquids like gasoline, benzine, etc., which give off explosive gases. It is an application of the principle of the Humphrey Davy safety lamp used in gaseous mines, supplemented by a fusible cap or plug. If a vessel of ordinary type containing an explosive liquid be subjected to sufficient outside heat, or if the contents be lighted at the orifice, the walls of the tank will burst by the force of the expansion. At an exhibition given by the Non-Explosive Device Company, a 20-gallon tank was partly filled with gasoline and placed upon a lighted bonfire. The fusible screw cap, made in two parts, which were simply soldered together, soon blew out, the solder having melted, and the ascending vapor caught fire immediately; but no explosion followed, because the orifice of the tank formed the upper end of a tube which projected down inside the vessel to its bottom, where it was closed. To allow the oil or gas to percolate from the interior of the tank each of the metal layers of which this tube was composed had been perforated, and, while the perforations would permit the spirit to be poured out, they prevented the passage of the burning gas to the interior by absorbing its heat as the wire gauze does in the Davy lamp. While the gasoline contained in the tube burned, the flame did not extend to the liquid or accumulated vapor in the half-full tank. The flame was easily extinguished with a bundle of rags and then lighted and put out several times. A motor car tank to which the device was affixed was lighted with a match and extinguished at will. A gasoline can without the device exploded almost instantaneously when lighted.

HYDRAULIC FLANGER.

Fielding & Platt, of Gloucester, England, who have equipped the majority of the leading locomotive and engineering shops of the world, have supplied the Hydraulic Steel Flanger, here illustrated, to the Locomotive and Machine Company, of Montreal.

This machine has a gap of 4 feet, and an opening of 5 feet, the total power exerted by the two vertical rams 100 tons (112 short tons), and by the horizontal rams 50 tons (56 short tons), generally as described below. The main frame is of cast iron of box section, amply strong and rigid, fitted with horizontal ram for flattening ends of plates. The frame is planed to receive cylinders which are secured by a pair of strong steel turned bolts fitting in bored holes. There are two vertical rams of cast iron, turned and polished and fitted with hemp packing, also one horizontal ram, the cylinder being gunmetal lined. The drawback cylinders are bolted to main cylinders and connected to the main rams by means of flat steel wire ropes passing over equalizing pulleys as shown, the cylinders being of cast iron, with cast iron rams turned and polished, and fitted with glands for hemp packing. The horizontal ram is fitted with direct piston drawback formed in cylinder cover. The operating valves are of Fielding's patent piston type, with gunmetal bushes and fittings. These valves to be designed to ensure ease of working, easy removal and renewal of same, having extra large area of water-ways. The machine is fitted with one set of blocks for sectional flanging circular plates, consisting of bottom block, with two curves of different radii; one vice block fitted with vertical ram; one flanging block fitted to rear vertical ram; one planed angle guide bracket for guiding flanging and horizontal rams; one horizontal ram extension piece and squaring uptool.

A crane was also supplied by Fielding & Platt, for lifting the plates into position in connection with this Hydraulic Flanger. It was designed for lifting 5 gross tons through a height of 5 feet, and with a rake of 20 feet, being to the following specification. The post and jib are of steel of I section, and the tee bars of steel. Contained between the posts is a cylinder of cast iron, bored out for ram with hemp packing, the cylinder also supports the jib, turned steel shafts are carried in bosses on the cylinder which carry rollers that guide the cylinder, and brackets with gudgeons



Hydraulic Flanger.

are fitted in top and bottom of post to support the crane, pressure is admitted through the ram, a carriage or jib with rollers and swivelling hook are provided, as shown. The working valve to be placed on the Hydraulic Flanging Press that this crane would serve.

The Canadian representatives of this company are Peacock Brothers, Canada Life Building, Montreal, who have been pioneers in the introduction in later years of British machinery, having imported the large majority of the heavy British machines brought here in the last six years for mining and general engineering purposes.

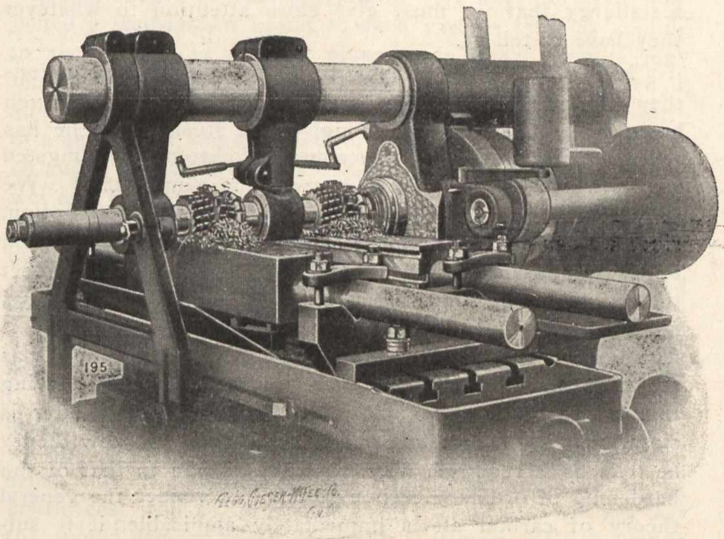
MACHINE SHOP NOTES FROM THE STATES.

By Chas. S. Gingrich, M.E.

IX.

One of the most tedious and most expensive pieces of work that are met with in manufacturing woodworking machinery is squaring and grooving the steel cutter heads to which the cutters of rotary wood planers are secured. For years it has been the custom to turn up the journals, and then work the body of the piece down square to the correct shape on a planer. These pieces are made of high carbon steel in order that the journals may be durable at the high speed at which they must work; consequently the machining process is a very slow one, particularly slow because of the accuracy required in order that the edge of each of the four cutters which each piece carries will be on a radial line and exactly the same distance from the centre of the piece.

The extensive use of the milling machine has simplified this job quite considerably, and the accompanying illustration shows a method recently adopted by the J. A. Fay & Egan Co., Cincinnati, Ohio. They fasten two of these pieces to the table of a No. 4 Plain Cincinnati Miller, and finish one side of each of the pieces at a single cut. The bars are



4½ in. in the rough, and the cut is ¼ in. deep, added to which are the grooves, one of which is ⅞ in. deep and 21-32 in. wide. The cutters are made of Novo steel, and are 4 in. and 5¾ in. in diameter. The work is fed through the machine 15-16 in. per minute, and the finished surfaces are smooth and accurate.

* * *

The municipality of Kildonan has arranged terms with the Winnipeg Street Railway Co. for the extension of the electric railway from the city to Bird's Hill va Norwood bridge. The company is to get exemption from taxation for twenty years and a franchise—but not an exclusive one—for thirty-five years. Two miles of the road are to be built the first year, operations to be commenced in the spring.

* * *

HIGH SPEED STEELS.

Changes in Machine Tool Design.

C. H. BENJAMIN, IN CASSIER'S MAGAZINE.

It has been interesting to watch the changes brought about in the designs of machine tools, as a result of the keen competition in manufacturing and the demand for a greater output per machine. Such a thing as running a lathe or a planer to the limit, even of its former capacity, was once a novelty. For the most part these machines jogged along in a comfortable and contented fashion with the operator also comfortable and contented.

The introduction of the new process steels for tools is a result rather than a cause of the recent awakening and of the endeavor to get out of each machine all that there is in it. Many of the tools built ten or twenty years ago were incapable of getting the best work or the limiting quantity from even the ordinary carbon tool-steels. The belt would slip, the gears would break and the frames and spindles would spring.

Of late, however, machines weigh more, have wider belts, bearings of greater surface, and can stand up to the work required of them. But now comes the high-speed steel and there is more trouble. Not only must the machine have stronger parts, but it must have more power to turn the spindle and to push the carriage. To understand this, it is only necessary to make a few comparisons.

Formerly the lathes, planers, shapers and other tools in an ordinary machine shop consumed from half a horse-power to two horse-each. The writer has seen a 16-inch lathe stalled when doing less than one horse-power.

Recent tests with a lathe of 20 inches swing, turning soft steel, have shown a gross horse-power of from seven to sixteen with one maximum reading of over thirty horse-power. The manufacturer of one well-known turret lathe recently told the writer that a new machine now building for use with high-speed steels would consume twelve horse-power. This will be more easily understood when we consider the enormous amount of metal removed by some of the new machines.

One lathe, when turning soft steel at a speed of 125 feet per minute, removed metal at the rate of 625 cubic inches per minute or about 1,000 pounds per hour. Another lathe, running three tools, cut steel with a speed of 50 feet per minute at the rate of 113 cubic inches per minute or about 1,900 pounds per hour.

A prominent firm making slab milling machines guarantee the removal of 210 cubic inches of cast iron per minute, or about 3,200 pounds per hour.

Now reliable tests of machines in actual service show a consumption of power per pound of metal per hour of 0.03 to 0.07 horse-power under favorable conditions, exclusive of the power required to run the machine itself. Using the smaller value, or 0.03 horse-power, gives the power required in these three instances as 30, 57, and 96 horse-power, respectively.

The cases cited are, of course, extreme ones and examples of what may be called "slaughtering stock," but they nevertheless show what these machines are capable of doing. The rapid reduction lathes, as they are sometimes called, present several points of difference from their immediate predecessors. The steps of the driving cone are fewer in number and have faces suitable for wide belts, sometimes four and sometimes even six inches wide. The speed of the belt is also increased, for it is an axiom that the power of a machine must be measured by the belt and not by the gearing. No complication of double or triple gearing will give power to a lathe which has a narrow, sluggish belt.

Cut spur gears are now used wherever necessary and gear boxes have taken the place of speed cones for controlling the travel of the tool. The mechanism inside the apron has received particular attention, for this is the weak point of many lathes. The use of steel gears and racks and of double bearings for the pinions has remedied this defect.

The tool-post has been strengthened, the head and tail spindles have been enlarged and all the bearings are made wider and longer. Some of these lathes are now capable of melting the points from the new steel tools.

It is rather remarkable that the principal advantage in using high-speed steel has appeared in the turning of wrought iron and mild steel, and that cast iron still remains obdurate. While it is no uncommon thing to-day to see soft steel turned at speed varying from 125 to 250 feet per minute, a speed of over 50 to 60 feet per minute for cast iron is unusual. The peculiar granular character of the casting or perhaps the presence of graphite is fatal to the life of the tool point at high speeds.

