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# The Canadian Engineer

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## 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.

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## CONTENTS OF THIS NUMBER :



—The fatalities of the past month, such as the boiler explosion at Newmarket, Ont., by which two men were killed and a number injured, and the numerous other fatal accidents to those handling electrical machinery, acetylene gas, and other apparatus, point to the need of Canadian legislation of a comprehensive kind, applying to all provinces alike. No better model could be taken than the act in force in Great Britain, and summarized some time ago in the Canadian Engineer, and a good thing would be done if a conference of the Provincial and Dominion Governments could be arranged for the purpose of relegating the legislation to the Dominion Parliament to secure uniformity in the law and economy in its administration. Under the British law no restrictions are put upon either the makers or users of machinery, but the onus of an accident is placed upon the person or company found to be at fault. This result is obtained by a commission having the powers of a court. If the owner of machinery is adjudged guilty of negligence, the judgment of the court is taken as the basis of any action for damages which a sufferer by the accident may bring. Thus the responsibility is placed exactly where it belongs, and the result is that there are fewer accidents in Great Britain in proportion to the machinery used than in any country in the world.

As to the Newmarket boiler explosion, it will probably never be certainly known why the boiler failed. The boiler was a 66-inch one, and had a double rivetted lap joint, and it was on one of these lines of rivets that the fracture occurred. In the expansion and contraction of the shell, the portion having this lap would yield less than where the plate was single, consequently the greatest strain would be along one or other of these lines of rivets, and moreover this lap was below the line of average water level, and this gave the explosion greater force. The lessons to boiler makers would appear to be, first, that a double strapped, butt joint affording a more perfect curve to the plate, and therefore causing less strain by expansion and contraction, ,gives a safer boiler; and second, that the joints should be placed above the water line, thus minimizing the damage should an explosion occur at the joint.

—According to the report of the special commissioner sent by the British Government to investigate the prospects for trade in South Africa, that country bids fair to become Great Britain's largest customer by the end of the current year, its imports having increased 250 per cent. in ten years. There has been a strong prepossession in favor of British goods since the war, even when they cost more than others. The most serious competitors are the United States, Germany, Belgium and Switzerland. The American competition is most perceptible in mining, agricultural, and electrical machinery; appliances, tools, fencing wire and furniture. This competition is materially aided by the low freights for which rival British steamship carry cargoes from New York to South Africa; also by the presence of American engineers at the mines, who favor United States machinery. The Commissioner also calls attention to the lack of vigor and enterprise on the part of the British manufacturers, especially those in the engineering trade, and he lays emphasis on the superiority of American descriptive catalogues, and the accessibility and bonhomie of American agents compared with the reserve of the British agents. The report also states that it is only American competition which the British have to fear. There is a moral in all this for the Canadian manufacturer; and with the preference now in operation in favor of British and Canadian goods, it will be our own fault if Canada does not loom large in the trade of South Africa henceforth.

—New Zealand has not been long in endorsing the policy of Mr. Chamberlain in a practical way, by adopting a new tariff giving the British Empire a trade preference over outside countries, and thereby following Canada's example in the effort to create a closer commercial union within the Empire. By the Preferential Trade Bill, which came into operation on November 20th, the following articles, while free to the British Empire, must pay a duty of 20 per cent., when from foreign countries: Bicycle parts, gas engines, gum boots, iron and steel cordage; sheet, bolt and bar iron; printing paper, steel rails, sail cloth, canvas, and duck;

surgical and dental instruments. Outsiders will also pay 50 per cent. additional on: Basket-ware, bicycles, boots, candles, carriages, clocks, cordage, cream of tartar, glass, china, stone, and earthen ware; hardware, furniture, fancy goods, toys, firearms, potted fish, hops, nails, lamps, pianos, paper-hangings, paper, plated ware and pumps. The duty on cement is doubled against non-British countries, while that on tea grown in British dominions is removed. This progressive step on the part of Britain's most distant colony, will be welcomed by Canadian manufacturers, (for we take it that the colonies are included in the preference), as affording greater opportunities for trade, and at the same time creating a system which will render Great Britain and her colonies commercially self-sustaining.

## LITERARY NOTES.

"Proceedings of Chemical and Metallurgical Society of South Africa," Vol. II., 1897-99, published by the Society at Johannesburg, Transvaal, R. W. Hunter, Edinburgh, and Engineering and Mining Journal, New York. 928 pages; size, 5½ by 8½.

In the working out of problems involved in the cyanide processes, the handling of low grade ores and problems of deep level mining, the Transvaal stands at the head of the list, and the work of this society is therefore of the highest value to the mining world. The volume gives the text and discussions upon a large number of papers by experts, with seventeen folding plates of diagrams illustrating the papers. These, with reports of committees and abstracts of articles from the mining press, make up a volume of unique value, admirably turned out from a typographical point.

"Modern Workshop Hints," by Robert Grimshaw, M.E. 428 pages, 4½ by 7; published by Samson, Low, Marston & Co., London, Eng.

This work, by the well known author of the "Steam Engine Catechism," "Boiler Catechism," and other books of like character which we have recommended, is a handy book containing 581 hints with 528 illustrations of these hints and "kinks." The author has adopted the best ideas from United States, as well as British, shop practice, so that the book is up to date, and helpful to the expert machinist, as well as those who do not claim expert knowledge. The type is good, the cuts are clear, and an excellent feature is that the measurements are given in the metric as well as the English system. On the latter point, and in view of the letter in another part of this issue, it is worth while to quote Mr. Grimshaw: "Of the superior convenience of the metric system, the author, brought up to British units with their unphilosophical and unpractical ratios, but for some years past working almost exclusively with decimal and interconvertible units, can testify and can only regret the time in calculation lost under the old regime and praise the superior flexibility and convenience of the new."

"The Steam Turbine," by Robert M. Neilson; illustrated; 294 pages, 6 by 9; 2nd edition; published by Longmans, Green & Co., London, England, at 10s. 6d., net.

This is the first comprehensive work on the steam turbine, and the interest in the subject is shown by the fact that a second edition has been called for. In this edition, the Parsons and De Laval types have been described in greater detail, while a chapter has been added on the Westinghouse-Parsons, the Stumpf, the Schulz, the Curtis and Seger patents. Comparisons have been made with the hydraulic turbine and the reciprocating engine, the theory of the action of steam treated of, and accurate tests recorded, so as to give the reader the broad grounds of the author's conclusion, which is that the steam turbine will be extensively used in the future.

"Technical Mechanics," by Edward R. Maurer, Prof. of Mechanics, University of Wisconsin; 382 pages, 5½ by 9; price, $4; published by John Wiley & Sons, New York.

This is prepared as a text book on the theory of mechanical forces, primarily for students in engineering. The headings of some of the chapters will give an idea of the scope of the work: Force, equivalence of force systems, centre of gravity and centroid, attraction and stress, general principles of equilibrium, application of the principles of equilibrium, rectilinear motion of a particle, curvilinear motion, motion of a rigid body, rotation; work and energy, impulse and momentum, etc. Appendices treat of vectors, rates, dimensions of units, and second moments of area. The author does not aim to present the results of experimentation, or the practical application of the theory of mechanics, such, for instance, as the analysis of trusses, friction, balancing, etc., but rather to explain the principles, leaving the student to make his own applications. There are many diagrams, equations and formulae, and an immense amount of study must have been put into the work.

Other publications received are: Decimal Association, Botolph House, Eastcheap, London, Eng.; list of subscribers and report for 1903.

Telegraphie sans Fil l'œuvre de Marconi; published by Librarie Scientific et Industrielle, Ramlot Freres et Sœurs, Bruxelles, Belgium. A description in French of the Marconi system; 64 pages with 88 engravings.

The World's Commerce and American Industries; 112 pages, with 86 graphic charts on the United States share of the world's trade. The Philadelphia Commercial Museum, Philadelphia, Pa. 50 cents.

Deep Gold Mining, by E. R. Faribault, C.E., of the Canadian Geological Survey; 16 pages, with folding plates, on the best methods of testing the deeper gold deposits of Nova Scotia. Published by Edwin Gilpin, Inspector of Mines, under authority of the Commissioner of Public Works and Mines, Halifax, N.S.

Handy Lumber Tables, for board, plank and scantling measure; 24 pages; price 10 cents. Industrial Publication Co., 16 Thomas St., New York.

American Railway Engineering and Maintenance of Way Association, L. C. Fritch, secretary, 1562 Monadnock Block, Chicago, bulletin No. 43, on ties, 34 pages; and bulletin No. 44, 87 pages, report of committee on yards and terminals.

Annual Report of City Engineer, Toronto, for 1902; 130 pages, with maps and plates.

North of England Institute of Mining and Mechanical Engineers, Newcastle-on-Tyne. Report of committee on mechanical coal cutting, part 1 on Longwall machines.

Armed Concrete Lattice-Girders; a pamphlet of 18 pages, on iron and concrete construction; by Max Emer, engineer, of Vienna. Published by Visintini & Weingaertner, Zurich, Switzerland.

Sixteenth Annual Report of Vancouver Board of Trade, to May, 1903; 126 pages, illustrated. Address Secretary, Molson's Building, Vancouver, B.C.

Bulletin No. 1 of Engineers' Club, of Toronto, containing sketch of the club's history, with constitution, list of members, etc. Willis Chapman, secretary, 103 Bay St., Toronto.

Terrestrial Magnetism, by Arthur Harvey, Toronto; synopsis of a paper read by the author before the Association of Ontario Land Surveyors, showing the connection between sun spots and the earth's magnetic disturbances.

Electrically Driven Shops, illustrated pamphlet; by Robert L. Warner; published by the Westinghouse Electric Mfg. Co., Pittsburg, Pa.

Influence of Electricity on the Development of Water Powers; reprint of a paper read before the N. E. Cotton Manufacturers' Association, by F. A. C. Perrine, D. Sc., Pittsfield, Mass.

Address to members of the American Park and Outdoor Art Association, in July, 1903, by J. W. Langmuir, of Toronto, chairman of Queen Victoria Niagara Falls Commission.

## RATING OF WATTMETERS FOR THREE-PHASE SYSTEMS.

By Charles Brandeis, C.E., Montreal.

The usual method of measuring the energy in a three-phase circuit is with two wattmeters connected as shown in Fig. 1, in which $W_1$ and $W_2$ represent the two wattmeters.

In a perfectly balanced three-phase system at 100 per cent. power factor these two wattmeters will read alike, i.e., each will record exactly one-half the total load. As soon, however, as the power factor drops below this value they become divergent in their readings until 50 per cent. power factor (or the current lag equals 60 degrees) is reached. At this point, $W_1$ will read the total energy, and $W_2 = 0$. Below

Fig. 1.