Planing machines have not profited by high speeds as have the lathes, probably on account of the intermittent character of the work. Sixty feet per minute is about the highest recorded speed, and this is not recommended for ordinary planing. A cutting speed of 35 feet per minute with a return of two to one is as high as can be economically used. A common mistake which has been made is to increase the return at the same rate as the cutting speed. This is apt to make trouble at the end of the return stroke.

The possibility of doubling the cutting speed without changing the return is excuse enough for the use of the new steel. A good arrangement adopted by our planing machine builder company is to vary the cutting speed from 20 to 40 feet per minute by gears and to keep a constant return of 72 feet per minute.

The power required for reversing a planing machine is so much greater than that ordinarily used in cutting metal that an increase in the latter, due to the use of high-speed steels, has not materially affected the driving power required. What is generally needed is not so much power as flywheel effect.

Some rather remarkable records have lately been made with twist drills of the new steel, but in Great Britain, rather than in America.

The cutting speed of the lip of an ordinary carbon-steel drill has usually been from 25 to 35 feet per minute. With the new drills these speeds have been more than doubled, with compounding increase of the feed and an even greater difference in the total number of inches drilled. This means a stiffer machine, more belt power, and the use of positively geared feeds.

The milling machine is beginning to feel the new influence, and both speeds and feeds are being increased, more particularly the latter. A feed of two or three inches per minute used to be considered good practice. To-day ten or even fifteen inches per minute are not excessive for the travel of the table.

Experience has shown that increasing the feed is more profitable than speeding up the cutter. The principal changes that are noticeable as a result of the new practice are a strengthening and stiffening of the support for the cutter arbor and a substitution of geared for belted feed motions.

It is to be noted, however, that the increase in power required with the new steels is not so great as the increase in output secured. There are numerous instances where the work done has been more than doubled,, while the power increase required has not been more than 50 per cent. The average consumption of power by carbon steels is usually 0.05 or 0.06 horse-power per pound of metal removed per hour, and the new steel will require only 0.03 or 0.04 horse-power.

The increasing use of electric motors is, or should be, a factor in the development of machine design. Except in a very few instances, however, little modification has been made in adapting machine tools to the new motive power. In most cases the change has meant a bracket cast or bolted to some convenient part of the frame and the connection of the motor by belt, gears or chain to the driving mechanism; in other words, merely substituting the motor for a countershaft.

At the present time there is no standard type of motor for such service, and most tool builders are advertising their willingness to adapt their machines in a tentative way to whatever motor the customer may elect.

In many shops the group system of driving is the more economical, and no modifications of the machines themselves are necessary. But even when its independent drive is decided upon, there is no unanimity of opinion as to how it shall be arranged. Some prefer the variable speed motor with a controller, some the smaller constant-speed motor with mechanical speed control, and some a combination of the two.

One designer uses belts, another gearing, and a third the silent chain; in fact, most builders advertise all three, leaving the burden of choice upon the buyer. Perhaps the general consensus of opinion is in favor of the constant-speed motor, as it is smaller and cheaper and can be run at a high speed.

On large machines, where a considerable range of speeds is economical, a combination of the two systems is desirable, using perhaps four to six speeds on the controller and multiplying these by the usual gearing. Some large lathes and boring mills have as many as 72 speeds obtained in this way.

It is evident to the unprejudiced observer, as he studies the various arrangements of motor drives shown in catalogues, that the machine tool builder and the electrician have not "got together" on this problem, and that in most instances the machine has not been adapted to the motor or the motor to the machine. There is some excuse for this in the fact that most manufacturers of machine tools build certain standard machines, which are to be sold to the trade and are to be driven, some in the old and some in the new way, and must consequently be adapted to either set of conditions.

The rapidly increasing use of electricity as a motive power will change all this, and every year more machines will be built for electric drives alone. We shall then see machine tools in which the motors will be an integral part of the design and the present loose and temporary relations will be replaced by a definite and permanent connection.

The Structure of High-Speed Steels.

THE ENGINEER, LONDON.

Although high-speed steels have sprung into popularity with surprising suddenness; although much has been written about their use and something about their manufacture, little has been heard as to the causes which give them their astonishing properties. We turn, therefore, with no small amount of interest to two papers which appear in the current "Bulletin de la Société d'Encouragement pour l'Industrie Nationale," one by Le Chatelier and the other by Osmond, which promise us some light on this subject. These gentlemen hold such an exalted position in the field of scientific metallurgy that we must give close attention to whatever they have to tell us.

It is, then, disappointing to find that the explanations they offer are only tentative, and, in Osmond's case, not even based on actual commercial high-speed steel, which he has not examined, but only on specimens of chrome and tungsten steels, which he assumes to possess the same nature. We are far from saying that he is not right in this assumption, since we can ask for no more capable judge of such matters; but it is impossible, when we remember the remarkable effect that minute quantities of certain ingredients have on alloys, not to regret that the examinations on which his theory is founded are not based on actual samples of such metals as are used daily in manufacturing works. However, leaving that to one side, the explanation Osmond has to offer is simple and up to a certain point convincing. No new theory he tells us is required, only a slight addition to that of the hardening of ordinary carbon steel. "To render the general theory of carbon steels immediately applicable, it is sufficient to take account of the fact that the separation of carbide during cooling and its corresponding solution during heating are rendered difficult by the presence of chromium, tungsten, or other substances." Hence the changes in the constitution take place slowly, and we need not adopt such a sudden method of arresting them at any particular stage as when we plunge ordinary carbon steel into water. It is sufficient to cool the tungsten steel slowly to obtain the same end. Put in another way, whereas we must use powder and shot to stop the hare, we may roll a ball fast enough to strike the tortoise. If such an explanation as this on further examination should be proved to hold good, it is entirely admirable for its simplicity. It, too, may be taken to explain the extraordinary fact that such steels cut well at temperatures which would soften ordinary tool steels. The reason the latter fail is that at the temperature reached the particular condition obtaining at the instant they were petrified by being suddenly chilled is destroyed; but with tungsten steels the brakes, so to speak, are hard on all the time. The change takes place slowly instead of rapidly, and, in place of the rapid softening at the edge which occurs with ordinary steel, a comparatively long period of subjection to the high temperature is necessary. This, combined with the fact that the changes do not occur until a fairly elevated temperature has been reached, gives us an explanation of why high-speed steels will cut at a dark red heat. Le Chatelier tells us that such steels will stand 500° to 600° C., "at least for a certain time," and that it requires the application of 700° for an hour to soften them completely. We may add to this that Osmond seems disposed to accept a suggestion of Le Chatelier's that the high temperature that must be reached to restore the qualities of tungsten steels is due to the fact that at this point "austenite transforms itself into martensite," and that hardening takes place instead of the softening to which one is habituated by ordinary carbon steels—a suggestive, if not a very satisfactory, explanation of their peculiar cutting properties.

Whilst Osmond has little or nothing to say about practical applications, Le Chatelier gives more attention to them than to questions of constitution. He urges, very rightly, a point which we believe has been thoroughly well grasped in this country, and which is testified to by the extraordinary success of British high-speed steels. It is, of course, the necessity for exactness, in manufacture—exactness in the apportionment of the ingredients and precision in the temperatures used in treatment, but he makes the curious reflection on the ease with which self-hardening steels are treated that it rather hinders progress, since that delicacy of manipulation, which he believes will some day be required when the highest duty is sought, is not now demanded. That is a point of view that will certainly not appeal to foremen and managers whose objection to the Taylor-White steel was that it could not be treated in their own shops, and whose preference for our English steels is that one may do pretty well what he wills with them, from not treating them at all to treating them badly, and they will still behave at least fairly well. We have ourselves subjected a well-known brand to such various tests as cooling in air, cooling in a blast, plunging in water from a high temperature, and hardening in oil, and it has not injured it, and we have taken a piece of the same steel from the centre of a square bar some six feet or seven feet long, ground it to an angle, and used without treatment at all; we have tried it wet and dry, and nearly red hot, and got equal results from it, and we think nearly all managers would agree with us that the ideal, from their point of view, is a steel of this order that they can hardly destroy by any treatment, and that can be used for any purpose. The former condition is nearly reached—the steel is not necessarily destroyed by bad treatment, but its highest results are not attained—but the latter is still far from attainment since no single steel is equally good for cast iron and steel. No brand, we believe we are right in saying, possibly with the exception of some drills, will do equally well on a casting as on a forging, on brittle cast iron as on ductile steel. That is a curious fact that would demand closer attention, if it were not that brands particularly suitable for each purpose are readily obtained.

The Practical Working of High-Speed Steels.

THOMAS BEASLEY, IN MODERN MACHINERY.

Since the introduction of high-speed steels there has been a great deal written and published on the subject, as there should be, for the discovery of this important adjunct to modern machine tools was a most important event, especially where mild steel of all descriptions, good, bad and indifferent, is used in so many different branches of trade as it is to-day, and seemingly crowding out iron, where formerly it was thought nothing else could be used for the purpose.

When mushet steel came on the market it was hailed with delight as the ideal tool for all purposes. It was a step far in advance of anything then thought of, but while for some purposes it is still good, it has practically lost its usefulness since the introduction of the "Blue Chip," "Air Novo" and other steels in this class.

The great trouble with mushet steel, when in operation, was the liability to burn and chip off and the extreme care required by the smith in working over worn-out tools or making new ones; also the great difference in hardness and ductility of different bars that came in the same shipment. I have not as yet found any such difference in either Blue Chip or Novo steel, and as far as the working in the fire is concerned, one piece works the same as the other and seemingly gives the same results when in operation.

I have done considerable experimenting in heating and working the above-mentioned steels, seemingly to good advantage, the results obtained being very satisfactory. As our high-speed tools have to cut and machine rails on switch and frog work, we encounter some tough customers at times, while on other jobs the cutting is as soft as would be the case with wrought iron. Such a varied class of work necessitates the very extreme of hardness, and while I had some difficulty for a time I finally obtained the desired hardness.

I found that the heating played an important part in this result. When the steel was heated rapidly up to a high heat the edge would not hold, but when heated to a white heat at a slow blast and then given a quick blast until it was as hot as it was possible to get it, the result was always satisfactory. The means I made use of to harden for extreme hardness was to heat the steel as hot as possible, dip the point in oil (linseed) just far enough back to cool quickly, and when the portion in the oil turned black I would transfer quickly to the air blast to cool. Where I had quenched the point entirely in the oil the heat was not always entirely the same through the tool (especially heavy ones like we use, 1½ x 2 inches), consequently, when this was the case, they would crack and be useless in service, until I hit upon the expedient of dipping only the portion that was the hottest and of the same temperature. Transferring to the air blast keeps the tool from drawing the hard point after the oil dip. It is necessary to be careful to use plenty of fuel and get as short heat on the tool as possible.

Probably the average machinist does not hail the introduction of this steel with the appreciation it deserves, simply because the machine does far more work in a given time than with tool or mushet steels, but speaking for the tool-smiths in general, nothing gave them more satisfaction than the banishment of mushet steel, for one could never put any dependence on the outcome when working over a mushet tool. Heat it and work it as you would, in many cases a failure was sure to be your reward; but with the advent of the new steel came the following instructions:

Heat it slowly, but heat it to a bright yellow, and you will find that you can forge it with a sledge or steam hammer; bend it, cut it, gouge it, in fact, do anything but break it, as long as the heat does not fall below a cherry red. Don't forge or work it below this heat, as this is the weak point and you will do the tool an injury; but the many good points will surely compensate for this one weak one.

Some smiths are foolish enough to believe that they stand in constant danger of overheating this steel if made too hot, but from my observations and practical experiments I find that it is out of the question to burn it or destroy the quality in an ordinary forge fire. While it is true that if heated too quickly the corners will waste slightly, the centre will stand intact after the fiercest heat. I once took a piece of this steel which had been forged from 1½ x 2 inches, to ¾ inch square, and heated as far as I possibly could, but this seemed to improve the durability and heat-resisting qualities. I made a drill from this same piece (Air Novo) and it drilled a hole through a hard gray casting at the highest speed at which the press could be run and showed no ill effects, burning or blunting of the cutting edge. Borax had no effect on this piece as it has on ordinary tool steel, for it laid on this steel like dust after the fire melting it; my efforts to weld it to a piece of iron with a V weld were futile. It is not weldable with borax for a flux.

This steel can be annealed by muffling in dry ashes, lime or charcoal dust. The latter gives the best results, but with it the steel is never soft enough to machine. If the edge will not stand and it seems to have lost its hardness, as all steels of this description will at times, have some leather scraps in a box or can (a double handful or more), heat your steel to a good yellow on the cutting point and cover the hot point with the leather scraps and allow to cool in this position. Repeat this process about four times and the tool will be restored.

In conclusion I will say that I think the usefulness and the varieties of purposes to which these steels can be put have not been fully tested as yet, and if they can ever be improved so that they can be machined, as tool steel can, and the cost placed within reason, the steel for all purposes will surely have been found. The ease with which it can be forged is the redeeming feature, and with a smith who is a close worker many tools can be fashioned close enough to dispense with the machining and be trued up on the emery wheel instead.

S.P.S. ANNUAL OUTING.

On Saturday, October 22nd, the School of Practical Science of Toronto University held their annual outing, this time going to Niagara Falls. A special Grand Trunk train carried the party, which numbered nearly 350, on such a time table that nearly twelve hours were available for sight-seeing. The morning was spent going over the works of the power companies on the Canadian side, where the party was met by representatives of the different companies, who explained the works under construction. In the afternoon the students broke up into four parties. One made further investigation on the ground covered in the morning; a second examined the construction of bridges; a third went down to Queenston, examining the geology of the region; while a fourth crossed the river and went through various plants in Niagara Falls, N.Y., including the Niagara Power Co., the Hydraulic Power Co., and the International Paper Co.

The committee having in hand the arrangements for the day were: Prof. C. H. C. Wright, E. A. James, C. H. Shirriff, Frank Barber, and J. E. Caldwell. These gentlemen are to be congratulated on the excellent programme which they arranged, and the splendid way in which it was carried out.

CATALOGUES RECEIVED.

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

Graham, Morton & Co., Limited, engineers and contractors, Hunslet, Leeds, Eng. Souvenir booklet containing photographs showing rapid construction of this firm's new engineering works, and a description of the same.

Kellogg Switchboard and Supply Co., Chicago. "Magneto Switchboards," a neat and well illustrated descriptive booklet of 100 pages.

John Morrow Machine Screw Co., Limited, Ingersoll, Ont. Revised catalogue of standard and special screws, etc.

August Mietz, New York. Catalogue of Mietz & Weiss gas and oil engines.

National Electric Co., Milwaukee. Bulletin 350, descriptive of air compressors for continuous and intermittent service.

Yale & Towne Mfg. Co., New York. Circulars descriptive of chain block exhibits at St. Louis Fair.

Joseph Dixon Crucible Co., Jersey City, N.J. Pamphlets, "Graphite as a Lubricant," "Oil vs. Grease," and "Dixon's Graphite Cup Greases."

Elmer P. Morris Co., New York. Catalogue of tubular poles and brackets for electric railways, lighting, telegraph, etc.

Sheldon & Sheldon, Galt, Ont. Bulletin 21, Hot Blast Heating Apparatus; also pamphlet descriptive of special fans designed for asbestus mines.

Browning Engineering Co., Cleveland, O. Catalogues of locomotive cranes.

Canadian Westinghouse Co., Hamilton. Circular 1,088, generators for three-wire direct current service.

Westinghouse Electric and Mfg. Co., Pittsburg, Pa. Circular 1,092, descriptive of multiple alternating arc lamp.

Sterling Electric Co., Lafayette, Ind. Catalogue of telephones and apparatus.

A. Leschen & Sons Rope Co., St. Louis, Mo. Illustrated booklet, "Wire Rope Tramways."

Jenckes Machine Co., Limited, Sherbrooke, Que. Booklet on Gold and Silver Milling. Bulletin 1,100.

Spaulding Print Paper Co., Boston, Mass. Circular about the Federal blue-printing machine, a continuous printing apparatus for making blue-prints by electric light.

Crane Co., Chicago. Special catalogue No. 100, pop safety valves, etc. Also folder illustrating globe and angle valves.

Allis-Chalmers Co., Milwaukee. "The Book of the Four Powers" is a very attractive and well-printed booklet describing in a connected way the products of the company in the realms of steam, gas, water, and electricity.

Pratt & Whitney Co., Hartford, Conn. Catalogue of small tools, with reference tables.

Niles-Bement-Pond Co., New York. "Horizontal Boring, Drilling and Milling Machines," illustrating the machines and the same at work.

Trussed Concrete Steel Co., Detroit, "Facts concerning the Kahn Trussed Bar," a booklet containing nearly 50 photographs of concrete constructions, and also of tests of the Kahn Bar.

Jeffrey Mfg. Co., Columbus, Ohio. Catalogue of Jeffrey "Century" rubber belt conveyors, also booklet illustrating grab buckets made by the same firm.

Norton Grinding Co., Worcester, Mass. Catalogue of plain cylindrical grinding machines for straight and taper work.

Waterous Engine Works Co., Brantford. Catalogue of the McEwen high speed automatic engine, with detailed description of construction.

Laidlaw-Dunn-Gordon Co., Cincinnati, Ohio. Bulletin L 601, catalogue of Meyer-gear pumping engines.

Hardie-Thompson Co., 110 Cannon St., London. Pamphlet, describing the Hardie-Thompson water-tube boiler, just being introduced on the market, the novel feature of which is independent water circulation in each tube.

Cunliffe & Croom, Ltd., Manchester. Brass Finishers' Machine Tools. An illustrated sheet giving list supplementary to catalogue.

Fairbanks Co., Toronto, Montreal, etc. Price list of Fairbanks Wood Split Pulleys.

Canadian General Electric Co., Toronto. Booklet, "Some Facts regarding Type H Transformers."

Garvin Machine Co., New York. "Special Machinery," a booklet containing condensed descriptions and reduced illustrations of over 100 special machines.

Newall Engineering Co., Warrington, Eng. Catalogue of measuring machines, micrometers, surface plates and other workshop gauges.

Smooth-On Mfg. Co., Jersey City, N.J. One hundred page catalogue of products of this company.

Canadian Rand Drill Co., Montreal. Coal Cutter catalogue. From the same company we have received a post-card cut in the shape of a compressed-air riveter, illustrating the latest "Imperial" tool.

Jenkins Bros., New York. Booklet entitled "Valve Troubles and How to Avoid Them." Besides suggestions such as indicated by the title, the book contains descriptions and illustrations of Jenkins' valves.

Diamond Saw & Stamping Works, Buffalo. A neat folding card containing price-list of Sterling Hack Saws.

Penn-Allen Portland Cement Co., Allentown, Pa. Booklet containing description of works, analyses of cement and testimonials of users.

North-West Machinery & Iron Co., Winnipeg. One hundred page catalogue of blacksmiths' and carriage-makers' tools and supplies.

Office Specialty Mfg. Co., Toronto. Folder, showing range of goods made by this company.

LITERARY NOTES.

The Street Railway Journal published a 360-page special number on October 8th, celebrating the completion of its twentieth year of publication. The number is taken up largely with historical articles. The development of street railways during the past twenty years, viewed from various aspects, is dealt with by contributors who are specialists in their respective lines. Interest for Canadian readers attaches to an article on "Electric Railway Work in America Prior to 1888," in which is described and illustrated the railway operated at Toronto Exhibition in 1884 and 1885, one of the earliest lines on the continent. Regular features of the journal are not neglected in this special number, and altogether it is an issue of great attractiveness and value.

Aluminothermics is the title of a lecture delivered by Dr. Hans Goldschmidt, of Essen-Ruhr, Germany, at McGill University, Montreal, on October 7th. The introduction of coal as fuel, and later the discovery of a new fire, the electric arc, have marked the onward strides of civilization. And now comes a new heat-producer—the use of aluminum by the thermit process. By this method great heat is obtained with a speed unattainable by any other process—5,400 deg. F. is reached in about one minute. The lecture explains the chemical reaction, and deals with many applications of the process, which were also explained at some length in the August number of the Canadian Engineer. Wm. Abbott, 334 St. James St., Montreal, is Dr. Goldschmidt's agent in Canada, from whom copies of the lecture may be had.

The Montreal Electrical Handbook is a neat book of 200 pages, descriptive of Montreal from the electrical standpoint, It is one of a series of ten books published in connection with the trip of the foreign delegates to the International and Electrical Congress in St. Louis, in September last. Though there was very little time in which to prepare the book, the articles are well written, and the whole is splendidly printed and illustrated. The articles are written by different contributors, each one an authority, and include a brief history of Montreal and district, and accounts of all the large electrical enterprises in that city, together with descriptions of Ottawa and of the Niagara region. The book is published under the auspices of the American Institute of Electrical Engineers.