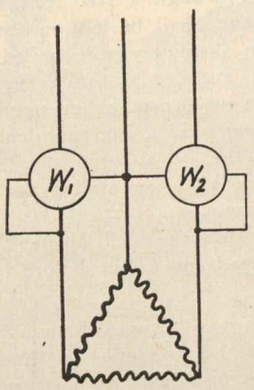



Diagram of Connections.

50 per cent. power factor the wattmeter $W_2$ will again indicate certain values, but they are negative, i.e., to get the total load the value of $W_2$ must be deducted from the value of $W_1$. On the other hand, above 50 per cent. power factor the sum of the two readings will give the total load. It is, of course, desirable to rate the wattmeters as low as possible for if they be too large it is not possible to read accurately when the load is small, say, at ¼ full load. Nevertheless, they must be large enough to allow for the inductive loads. To facilitate determining the correct ratings of indicating and recording wattmeters the curves devised by the writer shown in Fig. 2, will be found useful.

Let $E$ = E.M.F. of circuit,
$I$ = current.
$W_1$ = Greater wattmeter reading,
$W_2$ = Lesser wattmeter reading,
$W = W_1 + W_2$ = Total watts in circuit,
$X$ = Phase angle of system.

In a balanced three-phase circuit,

$$W = W_1 + W_2 = E\ I\ \sqrt{3}\ \cos x = \text{Total power},$$
$$W_1 = E\ I\ \cos\ (x - 30°)$$
$$W_2 = E\ I\ \cos\ (x + 30°)$$
$$W_1 = E\ I\ \frac{\sqrt{3}}{\sqrt{3}}\ \cos x\ \cos 30° + \sin x \sin 30°$$

$$W_1 = (E\ I\ \sqrt{3} \cos x)\ \frac{(.5 + \sqrt{3} \tan x)\ \cos x}{6} \qquad (1)$$

By a similar process:

$$W_2 = (E\ I\ \sqrt{3} \cos x)\ \frac{(.5 - \sqrt{3} \tan x)}{6} \qquad (2)$$

From this it will be observed that the wattmeter readings will be obtained by multiplying the total power in the circuit by a constant depending upon the tangent of the angle. It will also be observed that $W_1$ and $W_2$ are symetrical with reference to a horizontal axis of $+.5$. $W_2$ passes through zero when $(1/6\ \sqrt{4} \tan x = .5)$, or at an angle of 60°. $W_1$ is equal to total power expended in the circuit when $x = 60°$. The sum of the two readings represents at all times the actual power expended in the circuit. If we represent this total energy as equal to unity.

$$W_1 = \frac{.5 + \sqrt{3} \tan x}{6} \qquad (3)$$

$$W_2 = \frac{.5 - \sqrt{3} \tan x}{6} \qquad (4)$$

In practice the capacity of a machine at any given power factor is the rating of the machine multiplied by the power factor. We can derive equations representing this condition by multiplying equations (1) and (2) by cos x,

$$W_1 \cos x = (E\ I\ \sqrt{3} \cos x)\ \frac{(.5 \cos x + \sqrt{3} \sin x)}{6} \qquad (5)$$

$$W_2 \cos x = (E\ I\ \sqrt{3} \cos x)\ \frac{(.5 \cos x - \sqrt{3} \sin x)}{6} \qquad (6)$$

Assume as before, $E\ I\ \sqrt{3} \cos x = 1$

$$W_1 \cos x = \frac{.5 \cos x + \sqrt{3} \sin x}{6}$$

$$W_2 \cos x = \frac{.5 \cos x + \sqrt{3} \sin x}{6}$$

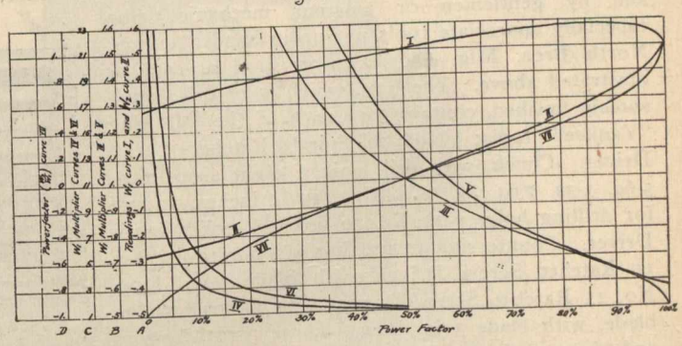
$$W_1 + W_2 = \cos x$$

If these values are plotted they give the curves I and II. These values $W_1 \cos x$ and $W_2 \cos x$ give the readings where the apparent watts in a circuit is equal to unity. In a 100-K.W. generator the volts and amperes on the line with a 100-K.W. at 100 per cent. power factor are the same as with an 80-K.W. load at 80 per cent. P.F. Consequently the values of equations (7) and (8) represent the wattmeter readings of a circuit rated non-inductively.

It is desired to find the actual wattmeter readings of a 100-K.W. machine at 80 per cent. P.F. By referring to the curves $W_1 \cos x$ (1) and $W_2 \cos x$ (2), and scale A, we find the wattmeter readings will be $.574 \times 100$ or 57.4-K.W., and $.236 \times 100$, or 23.6-K.W., a total of 80-K.W., while the apparent energy $E\ I\ \sqrt{3}$ will be 100-K.W. when the machine is loaded to its full capacity.

Multiplier curves 3 and 4, (4 continuation of 3), are derived from curve 1 by dividing the reading by corresponding power factor and enables wattmeter readings to be obtained for any given load and power factor as shown in

Fig. 2.




the following example, using scales B. and C. Actual load 50-K.W. Power factor 80 per cent. At 80 per cent. P.F. curve 3 reads .715, therefore $W_1 = .715 \times 50 = 35.75$-K.W. $W_2 = 50 - 35.75 = 14.25$-K.W.

It is now desired to find what should be the rating of the wattmeters which should be placed in three-phase circuits. This will again be determined by the apparent watts, or by the total watts which the meter will stand on a non-inductive load. It will be observed that under above conditions the volts and amperes on the generator are constant, and that the same will also be true of wattmeters placed in the circuit of the machine.

The total apparent watts on the meter in either case will be:

$$\frac{W_1}{\cos(x-30°)} = \frac{W_2}{\cos(x+30°)} = E\,I$$

Consequently the heating of the meter or its rating will be absolutely independent of the power factor and its rating will be $\frac{E\,I}{E\,I\,\sqrt{3}}$ or 57.7 per cent. of the non-inductive rating of the generator in which it is placed, and the same size of meter will be required in both circuits.

In the case of inductive loads we can proceed similarly, for instance, a three-phase motor having a power factor of 80 per cent., and 8,000 watts (virtual) capacity would require meters having a capacity $\frac{57.7}{.8}$ per cent. of 8,000 or 5,770 watts. To simplify these calculations, multiplier curves 5 and 6 (the latter being continuation of 6) using scales B and C, have been plotted. An example of using these curves is as follows: A motor takes a miximum overload 4,000 watts. Power factor 80 per cent. At this power factor curve reads .73. Therefore rating of $W_1 = .73 \times 4{,}000 = 2{,}920$ watts, say 3,000 watts wattmeter. The rating of $W_2$ must be the same as for $W_1$.

The rating of each of the wattmeters on a generator, synchronous motor or rotary converter is always .577 times the maximum non-inductive load capacity. The power factor curve may be included and plotted as a ratio $\frac{W_2}{W_1}$, being curve 7 using scale D. Example: In a motor or other three-phase circuit one wattmeter reads 10,000 watts, the other 5,000 watts. Then $\frac{W_2}{W_1} = \frac{5{,}000}{10{,}000} = .5$, whence from curve power factor is 87 per cent. The curves have proven to be very useful to meter men, testers, and to other engineers, as they give quick and reliable results without the necessity of tedious calculations, or even having the theoretical knowledge of same.

The author's thanks are due to Mr. W. S. Andrews and Mr. F. Oberly, of Schenectady, N.Y., for suggestions and assistance.

## "YANKEE" TOOL SET.

In response to frequent demands for "Yankee" screw drivers, put up in substantial and well finished boxes, to be used by mechanics who desire to keep tools in fine order, and by gentlemen or amateur mechanics who especially appreciate tools put up in handsome sets, North Bros. Mfg. Co. have prepared a set, as illustrated above. The box, which is of oak, handsomely finished, contains one each of the following "Yankee" tools: No. 30 Spiral Ratchet Screw Driver. Chuck, with drill points, eight sizes, 1-16, 5-64, 3-32, 7-64, ⅛, 9-64, 5-32, 11-64 inches, to use for drilling holes with No. 30 Spiral Ratchet Screw Driver. Countersink to use in the same tool. No. 11 Ratchet Screw Driver, with blade 6-in. long. No. 15 Ratchet Screw Driver, with finger turn on blade, with blade 3 in. long. These are the styles and sizes of "Yankee" tools most in demand, and the combination in a set covers all the usual requirements in tools for driving and drawing out screws. Manufactured by North Bros. Mfg. Co., Philadelphia, Pa.


## SPECIFICATIONS FOR PAINTING STEEL STRUCTURAL WORK

The painting specifications for the superstructure of the Blackwell's Island Bridge across the East river at New York, contracts for which have just been let, are of general interest to engineers. They are as follows:

All material shall be received and painted under cover; and no painting, either at the works or in the field, shall be done in wet or freezing weather. All structural steel and iron before leaving the shop must be thoroughly cleaned of all mill scale, dirt and rust, by the use of small hammers, steel scrapers and wire brushes, and of oil by the use of benzine, and must then receive one coat of red lead and boiled linseed oil. These materials must be brought to the work in their original packages and mixed in a revolving churn just before using, in the proportion of 33 lbs. of dry red lead to one gallon of linseed oil.

The red lead must be strictly pure, and shall contain at least 80 per cent. of true red lead (of the composition $Pb_3O_4$); the total amount of lead present shall not be less than 89 per cent., of which not more than 0.1 per cent. shall be present as metallic lead. The color shall be clean and pure tint. The red lead shall be of the fineness that when washed with water through a No. 19 silk bolting cloth no more than 1 per cent. shall be left on the screen. The linseed oil shall be an absolutely pure boiled oil, containing no matters volatile at 212 deg. F. in a current of hydrogen; it shall not contain any rosin or manganese. The oil shall be perfectly clear on receipt, and no deposit shall form on standing, provided the oil is kept at a temperature above 45 deg. F. The film left after flowing the oil over the glass and allowing it to drain in a vertical position must be dry to the touch after 24 hours. All finished surfaces shall be coated with white lead and tallow before being shipped from the shop.