The Michigan College of Mines Year Book, 1903-04, with announcement of courses for 1904-05, contains, besides information such as would be expected in such a publication, valuable maps of mine districts in northern Michigan. A list of graduates is also issued, giving present locations of alumni and information as to their employments since graduation. The college is at Houghton, Mich.

The University of Illinois engineering experiment station at Urbana, Ill., has issued its first bulletin under date September 1st. The experiment station was established a year ago, and is designed to carry on research work in problems of importance in engineering practice. The first issue deals with reinforced concrete beams. Exhaustive tests of various reinforcements were made, and the results are given in tables and charts. The report is prepared by Prof. Arthur N. Talbot, in charge of theoretical and applied mechanics.

Mines and Minerals, published at Scranton, Pa., issues a compact pocket directory containing a classified list of reliable manufacturers of and dealers in mining and milling machinery, supplies, etc. The directory is brought up-to-date twice a year, and is presented to subscribers of Mines and Minerals, and sold to others for the nominal sum of ten cents.

With the November number, the Technical World, of Chicago, dons a new and attractive dress, and we notice that it is now published by the Technical World Co., instead of the American School of Correspondence. Its leading article this month is The Making of the Panama Canal, by Waldon Fawcett. Among other articles of interest are, Modern Shop and Factory Lighting, Making a Talking Machine, and A Triumph of Metallurgy. The series of Great Technical Schools, which last month dealt with the University of Toronto, this month describes Perdue University. The characteristic departments of the magazine, such as Chalk Talks, Noon Hour Talks, and others, are continued in their usual happy vein.

The eighth volume of the Journal of the Mining Society of Nova Scotia contains the transactions of the society during the year 1903-4, and also publishes the papers presented to the society during the year. These deal with various topics, such as gold, coal and manganese mining, technical education, etc. Copies of the transactions may be obtained from the secretary, H. M. Wylde, at the society's rooms in Halifax.

The Department of the Interior has issued a book of cartoons advertising Western Canada as the granary of the Empire. One of the best hits in the book is a picture representing John Bull and Uncle Sam driving through the western country with only their heads visible above the grain, Uncle Sam remarking that the only drawback to the country is that "you can't see it for the wheat." Interspersed among the pictures are succinct statements of pertinent facts about the country.

Geo. A. Zeller, St. Louis, Mo., is the publisher of Spangenberg's Steam and Electrical Engineering in Questions and Answers. This is a reference book of over 600 pages, treating stationary and locomotive engineering, electricity, compressed air, mechanical refrigeration, gas and gasoline engines, hydraulic elevators, etc. It is edited by E. Spangenberg, M.E., Albert Uhl, A.I.E.E., and E. W. Pratt, all men of wide experience, the first two being connected with the St. Louis School of Engineering, and the last being master mechanic for one of the large railroads. The book is sent post-paid for $3.50, and the publisher announces that it is admitted free of duty into Canada.

The Opportunity of the Engineer is the title of the commencement address delivered at Thomas S. Clarkson Memorial School of Technology last June, by Francis N. Thorpe, Ph.D. The perusal of this address shows its author to be a man of clear intellect, deep thought, and a felicitous expression that would make any subject attractive. This address occupies nearly the whole of the July issue of the Clarkson Bulletin, issued by the school at Potsdam, N.Y.

The Steel Square Pocket Book, by Dwight L. Stoddard, New York: Industrial Publication Co., pp. 100, price 50c.

This book is, as its title indicates, a pocket book as regards size, and is a compendium of useful information for workers with the steel square. It is designed especially for the use of carpenters, and consists of over one hundred illustrations showing various uses of the square, together with just sufficient letter-press to make the illustration understood.

Reinforced Concrete. A. W. Buel and C. S. Hill. New York: The Engineering News Publishing Co., 12mo., pp. 430.

This book is intended for designing and constructing engineers following American practice, and governed by conditions which prevail in America. The first part of the book is devoted to methods of calculation, and is written by Mr. Buel, while the second and third parts, on representative structures and methods of construction, are written by Mr. Hill. The book deals with all varieties of construction in a thoroughly practical way, and yet with sufficient of the theoretical to establish the formulæ advanced. Illustrations in the form of diagrams and photographs abound throughout the book.

Manual for Engineers. Chas. E. Ferris, B.S., Professor of Mechanical Engineering, University of Tennessee, Knoxville, Tenn.; University Press.

This book is a companion of vest-pocket size for engineers and business men. It contains formulae and tables of general interest, together with a number of recipes and items of useful information. Handsome leather binding gives the book a very neat appearance.

DOMINION IRON AND STEEL CO.

At the annual meeting of the Dominion Iron & Steel Co., held last month at Montreal, the president, J. H. Plummer, spoke confidently of the outlook for both the steel rail and rod mill. The position of the company as to raw materials was better than supposed, as it had been found that the Lake Superior ore could be laid down at Sydney at very little greater cost than at Pittsburg, while European ore could be brought in as cheaply as to England. From the addresses of Frederic Nicholls and Graham Fraser, it was gathered that the whole production of the company's plant at Sydney in rails, billets and rods, could be sold in Canada and it might be decided later on to establish a mill to roll plates. The following is an extract from the report:—

"The chief source of supply is the company's mine on Belle Island, Newfoundland, known as the Wabana Mine. We shall take out this year about 315,000 tons, of which ore to the extent of 115,000 tons goes to Europe, where it has been sold at fair prices, and the balance to our own works at Sydney. There is a ready market for it in Europe, so that we can always dispose of our ore whenever that is found desirable. A new washing plant has been erected during the past spring and summer, consisting of two units, each capable of washing 100 tons of coal per hour. It is now practically complete and washing sufficient coal for two blast furnaces. While the plant is not yet doing the best work of which it is capable, coke made from washed coal is now exclusively used, and is found to be greatly improved in quality. I fully expect that as the men employed become more accustomed to the work still better results will be obtained. Five of the ten furnaces of the open hearth plant are in operation and doing fairly good work. The remaining furnaces are being carefully overhauled, and the additional gas producers needed to complete the plant are under construction. This mill is in good condition, and of sufficient capacity to roll all the ingots we are likely to produce in the ten open hearth furnaces. In order to get the best results, and a sufficient and prompt supply of blooms for the billet and rail mills, it is necessary to remodel and enlarge parts of the present heating furnaces. Plans for the work have been prepared and the necessary materials are on the ground or coming forward, so that the improvements may be completed by the time we are ready to operate the rail mill."

The old board of directors was re-elected, and Mr. Plummer was elected President, and Mr. Nicholls vice-president.

A REMEDY FOR FRAZIL ICE.

At the first autumn meeting of the Canadian Society of Civil Engineers, a paper by R. W. Leonard was read detailing some "experiments on loss of heat from iron pipes." The fact brought out in this paper is that water when only slightly warmed loses its heat much more slowly when exposed to currents of cold air or water than when made hot. The practical application of this fact is that by forming ice racks of hollow tubes and connecting these tubes with a heating system, a remedy is provided for troubles from frazil ice. This remedy is especially applicable where there is a high head of water.

After giving data and tables gathered from his experiments, the author says:

From the above data it is possible to calculate approximately the amount of warm water it is necessary to pump through the hollow bars of a rack protecting water wheels in order to prevent the accumulation of frazil thereon, as it is necessary to raise the temperature of such bars but a fraction of a degree to accomplish this end. The curves indicate that water slightly warmed loses its heat much less rapidly than hot water when exposed in a tube to a current of ice cold water. To illustrate the practicability of this idea the example of one of the units in the extension of the Hamilton Cataract Power, Light and Traction Co.'s plant, near St. Catharines, may be taken.

The data are as follows: Head of water, 267 feet. Capacity of turbine, 245 c. ft., per sec., delivered through steel penstock 6-ft. 6-in. diameter. Power of each turbine, 6,000-h.p. Rack is 18-ft. 6-in. wide with length of 16-ft. submerged at ordinary water level.

Thin iron pipe can be flattened to serve as bars spaced as desired, and connected top and bottom with headers to form sections of the rack suitable for the circulation of warm water under pressure from a pump. The water area through the rack may be arranged to allow of a current of 1½ feet, per second, thus corresponding with the conditions existing in the experiments quoted above. Now assume the water for warming the rack to be heated to 66 deg. and returned to the heater at a temperature of 35 deg. after being exposed to a current of 1½ feet per sec., in ice cold water. This loss of 31 deg. takes place in 4 min. from a 1-in. boiler tube from 1.6 lbs. of water = 50 B.T.U.'s from a surface of 1,463 sq. ft., or, say, 34 B.T.U.'s per sq. ft. in 4 min. or 510 B.T.U.'s from 1 sq. ft. per hour. The total pipe surface submerged in such a rack equals 695.3 sq. ft., therefore transmission of heat from whole rack per hour equals 354,603 B.T.U.'s.

Assume a boiler evaporating 9 lbs., water from and at 212 deg. F. per lb., coal or yielding 8,694, B.T.U.'s per lb., coal (latent heat 966 B.T.U.'s.) Therefore, the coal required per hour to warm water equals 41 lbs., requiring a grate area of 5 sq. ft. (with 8 lbs. coal burned per hour per sq. ft. grate area), or a boiler of 15-h.p. The quantity of water to be heated may be arrived at as follows: 1.6 lbs., water loses 31 temp., in 4 min., or at the rate of 290 B.T.U.'s per hour. Total loss from rack (as above), 354,603 B.T.U.'s requiring a circulation of 1,223 lbs., per hour or 122 gallons, or little over two gallons per minute. In order to avoid difficulties caused by the freezing of the water in the bars of the rack when the heating system is not being used, it would be desirable to use some fluid which freezes only at a very low temperature. It would appear that the same principle can be economically used to prevent the accumulation of frazil on other hydraulic machinery, such as water wheel casings, etc. It will be apparent to the reader that with a lower head of water and a corresponding increased volume, the circulation of a proportionately larger quantity of warm water would be necessary in order to effect the purpose desired, and there comes a point at which the object attained is not worth the expenditure of fuel necessary for the purpose.

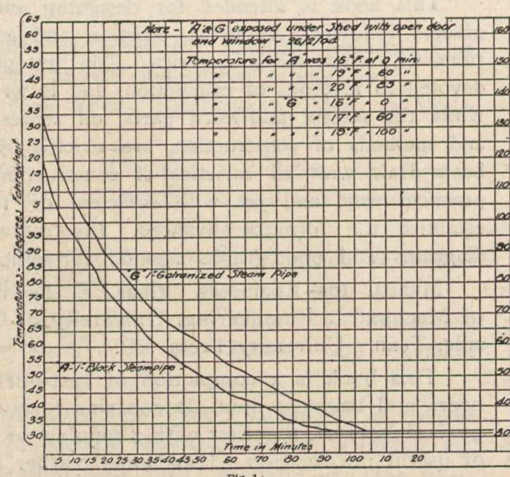


Fig. 1.

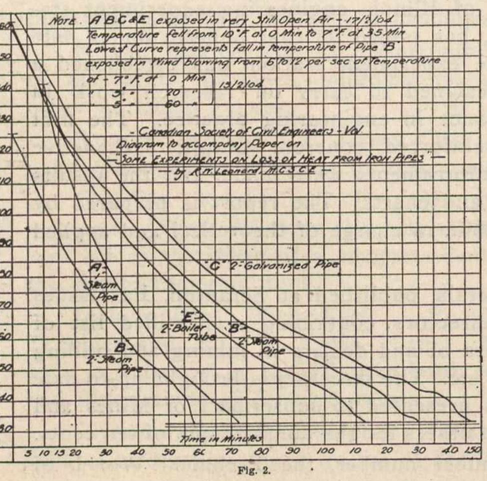


Fig. 2.

BOILER SCALE AND THE SUNNYSIDE CASE.

Editor Canadian Engineer:—

Sir,—Please correct an incomplete print of my letter in October issue, concerning the analysis of scale in the boiler which exploded recently at Sunnyside. The following is the complete analysis:

	No. 1. Sunnyside, Humber Bay Feed.	No. 2. Toronto Water.	No. 3. Toronto Water, B. Comp Used.	No. 4. Artesian Well.
Oil	0.40	0.00	0.00	9.03
Organic matter and water of combination	7.79	10.58	3.62	0.44
Carb. of lime	57.55	52.02	72.86	74.96
Sulphate of lime	4.87	9.29	0.51	0.20
Carb. of magnesia	0.00	1.22	8.97	6.61
Magnesia	19.72	13.81	7.03	3.40
Oxide of iron and alumina	2.94	3.12	3.42	1.65
Salt	0.00	0.00	0.07	Trace.
Silica	5.59	9.96	3.52	3.71
Undetermined	1.14	0.00	0.00	0.00
	100.00	100.00	100.00	100.00

THE "HARRIS-ANDERSON" PATENT FEED-WATER PURIFIER.

In modern power installations the importance of the complete removal of oil from the condensed steam that has to be used over again as feed-water is fully recognized by engineers who have any regard for the safe and economical working of their boilers, and efforts have for long been made, with varying success, to effect this much-desired result.

Steam separators and mechanical filters, while they are a step in the right direction, have not of themselves been found to completely overcome the difficulty of extracting the finest particles of oil from the water.

It is claimed for the Harris-Anderson apparatus, which we illustrate, that it affords a complete solution of the problem in a very simple and ingenious way, and working automatically, it effects the removal of all oil, whether free or emulsified, and leaves the feed-water brilliantly clear and in every way fit for boiler use.

The removal of the free oil in feed-water can be more or less effected by many filtering devices: it is the extraction of the finely-divided or emulsified particles, too small to be retained by any filtering medium, which has hitherto presented an insuperable difficulty. The difficulty has, however, been overcome at last by the Harris-Anderson system, which, speaking broadly, consists in the formation of a precipitate in the water, which envelops the particles of oil, rendering them capable of removal by filtration.

The formation of this precipitate is effected by the addition to the water of minute quantities of two mutually interacting reagents, quite innocuous to the boiler plates or fittings. The reagents are supplied to the machine in a solid form, and in any convenient quantity, while the machine supplies them to the water in the exact proportion desired, independently of any variation in the quantity of water passing through the apparatus. Thus, all need for weighing out, dissolving, and regulating the reagents on the part of an attendant is dispensed with. The principle upon which the machine supplies the reagents to the water in the required proportions, and independently of any change in the rate of flow, is as follows:

Two small equal fractions, usually 1 per cent., are taken from the total quantity of water, and are passed to two cylinders called "solutioners," where they are charged respectively with the reagents, and are converted into solutions of any desired strength. These solutions are then returned to the main body of the water.

The apparatus for parting off these fractions from the water is called the distributor, and is shown in Fig. 1. It consists of a Turbine B, into the upper part of which the water from the condenser is led, and from which it is discharged by the nozzles E into an annular trough formed between F and A. As the turbine revolves, the stream of water from each nozzle is delivered uniformly over the annular trough, and therefore the total water is evenly distributed over its surface.

In order to divide the fractional parts from the total water in the desired proportions, radial partitions are provided in the annular trough, forming the compartments H and J, each of which measures at the circumference 1 per cent. of the total circumference of the annular space. It is evident, therefore, that these radial compartments will each withdraw 1 per cent. of the total amount of water passing from the turbine, no matter what the quantity flowing may be.

The construction of the turbine is very simple, and the means adopted to reduce friction are ingenious and effective. As will be seen on reference to the figure, the revolving part B C of the distributor works round a central vertical spindle M, and is guided on ball-bearings on top and bottom. It also floats in the water contained in the vessel F, so that any friction there may be is reduced; indeed, it is so slight that a very small flow of water is sufficient to keep the apparatus working. The water, which is divided off from the main body by the two radial pockets H and I, is led away by pipes to the two solutioners, while the remainder of the water passes away through the pipes K and L to a mixing vessel mentioned hereafter.

The solutioners are fed, as before stated, with the solid reagents, which are dissolved up by the water led from the small pockets of the distributor. The two reagents—sulphate of alumina and carbonate of soda—are placed separately in a gauge container at the top of each solutioner, as shown at R, Fig. 5. The bottoms of these containers dip about two inches in the water, and as the reagent is gradually dissolved away at the bottom, that above takes its place until the whole is dissolved. The water taken from each pocket of the distributor is made into a solution of any desired strength by a very simple automatic arrangement, depending upon the balancing of a column of solution by a definite and adjustable column of water. The strength of the solution is independent, both of the amount of water passing through the apparatus, and of the amount of solid

Fig. 3.

Fig. 4.

Fig. 5.

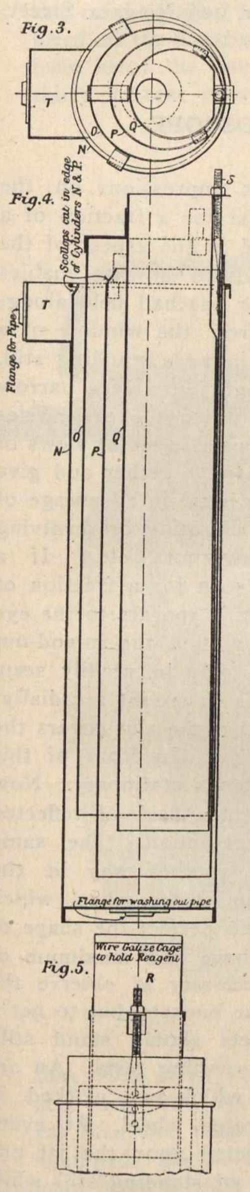


Fig. 6.

Fig. 1

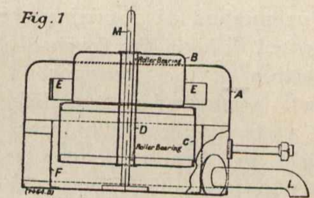
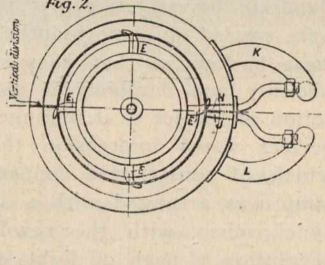


Fig. 2.



reagent present, and only depends upon the setting of the apparatus. The solutioner contains no valves, and requires no attention beyond the first adjustment. Their action can, perhaps, be better described by reference to Fig. 5. The solutioner consists of four cylindrical vessels, which fit one within the other, as shown. The gauze wire container, into which the reagent is put, is shown at R, the bottom of it being about two inches below the level of the scallop at top of cylinder N, Fig. 4. The water which comes from one of the pockets in the distributor is led by a pipe into the space between the cylinders P and Q. The water passes down the space between P and Q, and fills up the whole of the apparatus to the level of the scallop at top of N, dissolving the reagent, and forming a strong solution. The water which continues to flow down between the cylinders P and Q meets the strong solution descending from the cage, at the bottom of the apparatus, and carries it into the outlet space between N and O, and away over the scallop into the receiver T. This outer space then contains a column of solution, which is balanced by the column of water in the space between P and Q. This column of water must be longer than the column of solution, so that as the solution increases in strength the level of the water in the space between P and Q rises. When the outflowing solution attains a certain strength, water overflows at the scallop at the top of cylinder P, passes down the space between O and P, mixes with the solution at the bottom of the outlet space, and prevents it from getting any stronger. The amount of water flowing over this inner scallop automatically adjusts itself to keep the solution at constant strength, which can be regulated to a nicety by the screw shown at S, which raises or lowers the cylinder P, thus increasing or diminishing the difference in the head of water flowing over the scallop on N and the scallop on P. So delicate is the adjustment possible that any required degree of strength can be given to the solution flowing over the scallop on N, and this strength will be maintained so long as the reagent lasts, no matter what the variation may be in the quantity of water flowing through the solutioner; and the apparatus requires no attention whatever, except the occasional addition of reagent to the gauze basket.

Thus the machine supplies to the water, automatically and continuously, the exact amounts of the two reagents required per 1,000 gallons, whatever be the actual quantity of water passing. This is of special importance when the load is very variable, as in electric light stations.

The water, after the addition of the solutions, made as described, is passed through a treatment vessel in which the reagents act upon one another, and thus render the oil filterable. This reaction is very rapid, taking place in some two minutes. The water is made to traverse a definite path by means of deflection plates, so as to insure its being subjected to treatment for a sufficient time for the reaction to become complete. In this way the water is continually entering the apparatus at one end and passing out at the other.

After this treatment the water is found to have lost its milky appearance, the individual particles of oil, which could not previously be distinguished by the eye, having become entangled with the precipitate, forming visible masses readily capable of filtration. From the treatment vessel the water passes to the primary filter, a detail of which is not shown. This filter is constructed in sections working in parallel, each section arranged to be isolated and cleansed by a reverse stream of water, while the others continue to do duty. In these the coarser particles of the oil are removed.