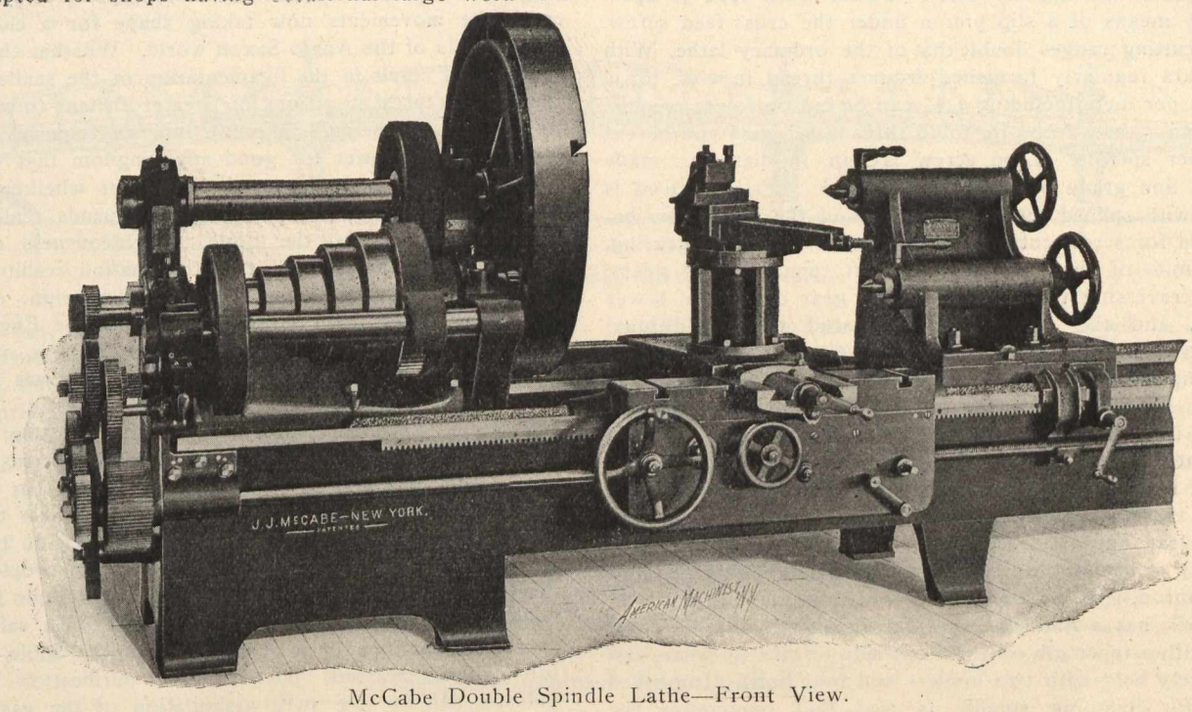
After the structure is in place all mud and dirt that may have accumulated during the erection must be removed and all abrasions in the first coat of paint must be thoroughly brushed with a stiff wire brush and such places "touched up." and all bolt heads and location marks thoroughly painted with the paint, as described, and then all the steel and iron work shall be thoroughly and evenly painted with an additional coat of red lead and boiled linseed oil, of the quality stated, mixed in a revolving churn in the proportion of 33 lbs. of red lead to one gallon of oil, with the addition of one-half pound of best lamp black (ground in oil) to every 99 lbs. of red lead used. The second field coat shall consist of red lead and boiled linseed oil, without lamp black.

Various newly discovered rays of surprising properties have been disclosed in the "n" rays recently discovered by M. Blondot. They have been found capable of raising the luminosity of a glowing solid or gas without raising the temperature thereof. More light without more heat may be regarded as something of a paradox. An article in the Electrician, commenting on this, says there seems to be, under the influence of the "n" rays, some modification of the atomic vibrations which, while leaving their energy unaltered, increases their frequency. In any case, the fact itself is of great importance and interest. Anything tending to increase the luminosity of a body at the expense of its temperature brings us nearer to a solution of the great problem of the economical production of light.

## THE McCABE DOUBLE SPINDLE LATHE.

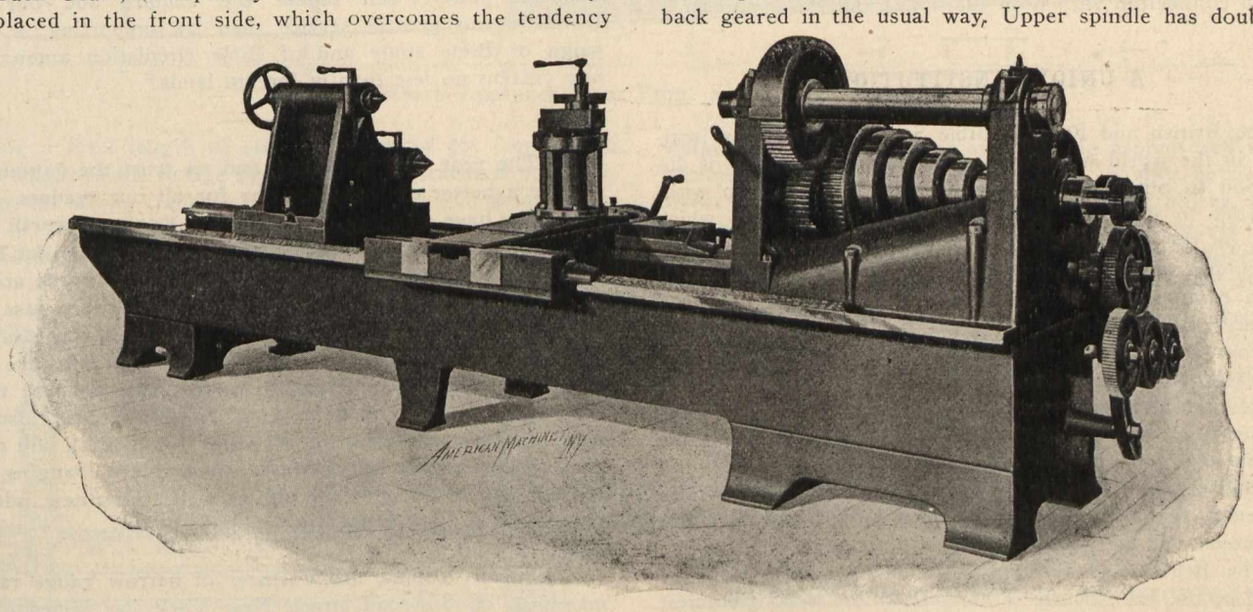
The accompanying illustration shows the new McCabe Double Spindle Lathe, of 26-49-in. swing, with geared plate and Universal Tool Holder, for which the Fairbanks Company, of Montreal, are the Canadian Selling Agents.

This lathe in reality combines two complete lathes, the large size triple geared and the medium size back geared, with all the modern conveniences. It is particularly well adapted for shops having occasional large work but where a heavy, expensive tool would stand idle most of the time, and it is also designed to take the place of the "Block-up" and "Gap-bed" lathes. Changing from one size to another is done quickly, and the floor space of but one machine is taken up. In re-designing this machine, all the good points of the early style have been retained, and a number of new features added, including a re-construction of head-stock, and new arrangement of gearing.




McCabe Double Spindle Lathe—Front View.

Back Gears, (completely enclosed and out of the way) are placed in the front side, which overcomes the tendency to lift spindle in bearings, by keeping the pressure constantly downward, on the same principle as roll-turning and gun lathes. Swing or upper spindle, over bed 49-in.—over the wings of carriage 45-in., over the carriage 40-in. Bed is wide as the average standard 48-in., so that the head or tail-stock do not overhang, and are perfectly rigid in handling heavy work on upper spindle. Leg under the tail-stock end arranged to swivel, (making it practically a three-point bearing), so as to accommodate itself to an uneven floor or foundation. Head-stock, is very wide on base and rigid in construction. The base is scraped to a flat bearing on the ways of the bed, and is held down by six cap bolts. Four adjustable screws are tapped through the flanges where the head-stock sets between flat ways of bed, and the fit is made 1-32-in., loose at this point. This allows the head-stock to be adjusted slightly in order to properly line up the spindle should the boring of the lathe taper owing to the wear of the boxes. Boxes are hard bronze, of extra length, carefully scraped and fitted to a perfect bearing. Thrust of the spindles is taken on hardened and ground tool steel washers of ample proportions. Spindles are large in diameter, and made from a high-grade of hammered steel of about 45 points carbon. Lower spindle has 2⅛ hole clear through. Centres made of tool steel, and are 1¾-in. in diameter. Cone is large in diameter, with five sections, and driven with 3½-in. double belt. Gearing strongly proportioned throughout, of coarse pitch, wide faced and accurately cut. Lower spindle back geared in the usual way. Upper spindle has double the power, being triple geared. Internal geared face-plate, (ratio about 72 to 1), can be furnished as an extra for unusually heavy work in place of large, plain plate—as it answers the purpose of both. Driving pinion for lower spindle that engages in geared plate is steel. Carriage, gib-bed front and back, with a bearing of 48-in. in length on the ways, and is 12-in. wide at the bridge or central part. Top is made flush, without any projections, and is planed and




McCabe Double Spindle Lathe—Back View.

slotted for clamping large pieces in boring. Powerfully geared, so that it can be operated conveniently, and has quick traverse along the bed with hand wheel of large diameter. Compound-rest is supported on a cross slide 24-in. in length on the carriage, and the full width of 12-in. It has sufficient traverse to face full swing on upper spindle without shifting the tool or loosing any of the bearing. Blocking-piece for compound-rest brings the tool level with the upper spindle and is made so that it can be quickly taken and rest set down in its regular place. Power-cross feed is operated by means of a slip pinion under the cross-feed screw. Screw-cutting ranges double that of the ordinary lathe. With the gears regularly furnished from 1 thread in 2-in. to 32 threads per inch, including 11½ can be cut on lower spindle, and from 1 thread in 4-in. to 16 threads per inch can be cut on upper spindle. Lead screw is 2-in. in diameter, made from a fine grade of high carbon steel. Friction feed is driven with splined screw, the threads of the lead screw being used for screw cutting only. Feed is driven by gearing, and admits of three changes without removing the gears, and by reversing the position of the gear on end of lower spindle, and the second gear on stud three additional changes can be obtained, making six changes of feed without using the regular gears that will give most any feed required. Feed is engaged by a hand wheel large in diameter so that it is an easy matter to tighten the friction by hand sufficient to carry the heaviest cut. Rack-pinion is arranged so that it can be entirely withdrawn from the rack while cutting threads, and has a double bearing in the apron, supported clear out to the face of the rack, which overcomes any tendency to spring. Reverse-motion for controlling the feed in the apron, is operated by a lever within convenient reach. Tail-stock has a flat bearing 25-in. in length on the ways, fitted with a taper gib on the front side to take up wear, and is securely held with two binders and four bolts. Improved device for clamping spindle is used that overcomes the necessity of splitting the casting at this point. Quick traverse along the bed by means of crank and steel pinion running in the rack. The usual set-over is provided for taper work. Taper attachment furnished as an extra is fitted to slide on back of bed, and being the simplest and most substantial form is unquestionably the best. Universal tool-holder for heavy boring and turning, furnished as an extra in addition to the regular style for ordinary use. Steady-rest, is heavy and substantial with opening of 10½-in. It can be used in connection with both the upper and lower spindle.