From the primary filters the water passes to a small collecting tank, whence it is conducted to the filter proper.

In order to show pictorially the results of this process, as compared with mechanical filtration alone, we reproduce four photographs, which speak for themselves. The first shows water taken straight from the condenser; the second, the same water after careful mechanical filtration; the third, the same water purified by the Harris-Anderson system; and the fourth, for the sake of comparison, a similar bottle of pure distilled water.

After the completion of the process, the only residue in the water is a minute trace of soda salts, which, of course, have no harmful action on the boiler, but which tend, if anything, to prevent the formation of scale. The cost of the reagents seldom exceeds, and is usually less than one cent. per 1,000 gallons of water treated.

The Harris-Anderson apparatus is now in constant use at a large number of power stations in Great Britain, with excellent results obtained from an extended experience, and an installation of this machine can now be seen at work at the factory of Messrs. Pugsley, Dingman & Co., Toronto Junction, makers of Comfort Soap. Here the machine is treating 500 gallons of water per hour, which is the condensed exhaust of the main engine and several large pumps, and contains a large quantity of emulsified oil. This used to be run to waste into the sewers, but now passes through the purifier, and, after the removal of the oil, is fed to the boilers, and, being already at a temperature of 160 deg. Fahr. before going to the heater, represents a considerable economy. It is besides pure distilled water, containing no scale-forming properties. Examination of the boilers after only fifteen days' working showed a considerable reduction of scale on the heating surfaces and no traces of oil in the boiler.

Arrangements to inspect this plant can be made by communicating with John T. Webster, 109 Niagara Street, Toronto, agent for the purifier for Canada.

USE OF THE STROBOSCOPE.

It is a peculiarity of vision that impressions on the retina do not fade instantly but persist for a fraction of a second after a change has taken place in the aspect of the object viewed. This persistence of vision is what enables a fairly good view of a fair ground or baseball field alongside of a railroad track to be seen from the window of a rapidly-moving train, when, if the train were standing still, all that could be seen would be a high fence with narrow cracks between the vertical boards. When the car carries one by the fence rapidly the eye receives a series of views of the field through the cracks, which blend together and give the panorama effect. This peculiarity is taken advantage of in investigating the action of certain vibrating or revolving mechanisms like engine flywheel governors, etc. If a rapidly-running flywheel governor is seen for a fraction of a second at one spot at every rotation, it appears to the eye to stand in space and under that condition the in-and-out movements caused by changing load, may be readily seen. One method of obtaining this effect is to mount a radially-slotted disk on the flywheel shaft so that the slot covers the portion of the governor to be watched. In front of this disk is another slotted disk which stands stationary. Now if a strong light illuminates the object a flash of reflected light will reach the eye at every revolution. The same stroboscope effect was obtained in another way in the elaborate investigations of the Pelton water wheel which were carried on some months ago. To perfect the shape of these buckets so that they should have the maximum of efficiency and durability it seemed necessary to observe the action of the jet as it impinged on the buckets, but to get a perfect visual impression the buckets should stand still, which, of course, was impossible in running tests. An arc lamp was arranged with a shutter, which was worked in synchronism with the revolving water wheel. At every revolution a flash of light was directed upon the jet and buckets, giving them the impression of standing still while the water entered the buckets and flowed out at the sides. With the same apparatus instantaneous photographs of the jet and buckets were taken.—Machinery.

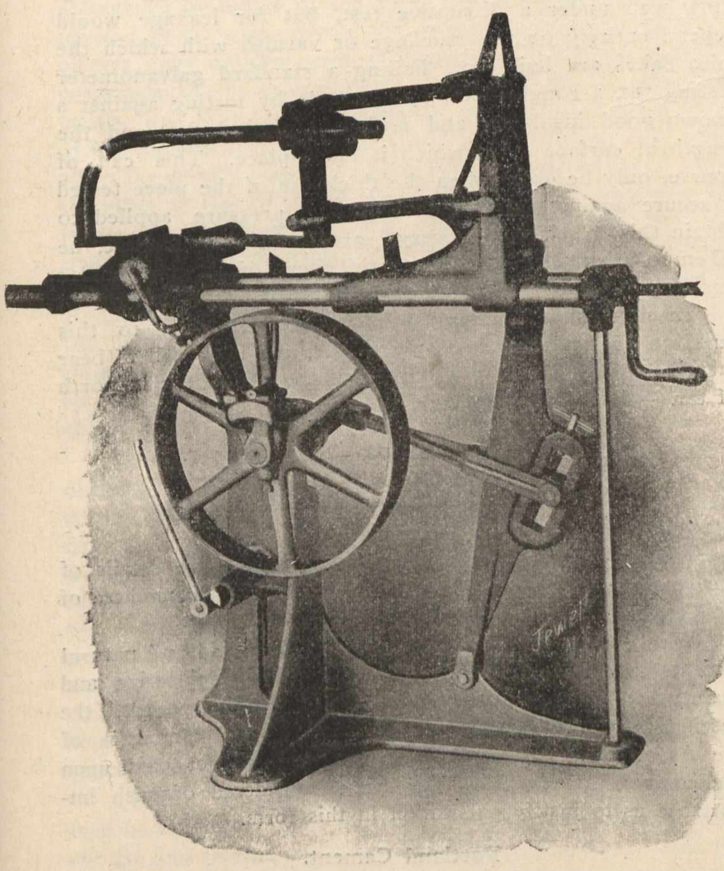
Henry Disston & Sons, Philadelphia, manufacturers of saws, files, etc., are locating a factory in Hamilton.

H. M. Whitney, the Boston millionaire, has purchased the asbestus mines at Thetford, Que., from the King estate. The purchase price is said to be $125,000. The asbestus mines will be worked on a large scale.

THE FAIRBANKS POWER HACK SAW.

The accompanying cut represents the Fairbanks Power Hack Saw, which is being manufactured and sold by the Fairbanks Co., throughout Canada. This saw was designed for the purpose of combining speed, accuracy, durability and economy, and the results obtained in each particular enable the makers to claim that it is superior to any machine on the market. Several of these saws have been placed in large manufactories throughout Canada, and to thoroughly appreciate the value of this machine it must be seen in operation. It is of interest to the shop-owner because it is durable, saves saws, and increases the output, while its simplicity and convenience please the operator. Although it has advantages lacking in other makes of saws, the cost is about the same.

The Fairbanks Power Hack Saw has been built to satisfy the demand for a reliable and economical saw. It is constructed on correct mechanical principles, for longest wear, and to obtain the best and greatest amount of service from hack saw blades. It is a compact and self-contained machine of a high grade, using saws from 9 to 14 inches long, though especially intended for blades up to 12 inches in length. It does the cutting on the pulling stroke, with weight of saw frame and levers lifted off the blade on its forward or idle stroke. This arrangement keeps the saw blade sharp longer, and enables it to do thirty per cent. more work than machines of ordinary construc-

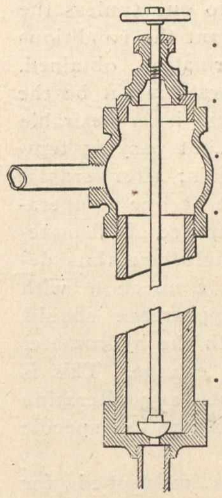


tion. One of its valuable features is the spring tension, which acts on the saw frame, and is much more effective and convenient than the weights with which hack saws are ordinarily equipped. The connection from the pulling end of saw blade to main lever is rigid. The steel overhanging saw arm gives a constant tension to the blade, and facilitates the quick insertion of blades or changing for different lengths. The stroke of the saw blade is readily changed while the machine is in motion, thus utilizing the full length of the blade for effective work. The stroke may be varied from 6¼ inches to 8 inches to suit the size of work being cut. It has means for adjusting the saw blade to make it cut straight or squarely through a piece of stock, even when the blade has more clearance, or is duller on one side than the other. It has a driving clutch that locks the crank to the driving pulley, without end friction on the bearings with its consequent loss of power. It is provided with an adjustable automatic stop that will always stop the machine when the cut is finished. The stop may be quickly set to stop the machine when the saw has cut partly through a piece, and it will operate positively to within 1-32-inch from the point where it is desired to end the cut. The machine is so quickly and yet so easily handled that it is almost impossible for even a careless operator to pinch or jam his hand in operating it, a fault very common with many of the machines on the market. Further information will be furnished by the Fairbanks Co., Montreal, or by any of its branch houses.

A HOME-MADE STEAM TRAP.

At the recent meeting of the New England Cotton Manufacturers' Association, Thomas H. Smith described, as follows, a home-made steam trap which he had invented:

"It consists of three feet of two-inch pipe with a cap on the top, and the stem and gland of a ¼-inch valve inserted in the top. That stem is attached to a brass rod 5-16-in inch diameter. On the bottom of the rod is a little hemispherical piece of packing, which is sufficiently hard to resist the action of steam. If you get anything softer than this, the steam will melt away. The ratio of expansion of brass and iron is practically as three is to two; that is, you will have three points of expansion in brass to two in iron. Steam at 50 pounds' pressure contains 297 degrees of temperature. Taking 200 degrees as the difference between the inlet steam and the outlet water, a 30-inch trap gives nearly 1-32 inch in expansion, which is sufficient to drain the trap. I have noticed that this trap has one advantage—the trap is open when it is empty. That should be the case with all traps, so that when the steam is turned on the water will drain out of the pipes, and the pipes can also drain themselves after the steam is turned roff. Turn the steam on, and the water will come out of the half-inch pipe and fill the pipe at a low pressure. As soon as the steam begins to come, the rod will close the valve entirely. After that it will open itself slightly and allow the water to trickle out in a hot stream. With this little valve arrangement at the top, you can set it so that more or less steam may pass."



Home-made Steam Trap.

ON INSULATION.

(Concluded from October issue.)

5. That insulators of any description should have a high insulation per mil of thickness is a very important matter, especially in generators and motors, when looked at from the "space factor" point of view. It is surprising what a large percentage of the available winding space is taken up by insulation in generators and motors, more especially in high-tension alternating-current work.