## A UNIQUE INSTITUTION.

The British and Foreign Bible Society is the only institution in the world which exists for the sole purpose of doing good to others and whose business is carried on without profit to itself. The centenary of this society, which occurs on the 6th March next, is to be specially celebrated in a unique way throughout the British Empire and in all foreign countries where its operations are carried on, by a "Universal Bible Sunday."

From an article in the November Canadian Magazine, it appears that there are in Canada twelve auxiliary societies with several hundred branches in all, some of them being over seventy years old, and that these auxiliaries contribute more in aid of the parent society in London than those of any other group of British colonies. It is proposed to raise a centenary thank-offering in Canada of $50,000, and no doubt this amount will be much exceeded.

"The British and Foreign Bible Society came into existence in the year before Trafalgar, in the very gloomiest crisis of Britain's awful struggle with Napoleon and his Continental allies, while the poor were starving, trade was depressed and crippled by war, and the dread of French invasion weighed upon all, from the King on his throne to the laborer in his hut. Yet the new society not only won generous support from all classes in Great Britain, but the enthusiasm of its workers became a contagion which spread into Europe, and it was the direct inspiration to the formation of a Bible society in the United States which afterwards became the American Bible Society, organized and maintained on similar lines—that is for the publication of the Word of God, and that alone 'without note or comment.'"

The British and Foreign Bible Society has circulated since the year of its birth 180,000,000 copies of the Scriptures, in whole or in part, and spent over £14,000,000 in the work. Its annual output is now 6,000,000 copies.

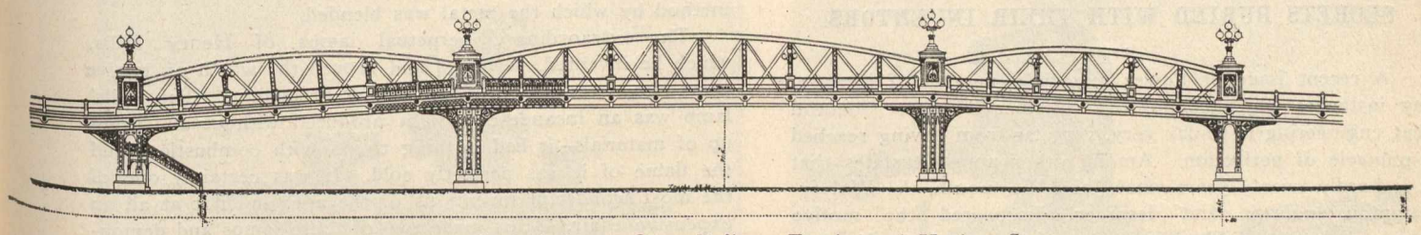
The article in the Canadian Magazine concludes: "This celebration may mean much to the British Empire, according to the spirit in which it is entered upon. It synchronizes with the movements now taking shape for a closer union of all parts of the Anglo-Saxon world. Whether these movements will result in the ligamentation of the scattered members of the present nations of Greater Britain (now comprising a fifth of the human race), into an Imperial federation surpassing in power for good any kingdom that has arisen since mankind appeared on the earth, or whether they will break up into incoherent fragments, depends really on this Empire's attitude to the Bible. 'Righteousness exalteth a nation.' In a large sense the Reformation resulted from a re-discovery of the Bible. During the reign of Queen Elizabeth no less than seventy editions of the English Bible were issued—a marvel considering the crudities of printing in that age—and the England of Elizabeth was a greater England than that of any era down to Victoria. It was in the age of Elizabeth that the Bible first became the book of the people, and remained so to a greater extent than with most other nations. The history of the nations of Christianity has shown with ever-increasing clearness that those countries have become influential in the world in proportion as the Bible has entered into the life of the people. Therefore the reaffirmation of the Bible as the supreme law is the only way of establishing the new Empire on a safe foundation. Canadians need a re-discovery of the Bible, not only for Imperial reasons, but for the purification of home politics, and for the swift assimilation of the vast tide of immigrants pouring into our great West. It is the common testimony of missionaries and teachers that the best and quickest method of teaching a foreigner the English language is by the reading of the Bible in parallel passages, comparing it with the Bible in his own tongue. We know that a people nurtured on the Bible will be a sturdy, reliable and patriotic people; we know that in proportion as Christianity is the real basis of civil life, race prejudices will be broken down; race and class antipathies softened. Hence Canadian patriots can render the Empire and our own Dominion no greater service than by supporting a campaign of Bible study and of Bible circulation among our new citizens no less than in foreign lands."

—The year 1903 is closing and we trust the coming one will be a better and happier one for all our readers. We hope they have all found the Canadian Engineer worth much more (as it costs the publishers more) than the dollar asked, but if the subscriber has doubt on this point, let the account be squared and the paper stopped. Short accounts make long friends, and the proverb applies with special force to subscriptions. We will take it as a vote of confidence from all who remit, and encouraged by this vote we will try to produce a better paper next year. As this month closes the volume, those who wish for the index for binding will please send request giving full address. Subscribers changing their address will please give the old, as well as the new, address.

—Arthur Koppel, manufacturer of narrow gauge railway materials, 66-68 Broad street, New York, has issued a neat memorandum book. It is shaped to fit the vest pocket. Twenty-six pages are devoted to useful information on various subjects, and the balance of the pages are blank for memoranda. The cover is of celluloid with a picture in the centre, of a standard steel side dump car dumping to both sides, which is one of the many different styles of cars manufactured by this firm. A copy of this book, also a complete catalogue of railway materials, will be sent to all interested parties.

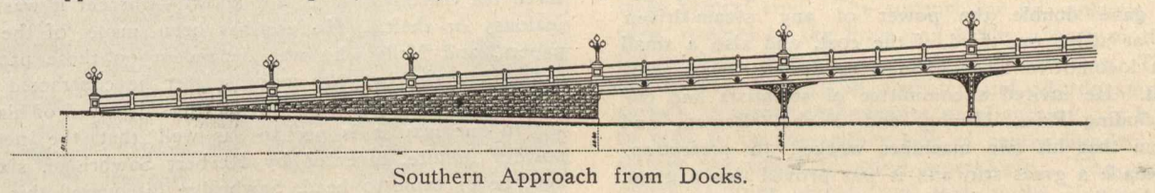
## NEW YONGE ST. BRIDGE, TORONTO.

In accordance with the decision of the Railway Committee of the Dominion Parliament, a large bridge will be built, by which the heavy traffic to and from the lake steamers will be carried over the tracks of the Grand Trunk and Canadian Pacific railways at the foot of Yonge St., Toronto. To bring the traffic to dock level on an easy grade, the present basins around the foot of Yonge St. will be filled in, and new wharves built several hundred feet further out into the bay, where a new street will be formed running west to York St. The new bridge, for which tenders will soon be called, but the substructure of which will not be started before spring, will cost probably $200,000.

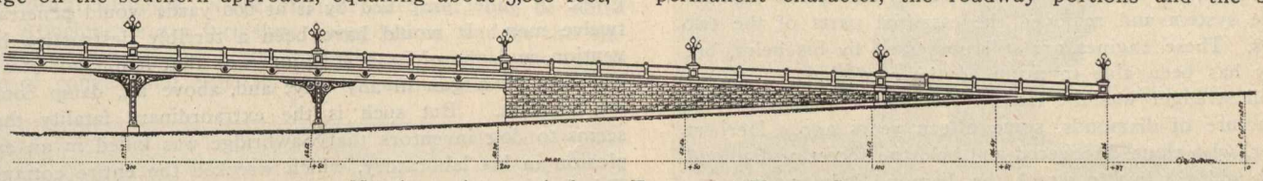


Central Spans Over Railway Tracks and Harbor St.

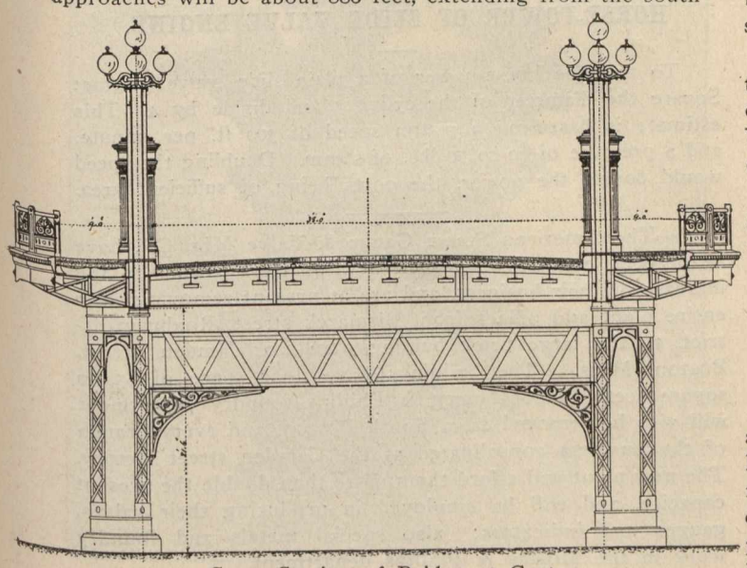
The bridge is to be 56 feet wide over all, having a roadway of 38 feet in width, and two sidewalks of 9 feet in width each, on the approaches and deck spans, and 6½ feet in width on the through spans. It is to be composite in character, consisting of three spans of a through bridge over the tracks and sidings of the Grand Trunk and Canadian Pacific railways, equalling about 295 feet, and 3 spans of a deck bridge on the northern approach, and 3 spans of a deck bridge on the southern approach, equalling about 3,000 feet, making a total length of steel structure of 595 feet. The clear height of the bridge over the railway tracks is 21½ feet, except the siding tracks leading into the freight sheds at the foot of Yonge street. The total length of the bridge and approaches will be about 880 feet, extending from the south side of Front street to the north side of Lake street. The northern end, that is from Front street southward, is carried on concrete masonry walls for about 145 feet, and the southern end, that is from Lake street northward, is also carried on concrete masonry walls for about 140 feet, the remainder being supported by steel columns on concrete piers.