Having considered in detail the points of good insulation, it remains to consider what tests can be conveniently made with a view to securing a many good points in the insulation used, always bearing in mind that electrical tests are by far the most convenient in a manufacturing works, which is generally far from being a chemical laboratory. Particulars of tests as published by manufacturers of insulation are at times misleading, as frequently it is not stated whether the breakdown voltage was with continuous current or alternating current, and if the latter, whether the value is R.M.S. or maximum. Further, some manufacturers test between terminals shaped hemispherically and others between two flat discs. Again, some only test for an instant at the voltage named, merely bringing the voltage up and down again. It is possible, therefore, for the material to break down under a much lower voltage even if only sustained for a short time. Information of this description is of no use to the designer; that will readily be understood. Consequently some systematic way of testing all insulating materials is required. This need only be "thorough" on first testing a new material, as there will be probably many evidences visible on mere inspection which would lead one to expect changes in the material. Subsequently a far less pretentious test will be all that is required to ensure repeat orders of material being satisfactory. As the best means for obtaining high pressures, and also of varying the pressure, is by means of alternating current; this, of course, should be used. It must be noted that varying periodicity would give varying results; also, that the shape of E.M.F. curve affects the results in the same way, a peaky curve being more apt to break down the insulation than a flat curve, though both may have the same R.M.S. value. An alternator giving fifty periods and approximately a sine curve of E.M.F. would be suitable, and would correspond somewhat to prevailing practice in alternating-current work in England. A variable-ratio transformer is practically indispensable for obtaining the varied voltages required to test the different classes of insulators. Though it may be possible at times to use one of two machines for testing purposes, it is preferable to stick to one (unless the machines are identical), as the more constant the conditions of testing the more reliable is the information obtained. The larger the works and the more elaborate might be the testing, but however simple the apparatus, it is desirable to pressure test all insulating papers, etc., at varying temperatures on first testing unknown materials; afterwards it would probably only be necessary to test at one temperature, supervision being kept over the appearance of all materials, as variations from the standard article are thus detected. Supervision is most essential in connection with varnishes and paints, and attention to appearance should, if possible, be supplemented by testing with the hydrometer to see that the specific gravity does not change. This is partly a check on its chemical constituents, any alteration in chemical composition generally affecting its specific gravity.

Taking tests for the specific points mentioned for insulating materials in the foregoing in the order named, we have for paints and varnishes:

1. Quick Drying.—This is merely a matter for trial, and can be done either in the open air or in a drying-stove, as desired.

2. Elastic Strength.—This may be tested by coating a piece of presspahn, tin or copper (metal for preference), and when dry bending backwards and forwards. An electrical test can also be made after the bending to see if this has affected the insulating material.

3. High Melting Point.—First dry off the liquid components and then heat the residue, and see at what temperature it melts. If the drying was done in a thin layer, it would also be possible to note when it commenced to char.

4. Affecting Copper.—Copper strips may be coated and examined after an interval (which is practically working conditions), but a quicker way is to put copper filings into a quantity of the varnish. They will readily show if the varnish will in any way affect the copper.

5. Waterproof, etc.—The varnish or paint could be tested on some plant about the works, where there is generally some motor or other running under adverse circumstances as regards oil, etc. A test might be made of a piece of metal left exposed to the elements for some considerable time.

6. This we will deal with later, along with 4 and 5 for fibres, etc.

Taking now fibres, papers, etc., we find—

1. Pliability.—This is, of course, purely a matter of trial.

2. Creasing.—A good test to subject the material to is to make two creases crossing each other. This is likely to be as severe as anything short of an actual tear.

3. Non-Hygroscopic.—This might be tested by immersing all samples systematically for a short time in water and then testing for breakdown after drying the surface.

The tests for 4 and 5 for fibres, papers, etc., and for 6 in varnishes and paints, can conveniently be made in a felt-lined box, heated by either lamps or a resistance frame, the latter for preference if the higher temperatures are desired. If a thermometer be fixed projecting into the box, the desired temperature is easily noted, and can be regulated by varying the current through the resistance. The box should be fitted with two terminals about 1½ in. in diameter, the flat surfaces having the sharp edge rounded off to prevent excess of pressure at these points. If one of the terminals be fitted with a flat spring, a fairly uniform pressure will be secured, as the thickness of the samples tested does not vary within very wide limits. Ordinary instruments would be necessary for reading current and voltage, the ammeter indicating at once the breakdown of any specimen under test. It is the systematic recording and making of these electrical tests that enable the designer to make the most of the materials at his disposal. They also, as previously noted, keep the materials used up to sample, and, therefore, more reliance can be placed on the work of the various departments. One point remains to be emphasized in pressure tests, and that is that the breakdown strength is not proportional to thickness, especially in the case of fibres and such like materials which are built up in layers. It would appear very difficult to get rid of moisture in the thicker sheets, and this brings down the insulating strength.

A very important test which should not be overlooked is the galvanometer test for leakage, as some materials may be good against piercing and yet be bad from a leakage point of view. Take mica-paper for instance. This, if the mica is well laid—that is, with all joints well lapped—will show well under a disruptive test, but for leakage would depend entirely on the mucilage or varnish with which the mica flakes are built up. Failing a standard galvanometer testing set, a rough test may be made by testing against a known good insulator, and noting the discharge and the length of surface over which it takes place. This can, of course, only be done when the thickness of the piece tested is secure against breakdown from the pressure applied to obtain this discharge. Every care should, of course, be taken to accurately gauge the thickness of material under test, especially at the point of breakdown.

In conclusion, it may be said that attention to this question of insulation is amply repaid, and it is well to bear in mind that it is not well "to spoil the ship for a ha'porth of tar."—Electrical Engineer, London.

CEMENT SPECIFICATIONS.

The Canadian Engineer for March, 1902, gave details of standard Portland cement tests as prepared by a committee of the Canadian Society of Civil Engineers.

We here give the specifications for Portland and natural cements adopted by the American Railway Engineering and Maintenance-of-Way Association. There is also appended the specifications for concrete as submitted by the committee of the Association. Though the convention did not pass upon the concrete specifications, they were considered of such importance as to justify publication in this form.

Portland Cement.

Portland cement is a product of the mixture of clay and lime-carbonate in definite proportions, calcinated at a high temperature and reduced to a fine powder. Cement shall be packed in well-made wooden barrels lined with paper, or in strong cotton or paper sacks. Each package shall be plainly marked with the brand and name of the manufacturer, and the net weights shall be exact and uniform. One barrel shall contain not less than 376 pounds of cement, and four sacks shall be equivalent in weight to one barrel. All cement shall be delivered in sound packages, undamaged by moisture or other causes. Cement must be stored, until used, in a perfectly dry place in such manner as will ensure it from all damage. All cement failing to meet the requirements of the specifications may be rejected, and all rejected cement, whether damaged or rejected for other causes, shall be removed at once from the company's property.

All cement shall be subjected to the following tests: (1) The selection of the sample for testing, the number of packages sampled, and the quantity taken from each package, must be left to the discretion of the engineer, but each sample should be a fair average of the contents of the package from which it is taken. At least one barrel in every ten should be sampled. (2) Cement in barrels should be sampled through a hole made in the centre of one of the staves, midway between the heads, or in the head, by means of an auger or sampling iron similar to that used by sugar inspectors. If in bags, it should be taken from surface to centre. (3) All samples should be passed through a sieve having twenty meshes per linear inch in order to break up lumps and remove foreign material. For determining the characteristics of a carload of cement the individual samples may be mixed and the average tested; where time will permit, however, each sample will be tested separately.

Not less than 94 per cent. of the cement tested shall pass through a No. 100 standard sieve. The standard sieve shall be circular, about 20 cm. (7.87 ins.) in diameter, 6 cm. (2.36 ins.) high, and provided with a pan 5 cm. (1.97 ins.) deep and a cover. The wire cloth in the sieve to be woven (not twilled) from brass wire having a diameter of 0.0045 ins. This cloth to be mounted in the frame without distortion; the mesh should be regular in spacing, and for a No. 100 sieve shall contain not less than 96 nor more than 100 meshes per linear inch. The cement to be thus tested shall be thoroughly dried at a temperature of 100 C. (212 degrees Fahr.) before sieving.

Set.—(1) Initial set shall not occur in less than thirty (30) minutes. (2) Final set shall not occur in less than one hour nor more than ten hours. (3) The time of setting shall be determined by means of the Vicat needle apparatus, as recommended by the committee of the American Society of Civil Engineers upon uniform tests of cement in conjunction with the committee of the International Association for Testing Materials. (4) Using a paste composed of neat cement and water, of normal consistency, the initial set is said to have commenced when the needle ceases to pass a point 5 mm. (0.20-in.) above the upper service of the glass plate in the Vicat apparatus, and is said to have terminated the moment the needle does not sink visibly into the mass. (5) The paste is of normal consistency when the cylinder of the Vicat apparatus penetrates to a point in the mass 10 mm. (0.39-in.) below the top of the ring. (6) The amount of water required to make a paste of normal consistency varies with different cements, but will be found to be approximately 20 per cent. of the weight of the cement. It should have a temperature of 70 degrees Fahrenheit.

Soundness.—(1) A pat of neat cement 2½ to 3 inches in diameter, ½-inch thick at centre, tapering to a thin edge, and allowed to take its final set in moist air, must withstand indefinite exposure in water or air at any ordinary temperature without checking, distortion or softening. (2) A pat of neat cement, as above, placed in water, which shall be slowly raised to the boiling point and then maintained in that condition for three hours and allowed to cool gradually, shall not show any signs of checking, distortion or softening. The same result should follow exposure to steam not under pressure for three hours. This test may or may not be cause for rejection, at the option of the engineer in charge.

Tensile Strength.—(1) The briquette used in testing shall be formed in moulds of the size and form now in customary use and recommended by the American Society of Civil Engineers, the stress to be applied at a uniform rate of 600 pounds per minute until fractured. (2) All briquettes of neat cement are to be made from paste of normal consistency in the following manner: The moulds shall be filled with the paste as soon as it is thoroughly mixed and tempered, the material pressed in firmly with the fingers and smoothed off with a trowel without ramming; the material should be heaped up on the upper surface of the mould, and in smoothing off the trowel should be drawn over the mould in such a manner as to exert a moderate pressure upon the excess material. The mould should then be turned over and the operation repeated upon the other side. (3) Briquettes for twenty-four-hour tests shall be allowed to set twenty-four hours in moist air. (4) Briquettes for seven and twenty-eight day tests shall be allowed to set one day in moist air and remainder of period in water. (5) All briquettes are to remain in the water until they are placed in the testing machine, except in the case of twenty-four-hour tests. (6) Neat twenty-four-hour tests shall not show less than 125 pounds per square inch. Neat seven-day tests shall not show less than 400 pounds per square inch. Neat twenty-eight-day tests shall not show less than 500 pounds per square inch, and should show at least 10 per cent. increase above the seven-day test.