Southern Approach from Docks.



Northern Approach from Front and Yonge Streets.



Cross Section of Bridge at Centre.

It is proposed to erect this bridge so that the north end will be immediately east of the west side of Yonge street, and 10 feet therefrom, so as to leave a sidewalk of 10 feet in width at the west side of Yonge Street. It will be built in a straight line, parallel to the street lines of Yonge street, and extending to the north street line of Lake street. Where it crosses the Custom House lane, Esplanade street and Harbor street, it will be sufficiently high to enable all ordinary traffic to pass under. For foot passengers who wish to pass from the bridge to Harbor street, an 8-foot stairway will be built on the west side of the bridge. To preserve the grade of the northern approach, shown on the drawing, Lake street will be raised about 4 feet above its present level opposite the southern end of the bridge.

It is proposed to make the deck of this bridge of a permanent character, the roadway portions and the sidewalks to have a surface of asphalt, and asphalt and wooden blocks on a concrete foundation; the paving between the street railway tracks to be square cut wood blocks, also on a foundation of concrete. The whole of the concrete foundation and asphalt and block surface is to be supported by steel buckled plates, rivetted to floor girders and stringers.

The only lands necessary to be taken for the erection of this bridge will be the warehouse now occupied by the Canadian Rubber Company at the south-east corner of Front and Yonge streets, and a small piece of the Grand Trunk freight office buildings.

This bridge is designed in the office of the City Engineer by John Williams, M. Can. Soc. C.E., assistant city engineer in charge of bridges.

## DETROIT LUBRICATOR CO. VS. MICHIGAN LUBRICATOR CO.

The Circuit Court, for Wayne County, Michigan, issued an injunction on November 17th, in favor of the Detroit Lubricator Co., and against the Michigan Lubricator Co., restraining them from using the words "Detroit Lubricators," "Improved Standard Lubricators," "Detroit Improved Standard Lubricators," in connection with their lubricators or advertising matter, also restraining them

from using boxes or packages for their lubricators bearing the words "Detroit," or "Detroit, Mich." unless their firm name be also given. It appears, for some time past, the Michigan Lubricator Co. had been making lubricators resembling those made by the Detroit Lubricator Co. in outward appearance, and they had stamped on these lubricators and on the boxes containing them only the words, "Detroit, Mich.", making no mention of their firm name, the object apparently being to have such lubricators substituted for the Detroit Lubricator Co.'s make.

## SECRETS BURIED WITH THEIR INVENTORS.

A recent issue of Power reviews a number of interesting instances which cannot but convince the most doubtful that engineering is to-day very, very far from having reached a pinnacle of perfection. Among other notes, it states that it is hardly twenty years since John Waymouth, the Wolverhampton engineer and designer, discovered the motive power of heat, exhibited it in one of the simplest, cheapest, and most useful engines imaginable, and then deprived the world of its benefit. He had produced beforehand a round dozen of excellent inventions which still bear his name, including the modern revolving chimney cowl; and, having made a large fortune, he devoted himself to harnessing the ordinary heat of a fire and making a new power of it. The idea was laughed at by all his friends; but, after four years of study and experimenting, he produced a stationary engine that gave double the power of any steam-driven mechanism at about one-third of the cost, and also a small model heat locomotive large enough to draw a truck with a man in it. He invited a committee of scientists and engineers, including Prios, Huxley and Forbes Brown, and showed them that his two machines worked to perfection. The affair made a great stir, and it was proved that a great power of unlimited scope had been discovered. Waymouth was flooded with offers of huge sums for his invention, but, for no apparent reason, except, perhaps, the alleged madness of genius he absolutely refused to either bring it out himself or to sell the secret. He announced himself satisfied with the triumph of the invention, and before his death, a year later, he destroyed all the papers and plans explaining the system and removed the essential parts of the two engines. These engines are still possessed by his heirs, but nobody has been able to make anything of them.

Still stranger was the famous loss of the receipt for the manufacture of diamonds, some fifteen years ago. Herbert Warner, who alone discovered and held the secret of diamond making, did not live to wreck the diamond industry, as people thought he would, and the circumstances of the loss was mysterious and tragic. Inferior diamonds can still be produced artificially, but only at a cost of about ten times their value. Warner, after years of experimenting, was able to turn out a genuine diamond of large size and of the first water at the cost of a small fraction of the complete stone's worth. He, like Waymouth, of heat power fame, manufactured his diamonds before an audience of scientists and produced three fine stones, which were tested and pronounced faultless. Two of them are still in existence and are the greatest curiosities the jewel world has ever seen. But within a fortnight of this triumph, before any new stones were put on the market, Warner utterly disappeared from his house on Harley St., London, leaving no trace whatever. So complete was his disappearance that from that day to this not the smallest explanation has been hit upon.

Then there is the lost secret of the wonderful new metal called talium, which would certainly have been worth many millions to the inventor. Grantley Adams discovered it just eight years ago, and during its short life it was one of the greatest wonders of the science and commerce world. Talium was an alloy of metals electrically treated, nearly 55 per cent. lighter than steel, both stronger and tougher, and costing 30 per cent. less to produce. It was the fruit of four years' hard work and study, and eventually Adams completed it and exposed it to every kind of test. Trains or any other vehicles, as it was proved, would be able to travel at nearly double their present speed if constructed of talium, and there was no kind of edged tool that would not be as keen, as well as much lighter, if made of the new metal. The commotion caused by this discovery was extraordinary, and still more so was the upshot of it, for the magnitude of its success overcame Adams' reason, and he became insane before ever the secret of the construction of talium was given out. Adams died a year later, a hopeless lunatic, and as there were no papers explaining his method, the great secret was lost. All the tools and engines of talium, which he had made, remain, but no analysis has revealed the method by which the metal was blended.

The extraordinary perpetual lamps of Henry Mills, which he invented, perfected and proved the worth of, twelve years ago, were lost in quite a different manner. The Mills' lamp was an incandescent light produced without any using up of materials—it had nothing to do with combustion, and the flame of it was perfectly cold. It was certainly one of the most wonderful inventions of the age, and not at all an expensive affair. Mills made two of these lamps and demonstrated their absolute success, but an extraordinary thing happened before the invention was put at the disposal of the public. On the night of May 20th, 1899, Mills' laboratory in Hampstead was broken into, both lamps broken into fragments, and all the papers describing the invention, involving years of work, stolen. There was not the slightest clew to the perpetrators of the burglary, which was done most scientifically, and the crime has never been traced. Even the reason for it is not known—whether it was malice, jealousy or theft. No use has been made of the stolen papers, and Mills who was dependent on these papers set to work again, but two months later he contracted typhoid fever and died, and the world was thus deprived of his secret.

In one way it is perhaps as well that the new gunpowder fulmite, invented by Herbert Sawbridge, six years ago, never came to head. Sawbridge discovered this powder by accident in his little chemical experimenting room at Exeter, England. He perfected the powder, after a good deal of study and trouble, and finally showed that in an ordinary service rifle this powder could drive a bullet accurately a distance of nearly six miles, and that at ordinary ranges it gave over ten times the penetration that cordite gives. A bullet propelled by it at 600 yards would penetrate twelve men. It would have been a terribly destructive invention, and one of its best points was that it did not strain or corrrode a gun in any way; and, above all, damp could not harm it. But such is the extraordinary fatality that seems to dog inventors that Sawbridge was killed in an explosion in his laboratory, which wrecked the entire cottage. This happened soon after the British Government had begun to negotiate with Sawbridge for the purchase of his invention; but the explosion that killed him destroyed any records there might have been of his work. It was not fulmite that killed him, but an accident with ordinary nitro-glycerine.

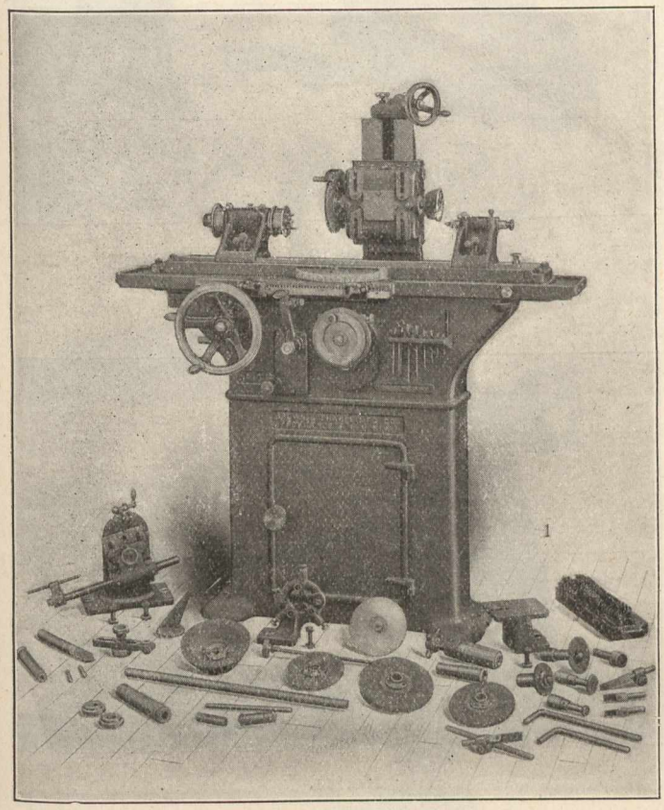
## HORSE-POWER OF SLIDE VALVE ENGINE.

To find the horse-power of a plain slide valve engine: Square the diameter of the cylinder and divide by 4. This estimate is based on a piston speed of 300 ft. per minute, and a pressure of 60 to 70 lbs. of steam. Doubling the speed would double the power, the ports being of sufficient area.

—The American Steam Gauge & Valve Mfg. Co., have again been compelled to seek new quarters, owing to the increase of their business, and are at present removing their entire plant and offices from Bismarck street, Roxbury district, to the large brick buidings, 208-220 Camden street, Boston, Mass. The buildings have floor space of 85,000 square feet. The Mowry & Phillips foundry department will also be removed from South Boston, and every branch of the business consolidated at the Camden street factory. The new plant will afford them more than double the present capacity, and will be employed in producing their valves, gauges and indicators; also special metals and foundry work in the Mowry & Phillips department.