The specific gravity, determined upon dried cement which has passed through a No. 100 sieve, shall not be less than 3.10 nor more than 3.30. The specific gravity can be conveniently and accurately determined by the use of Le Chatelier's apparatus, as recommended by the committee on uniform tests of cements. Chemical analyses should show not more than 5 per cent. of magnesia, nor more than 1.75 per cent. of sulphuric anhydride. If in the tests of any given brand of cement any sudden, irregular or wide variation from its normal action is found, it should be withheld from use until more extended tests shall have demonstrated its reliability.

Natural Cement.

Natural cement is a product formed of calcinated limestone containing clay and carbonate of magnesia reduced to a fine powder. Cement should be packed in well-made wooden barrels lined with paper, or in strong jute or paper sacks. Each package shall be plainly marked with the brand and name of the manufacturer, and the net weights shall be exact and uniform. One barrel shall contain not less than 300 pounds of cement. (West of the Alleghany Mountains this may be 265 pounds.) Three paper sacks of cement shall be equivalent in weight to one barrel. All cement shall be delivered in sound packages, undamaged by moisture or other causes. Cement must be stored until used in a perfectly dry place in such manner as will ensure it from all damage. All cement failing to meet the requirements of the specifications may be rejected, and all rejected cement, whether damaged or rejected for other causes, shall be removed at once from the company's property. All cement shall be subject to the following tests:

Test Sampling.—(1) The selection of the sample for testing, the number of packages sampled, and the quantity taken from each package, must be left to the discretion of the engineer, but each sample should be a fair average of the contents of the package from which it is taken. At least one barrel in every ten should be sampled. (2) Cement in barrels should be sampled through a hole made in the centre of the staves, midway between the heads, or in the head, by means of an auger or sampling iron similar to that used by sugar inspectors. If in bags, it should be taken from surface to centre. (3) All samples should be passed through a sieve having twenty meshes per linear inch in order to break up lumps and remove foreign material. For determining the characteristics of a carload of cement the individual samples may be mixed and the average tested; where time will permit, however, each sample shall be tested separately.

Fineness.—Not less than 80 per cent. of the cement tested shall pass through a No. 100 standard sieve. The standard sieve shall be circular, about 20 cm. (7.87 ins.) in diameter, 6 cm. (2.36 ins.) high, and provided with a pan 5 cm. (1.97 ins.) deep and a cover. The wire cloth in the sieve to be woven (not twilled) from brass wire having a diameter of 0.0045 ins. This cloth to be mounted in the frame without distortion; the mesh should be regular in spacing and for a No. 100 sieve shall contain not less than 96 nor more than 100 meshes per linear inch. The cement to be thus tested shall be thoroughly dried at a temperature of 100 C. (212 degrees Fahr.) before sieving.

Set.—Initial set shall not occur in less than twenty (20) minutes. (2) Final set shall not occur in less than forty-five (45) minutes nor more than four (4) hours. (3) The time of setting shall be determined by means of the Vicat needle apparatus, as recommended by the Committee of the American Society of Civil Engineers upon uniform tests of cement in conjunction with the Committee of the International Association for Testing Material. (4) Using a paste composed of neat cement and water, of normal consistency, the initial set is said to have commenced when the needle ceases to pass a point 5 mm. (0.20 ins.) above the upper surface of the glass plate in the Vicat apparatus, and is said to have terminated the moment the needle does not sink visibly into the mass. (5) The paste is of normal consistency when the cylinder of the Vicat apparatus penetrates to a point in the mass 10 mm. (0.39 ins.) below the top of the ring. (6) The amount of water required to make a paste of normal consistency varies with different cements, but will be found to be approximately 30 per cent. of the weight of the cement. It should have a temperature of 70 degrees Fahrenheit.

Soundness.—(1) A pat of neat cement 2½ to 3 inches in diameter, ½-inch thick at centre, tapering to a thin edge, and allowed to take its final set in moist air, must withstand indefinite exposure in water or air at any ordinary temperature without checking, distortion, or softening. (1) The briquette used in testing shall be formed in moulds of the size and form now in customary use and recommended by the American Society of Civil Engineers, the stress to be applied at a uniform rate of 400 pounds per minute until fractured. (2) All briquettes of neat cement are to be made from paste of normal consistency in the following manner: The moulds should be filled with the paste as soon as it is thoroughly mixed and tempered, the material pressed in firmly with the fingers and smoothed off with a trowel without ramming; the material should be heaped up on the upper surface of the mould, and in smoothing off the trowel should be drawn over the mould in such a manner as to exert a moderate pressure upon the excess material. The mould should then be turned over and the operation repeated on the other side. (3) Briquettes for twenty-four-hour tests shall remain in moist air until final set has occurred, then be placed in water for the remainder of period. (4) Briquettes for seven and twenty-eight-day tests shall be allowed to set one day in moist air and remainder of period in water. (5) All briquettes are to remain in the water until they are placed in the testing machine. (6) Neat twenty-four-hour tests shall not show less than 60 pounds per square inch. Neat seven-day tests shall not show less than 100 pounds per square inch. Neat twenty-eight-day tests shall not show less than 150 pounds per square inch, nor less than 25 per cent. above the seven-day test.

The specific gravity, determined upon dried cement which has passed through a No. 100 sieve shall not be less than 2.50 nor more than 2.80. The specific gravity can be conveniently and accurately determined by the use of Le Chatelier's apparatus as recommended by the committee on uniform tests of cements.

If in the tests of any given brand of cement, any sudden, irregular or wide variation from its normal action is found, it should be withheld from use until more extended tests shall have demonstrated its reliability.

Owing to insufficient data, the committee was not prepared to specify a sand test in either class.

Portland Cement Concrete.

Cement shall be Portland, either American or foreign, which will meet the requirements of the standard specifications. Sand shall be clean, sharp and coarse, but preferably of grains varying in size. It shall be free from clay, loam, sticks and other impurities. Stone shall be found, hard and durable, crushed to sizes not exceeding two inches in any direction and freed from dust by screening. Gravel shall be composed of clean pebbles of hard and durable stone, of sizes not exceeding two inches in diameter, free from clay and other impurities except sand. When containing sand in any considerable quantity, the amount per unit of volume of gravel shall be determined accurately to admit of the proper proportion of sand being maintained in the concrete mixture. Water shall be clean and reasonably clear, free from sulphuric acid or strong alkalies.

Mixing by Hand.—(1) Tight platforms shall be provided of sufficient size to accommodate men and materials for the progressive and rapid mixing of at least two batches of concrete at the same time. Batches shall not exceed one cubic yard each, and smaller batches are preferable, based upon a multiple of the number of sacks to the barrel. (2) Spread the sand evenly upon the platform, then the cement upon the sand, and mix thoroughly until of an even color. Add all the water necessary to make a thin mortar and spread again; add the gravel if used, and finally the broken stone, both of which, if dry, should first be thoroughly wet down. Turn the mass with shovels or hoes until thoroughly incorporated and all the gravel and stone is covered with mortar; this will probably require the mass to be turned four times. (3) Another approved method, which may be permitted at the option of the engineer in charge, is to spread the sand, then the cement, then the gravel or broken stone; add water and mix thoroughly as above.

Mixing by Machine.—A machine mixer shall be used wherever the volume of work will justify the expense of installing the plant. The necessary requirements for the machine will be that a precise and regular proportioning of materials can be controlled and the product delivered be of the required consistency and thoroughly mixed. The concrete shall be of such consistency that when dumped in place it will not require much tamping. It shall be spaded down and tamped sufficiently to level off, and will then quake freely, like jelly. (1) Each course should be left somewhat rough to insure bonding with the next course above; and if it be already set, shall be thoroughly cleaned and dampened before the next course is placed upon it. The plane of courses shall be as nearly as possible at right angles to the line of pressure. (2) An uncompleted course shall be left with a vertical joint where the work is stopped. (3) The work should be carried up in sections of convenient length and completed without intermission.

Expansion Joints.—(1) In exposed work expansion joints shall be provided at intervals of thirty feet to fifty feet. A temporary vertical form or partition of plank shall be set up and the section behind completed as though it were the end of the structure. The partition will be removed, when the next section is begun and the new concrete placed against the old without mortar flushing. Locks shall be provided if directed or called for by the plans. (2) In reinforced or steel concrete the length of these sections may be materially increased at the option of the engineer. Concrete shall be placed immediately after mixing and any having an initial set shall be rejected. About one inch of mortar of the same proportions as used in the concrete may be placed next to the forms, immediately in advance of the concrete, or a shovel facing made, at the option of the engineer in charge.

Forms.—(1) Forms shall be substantial and unyielding, properly braced or tied together by means of wire or rods. (2) The material used shall be of dressed lumber, secured to the studding or uprights in horizontal lines. (3) Planking once used in forms shall be cleaned before being used again. (4) The forms must not be removed within forty-eight hours after all the concrete in that section has been placed. In freezing weather they must remain until the concrete has had a sufficient time to become thoroughly set. (5) In dry but not freezing weather, the forms shall be drenched with water before the concrete is placed against them. (6) For backings, undressed lumber may be used for forms.

Finishing.—(1) After the forms are removed, any small cavities or openings in the concrete shall be neatly filled with mortar if necessary. Any ridges due to cracks or joints in the lumber shall be rubbed down; the entire face shall then be washed with a thin grout, of the consistency of whitewash, mixed in the proportion of one part of cement to two parts of sand. The wash should be applied with a brush. (2) The tops of bridge seats, pedestals, copings, wing walls, etc., when not finished with natural stone coping, shall be finished with a smooth surface composed of one part cement to two parts of granite, or other suitable screenings, or sand applied in a layer 1 to 1½ inches thick. This must be put in place with the last course of concrete. (3) In arch tops, a thin coat of mortar or grout shall be applied over the top to thoroughly seal the pores.

STRUCTURE.	PARTS BY VOLUME.			
	Cement.	Sand.	Gravel.	Broken Stone.

The proportion of the materials in the concrete shall be as specifically called for by the contract, or as set forth herein, upon the lines left for that purpose; the volume of cement to be based upon the actual cubic contents of one barrel of specified weight.