## UNIVERSAL AND TOOL GRINDING MACHINE.

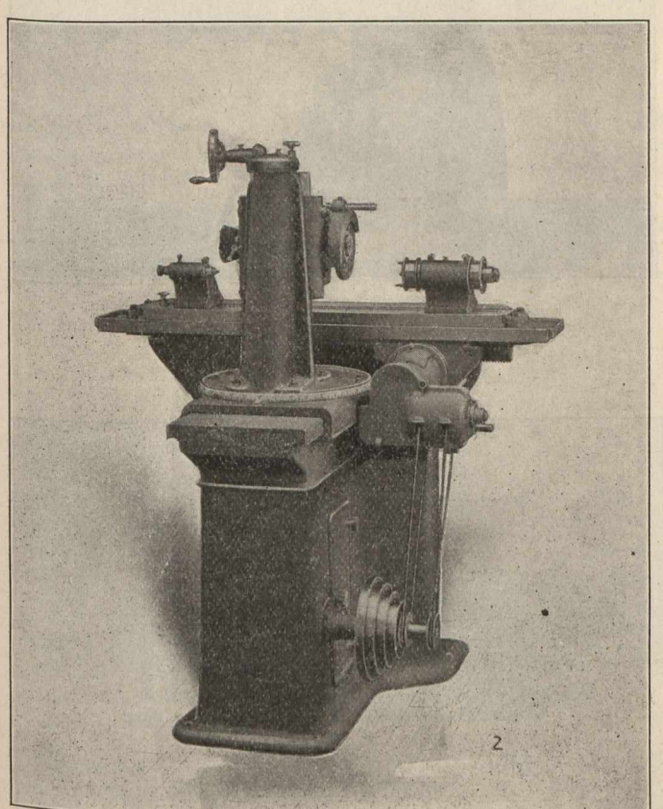
One of the most complete machines recently placed upon the market is the Universal and Tool Grinding Machine, illustrated herewith. It is designed to meet the requirements of the tool room in the grinding of milling cutters, formed cutters, straddle and face mills, bevelled cutters of



No. 1.

any angle, straight or taper reamers, etc., and in addition cylindrical grinding, either straight or taper, can be done.

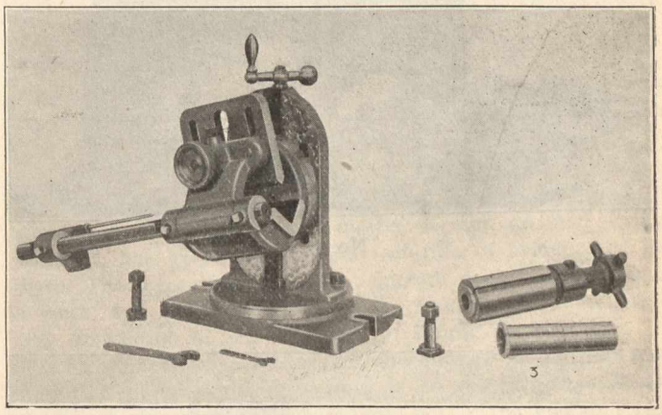
Attachments are furnished when desired, and fit the machine for internal and surface grinding, as well as the grinding of convex and concave cutters whose teeth are not



No. 2.

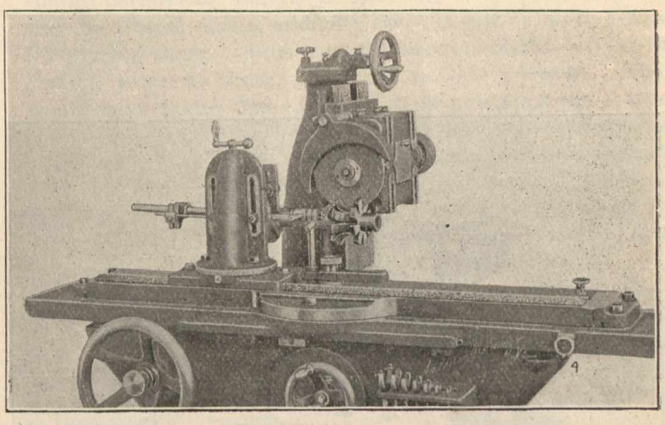
formed and require to be ground on the periphery. These features adapt the machine particularly to the needs of shops where the volume of work does not warrant the installation of grinding machines of different kinds to accommodate the variety of work that can be ground upon this machine.

An idea of the rigid construction of this machine can



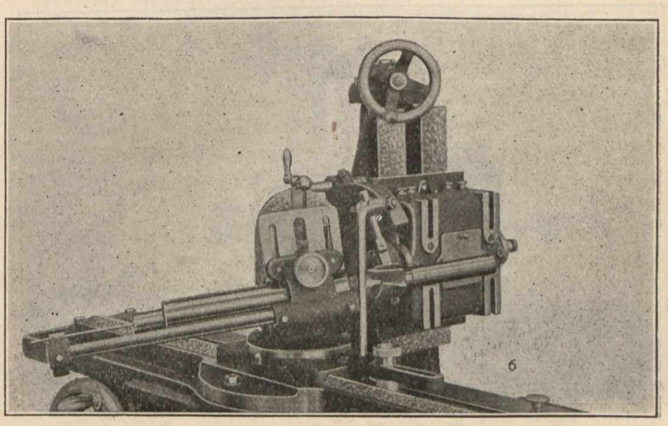
No. 3.

be obtained from the two views shown in Figs. 1 and 2. The wheel is supported by a column that swivels upon a large central stud. The support for this column, as will be seen, reaches to the floor and forms a part of the base of the machine, thus adding much to the rigidity. The base of the column is large in diameter and affords ample bearing surface to insure maintenance of alignment. It is graduated to read to 90 deg. either side of centre line to allow for setting the wheel to grind tapers, etc. The swivel table differs to some extent from that of the Universal Grinding



No. 4.

Machine in order to meet the requirements of grinding abrupt tapers on cylindrical work or cutters of abrupt angles. For this purpose there is a graduated arc placed upon the front of the table, which reads to 45 deg. beyond the parallel position. When grinding angles greater than can be reached by the swivel table, the head-stock spindle is placed



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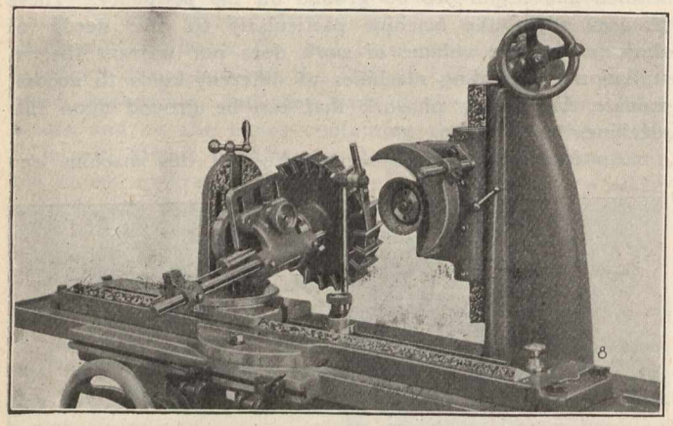

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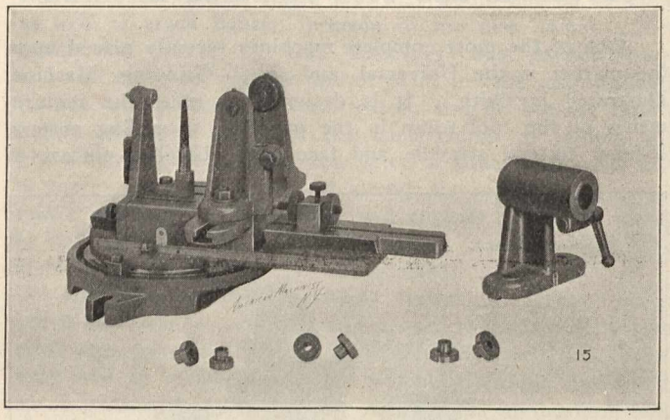

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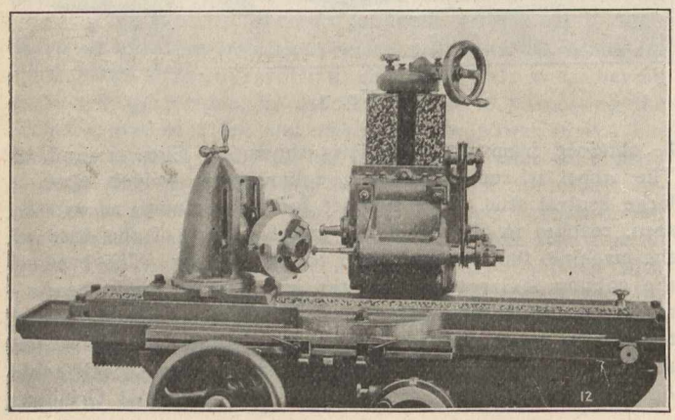

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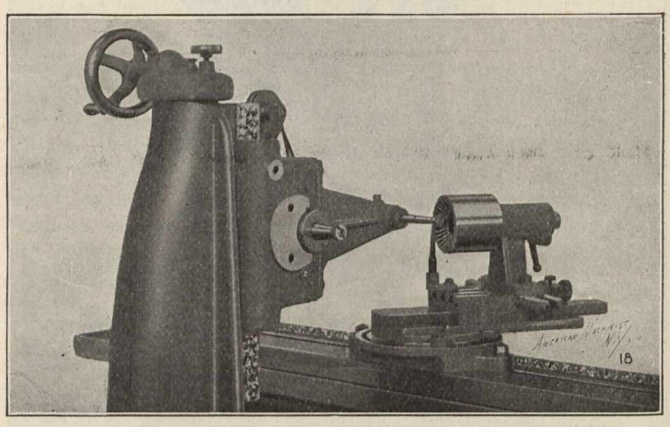

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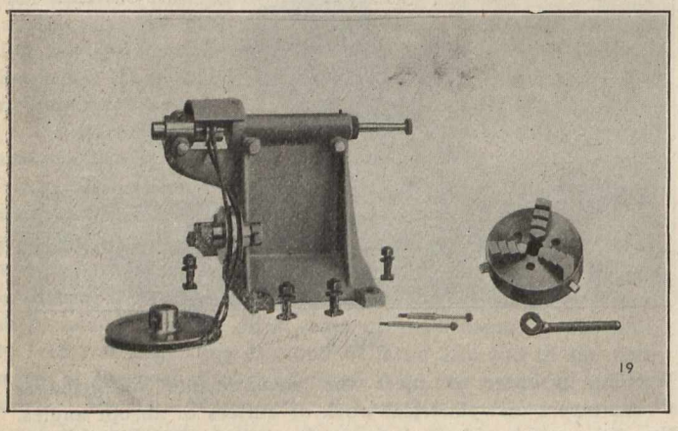

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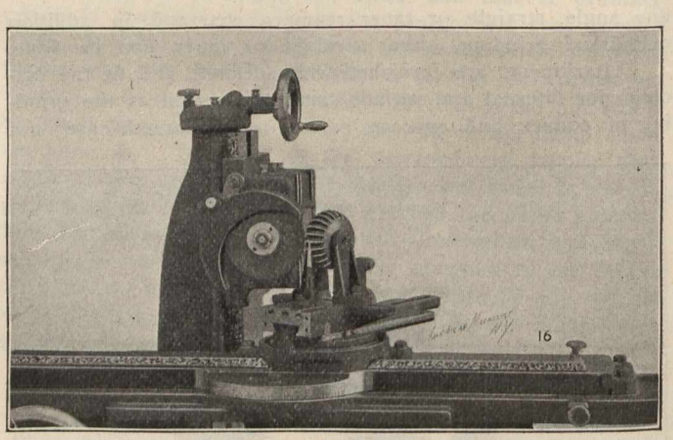

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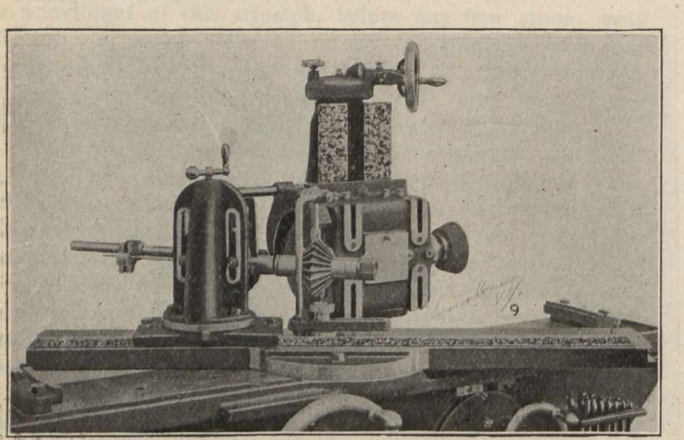

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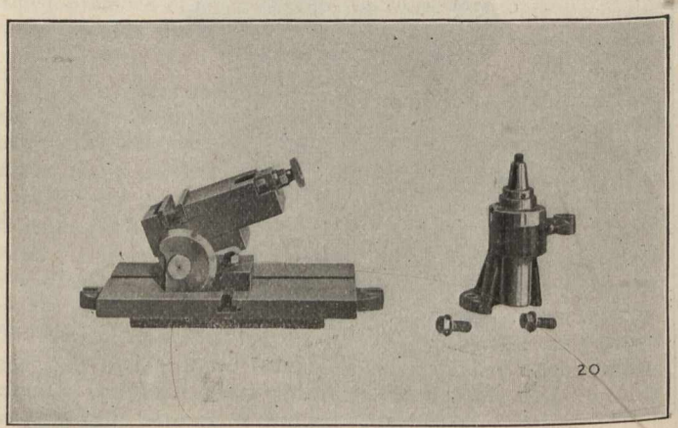
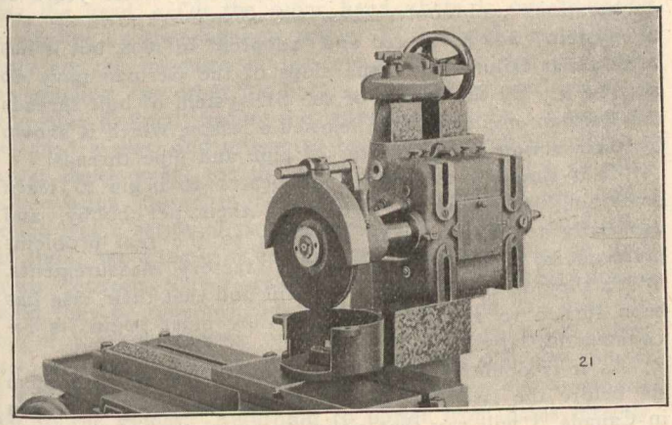


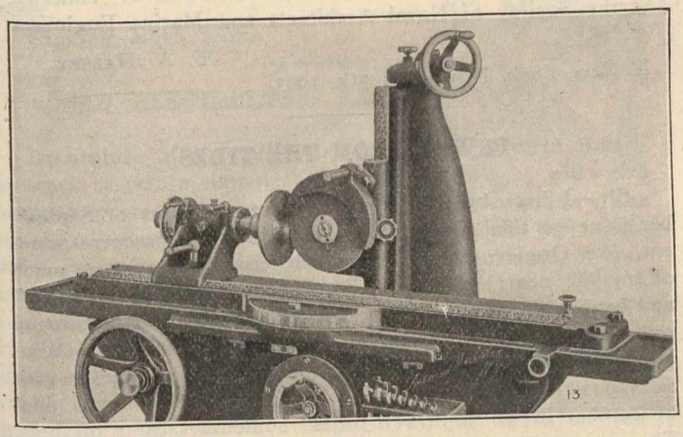
No. 13.

in the universal head shown in Fig. 3. This head is used for a great variety of cutter grinding, as shown in Figs. 4, 5, 6, and 7. The internal grinding attachment, Fig. 8, is used for grinding either straight or taper holes as well as cutters with fine teeth that require small wheels running at a higher speed than can be obtained from the main wheel spindle. Its application is shown in Fig 9.



No. 14.

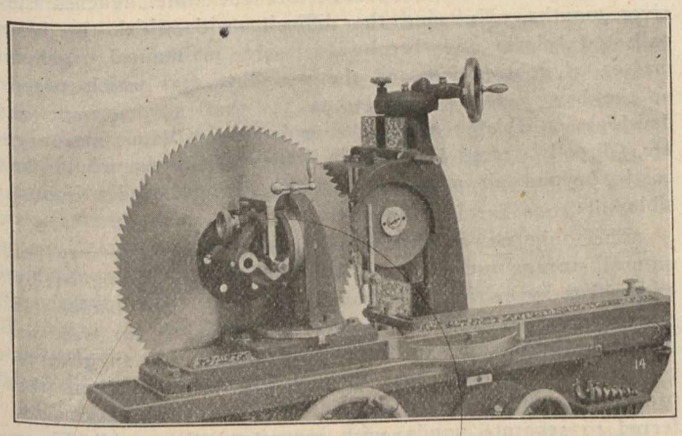
An attachment for grinding convex and concave cutters, Fig. 10, and work of a similar nature is furnished when desired. This attachment consists of a base and two slides, the lower one of which swivels upon a large central stud, and the limit of the movement is controlled by adjustable stops. A series of graduations on the side of this slide pro-



No. 15.

vides for adjusting to the correct radius. Provision is also made for mounting a diamond on the slide to be used in trueing off the wheel to the proper radius. Figs. 11 and 12 show applications of the attachment.

The attachment for surface grinding is convenient for



No. 16.

all varieties of surface grinding, as flat gauges, angles, etc., and consists of a wheel spindle extension that fits over end of the main wheel spindle to permit the wheel being used over the entire surface of the table-plate. This attachment is shown in Figs. 13 and 14. Fig. 15 shows the wheel spindle set at right angles to the table, in position for grinding the sides of a saw or cutter held in the face chuck. Fig. 16 shows the method of grinding large saws to 24-in. diameter. This grinding machine is made by Brown & Sharpe Mfg. Co., of Providence, R.I.

## THE METRIC SYSTEM.

Editor Canadian Engineer:—

Sir,—Referring to the articles on the metric system in your November issue, I note that you repeat the assertion that the system has been adopted by forty-four countries.

This assertion has been made so often that it has come to be generally believed, and, no doubt, it is repeated in good faith, but, as a simple matter of fact, no man, living or dead, has ever seen the first scintilla of evidence of its truth. The mere repetition of an untruth does not make it a a truth, and this statement has no foundation in fact, nor any foundation of any kind, except simple assumption.

Experience has shown that the change involved in the adoption of the metric system is so difficult that in no nation of the world is it complete, nor is the end in sight, but, notwithstanding this experience, the metric advocates start out with the primary assumption that the change is an easy one. According to your count, forty-four countries have adopted laws of some kind that are favorable to the system, and, having assumed the change to be easy, you follow that assumption by another—that because of these laws the people of these countries have dropped their old measures and taken up the new.

Your party have never enquired into the working of these laws, nor into their wording, their scope nor their purpose. Had they done so, they would have learned that in some of these so-called metric countries the laws are simply permissive, exactly as they are in Canada, England, and the United States, and that there is just as much reason for placing those countries in the metric column, as for including some of those which are in that column. They would have found that in many more countries the system has been adopted for Government purposes alone, and that there is no basis for the slightest pretext that it is in common use in trade and commerce. They would have found that in some of these countries the system has led to the most grotesque mixture of old and new units and in none is it universal.

The evidence which I have collected in support of the above assertions could scarcely be contained in an issue of your paper, and for it I must refer you to my forthcoming book,—The Metric Fallacy—which is now in the printers' hands, and from which I shall draw for the remainder of this letter.

Nowhere has the system been adopted by any people except under compulsion, and I am unable to understand why it should be necessary to compel people to use such a good thing as this is claimed to be. Moreover, nowhere has compulsion succeeded in driving the old units out of factories nor in stopping their use in trade and commerce, though it has been far more successful in commercial than in industrial measurements. It is easy to show, and my book will show, why this is so; the basic fact being that in any country in which the individual has any rights whatever, compulsory laws have no jurisdiction over factory measurements.

As an illustration, it is a fact that, while the system has been compulsory in Mexico for nineteen years, the lumber industry of that country is still conducted as it is with you and with us. Lumber is sawn in length, width and thickness to feet and inches, and the price and bargain for a sale of lumber are based on the thousand feet, but, when the purchaser gets his bill, he finds that the bookkeeper, out of respect for the law, has converted the thousands of feet into square metres, and the bill calls for so many square metres of one-inch lumber. The purchaser then converts the figures back to thousands of feet in order to verify his bill, and of course you will recognize the large saving of

time in calculation which results from this double and useless conversion! Similarly, bills for the purchase of bar iron in Mexico call for so many kilograms of one-inch iron (of Mexican manufacture), and this is called "using" the metric system. In both cases the commercial units are metric, but the mill units are English.

As another illustration, it is a fact that the fabrics which are sold across the shop counters of Paris, by the metre, are made in the mills of Lyons by the aune and French inch as units of length, and the denier as the unit of weight. The whole textile industry of metric Europe has been laid bare by Mr. S. S. Dale, editor of the Textile World Record, of Boston, and from the metric standpoint it is the most screaming of farces. In all the textile industries of metric Europe, outside of the cotton industry in France, there is no pretext that the metric is the mill system of weights and measures, while in the French cotton industry, the system is pseudo metric only. In metric Europe they have to-day thirty-three systems of yarn numbering, but one of which is metric, and the combination of these systems produces a confusion which is beyond the understanding of any but a textile expert. The roaring farce of the metric system as applied to the textile industry is, however, too large a subject to be more than alluded to here, and I must refer those interested to Mr. Dale's remarkable exposure of the facts contained in The Metric Failure in the Textile Industry—which will appear as Part II. of the book above named, of which part Mr. Dale is the author. The facts are confirmed from French sources, and, best of all, by an agitation which is now on in France for more compulsory law to compel the textile industry to use the system. No cause ever had such a staggering blow as the metric cause has now in this demand for more compulsory law in France after the people have had the wonderful superiority of this system under daily observation for more than a century.

Nearly universally in this discussion the metric advocates ignore completely the crux of the whole matter—the problems involved in changing the list of sizes to which all manufactured things are made. Examine a graduated English scale of suitable length and its divisions represent the dimensions to which all parts of all manufactured things are made by English-speaking people. Similarly a metric scale gives the sizes used in metric countries, except that in all metric countries there are many exceptions due to the imperfect adoption of the system. The proposition is that English-speaking nations shall change from one set of sizes to the other. The strength of this movement lies with scientific men, but will you tell me why a scientific man is qualified to express an opinion upon the purely factory problem of discarding a set of sizes to which all manufacturing processes and plants are adjusted and adopting a new set? Scientific men are measurers not makers. The change in scientific work involves nothing but a change in measuring instruments, while in industrial work it involves a thousandfold more radical change in the sizes of the things measured—that is of the things in process of making.

The few who recognize the difficulties of this change in sizes tell us that we will make the change only in those cases in which it is easy—that in the case of standardized things, as bolts and nuts, pipe, and fittings, etc., the present sizes will be retained, but that they will be measured in millimetres instead of inches. As is shown in the above-named book, this scheme is hopelessly impracticable. In France and Germany the Whitworth screw threads are in nearly universal use, and they are always measured in inches. That is, the very thing that we are told we are to do in the case of screw thread standards is just the thing which the French and Germans do not do.

Only last summer at its July meeting the German Society of Engineers, in co-operation with associations of pipe makers and users, adopted a "new" standard of pipe and pipe threads* of which, in the published tables, the bore of the pipe and the pitch of the threads are given in English inches and in no other way. This "new" standard is substantially the Whitworth standard which the German engineers thus acknowledge they cannot change, and thereon hangs a tale.

Beginning in the early 90's and culminating in 1898 a tremendous international effort was made by the engineering societies of the leading nations of metric Europe to introduce a metric system of screw threads. After years of deliberations and conferences, the system (known as the SI. system) was presented and "adopted" in 1898, but it has been a flat failure—even the ships of the German navy do not use it. By the failure of the SI. system of bolt threads the German engineers have learned a lesson, which is shown by their action in the matter of pipe and pipe threads.

It is time for the metric advocates to begin to learn something of the real history of their pet hobby, and especially to devote some attention to the real problems involved in changing a system of factory measurements. When they do these things they will find that their case has been turned to ridicule, and that they must begin its reconstruction afresh.

As it is doubtful if the opposition to the metric system bill before the last American Congress* has become known in Canada, I will say that since the reporting of the bill it has been formally condemned by the following organizations: The National Association of Manufacturers, the National Association of Machine Tool Builders, the American Society of Mechanical Engineers, the Railway Master Mechanics' Association, the Master Car Builders' Association, the National Metal Trades Association, the Engine Builders' Association, the Providence Association of Mechanical Engineers, the Furniture Association of America, and the Society of Naval Architects and Marine Engineers.

F. A. Halsey.

New York, November 7th, 1903.

*See Zeitschrift des Vereines Deutscher Ingenieure, for Sept. 5th, 1903.

* This bill did not become law as your editorial implies, and the system is *not* required in Government or any other transactions

## POWER FROM THE TIDES.

Sir,—I have been interested in your remarks of September issue on tidal power, and also those of your correspondent, Mr. Ongley, on the same subject. I have spent much of my life near the Bay of Fundy, this "Baie de la Fond," and have had some experience in the construction of bateaux or dykes across its rivers for the purpose of land reclaimation; which work has brought me into direct conflict with tidal power. There has been on these shores many a trial by combat in which "Davy Jones" sometimes came off best. There are many conditions to be considered, and first is storage of power. This solved, we then have the condition that, although the extreme rise and fall of tide in the bay is about 60 feet, only one-half of this is available under the usual conditions, for the opportunities for power development lie almost wholly at the river mouths, and inward along the banks and not on the bold, rough shores of the bay; and it is about half-tide before the water reaches the river mouths. Knowing the difficulty with which the best ballasted piers and breakwaters are maintained against masses of floating ice, and the pounding seas which sweep up the bay, I do not hesitate to say that any attempt at development which requires the projection of dams, masonry, etc., directly across the paths of these elements would be costly beyond all possible economy, if not wholly impossible.

The only power development possible in the way of natural storage must be by dams across the rivers, or by excavating basins in the alluvial soil along their banks. If power were taken by dams directly across, I can see no advantage in the two or three pond system you suggest, as the same water must pass through all the dams, and the process of refilling would still interrupt. I presume you referred to separate ponds, with separate outlets. All things considered, it seems that a dam with a system of wheels large enough to let out all of the water at a single tide, with another system to be operated by the incoming tide, gives all there is in both time and power. Another feature

that must be observed is that a mean must be established between time and head. If a turbine be placed in the bottom of the river channel, one would, when the tide was out, have the greatest available head of 30 feet, but we have reduced to the minimum the time from which the wheel is uncovered till it is again covered by the return tide; while if we locate the wheel higher, we will gain more time but lose the head. On the other hand, there is one thing in our favor, an abundance of water. Within sight of where I write are the remnants of two old tidal mills, one was used for grinding, the other for light wood-working machinery. I remember distinctly seeing the latter in operation. I recently designed a pier, and attempted to combine with it sufficient power development for the working of crane and hoist, the power being stored in the form of compressed air. My design was a series of rectangular timber boxes or pontoons, air tight, set directly under the pier, and moving up and down between timber guides. Considerable lifting power could thus be obtained, but after all we could use only the top of the tide, unless on a very bold shore where piers are rarely built or used. And even with this difficulty solved, I am of opinion that ice would have frozen the pontoons fast to the guides. Returning to power from dams directly across river channels, there are places near me where tidal rivers 300 to 1,000 feet wide at their mouths are filled and emptied twice in twenty-four hours, and for a distance of two to four miles inland, while along their banks villages are paying high prices for electric lighting with coal. In these cases I think there is little doubt as to both feasibility and economy. Outside of these conditions, I do not see at present any hope of practical application of tidal power.

WM. RAND,
County Engineer.

Canning, Nova Scotia.

## AN ELECTROLYSIS PROOF CONDUIT.

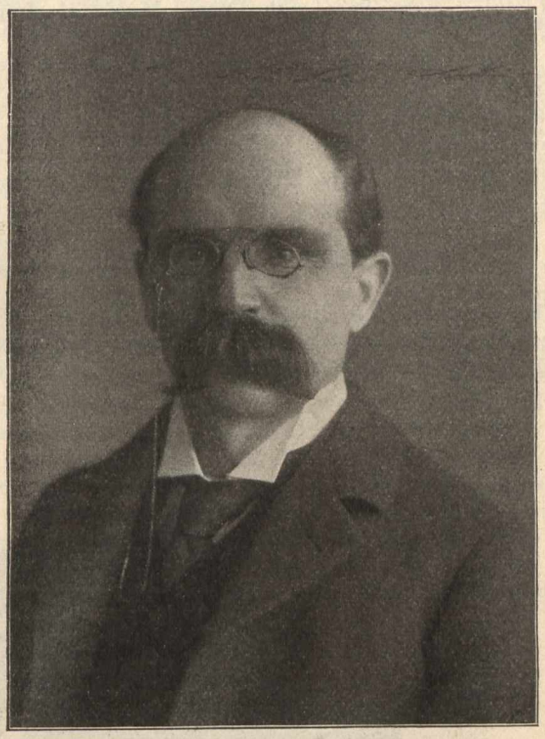
No feature of a conduit for use in underground electrical work is more important than that which will give thorough protection to cables from electrolytic action. The amount of money spent by telephone and electric light companies in replacing cables which have been enclosed in conduits not electrolysis proof, is very considerable. With a view of entirely overcoming the evils due to electrolysis, the American Conduit Company have been successful in producing a bituminized fibre conduit which is moisture proof, non-abrasive, non-corrosive, a perfect insulator and absolutely electrolysis proof. Exhaustive tests made of this conduit enable the company to guarantee it against breakdowns for systems employing a current of from 25,000 to 30,000 volts. Actual tests have been made up to 60,000 volts before any breakage occurred. Another remarkable feature of this conduit is its extreme lightness and the ease with which it can be handled, two men being able to carry a crate containing 140 feet of three-inch duct. Being made in seven-foot lengths and the method of joining unit to unit being very simple, it is claimed that with unskilled labor a greater amount can be laid in a less time, with fewer men and at a lower cost than any other conduit, which owing to greater weight and shorter lengths, require skilled labor and more men. Several millions of feet of this conduit is in use in Chicago, Kansas City, San Francisco, Portland, St. Louis, and other cities; large contracts have been made during the past year with some of the most important railroads, lighting and telephone companies in the United States. From the testimonials received from engineers of companies using this conduit, there is no doubt that its merits are such as will ensure its adoption by a large number of telephone, electric light and power transmission companies in the United States and Canada.

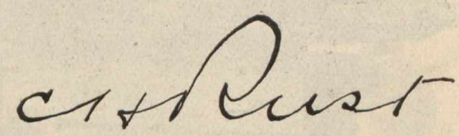
The American Conduit Company have just established a large factory at Philadelphia, which, together with their factories at Chicago and Los Angeles, will enable them to accept contracts and make prompt deliveries to any point in the United States or Canada. Complete details of the cost of laying under all conditions, and estimates will be given of the cost of constructing underground systems, on application to their nearest office.

## THE AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.

The recent convention of this society, held at Indianapolis, was of more than usual interest to Canadians from the fact that its president for the past year has been City Engineer, C. H. Rust, of Toronto, Ont. Mr. Rust's election to that position was no doubt due not only to the society's appreciation of the value of his wide experience and counsel in the matter of municipal improvements, but also to the high reputation as a beautiful and well managed city, which Toronto has gained in the minds of the many Americans who visit that city, much of the credit for which is due to the able administration of the City Engineer's department by its chief. It is, nevertheless, gratifying to find Canadians taking such a prominent part in the proceedings of societies, representative of the municipal engineers of the largest cities in the United States.

In his presidential address, Mr. Rust referred to many important matters relating to municipalities, among them being the growth of street railway systems, the necessity of



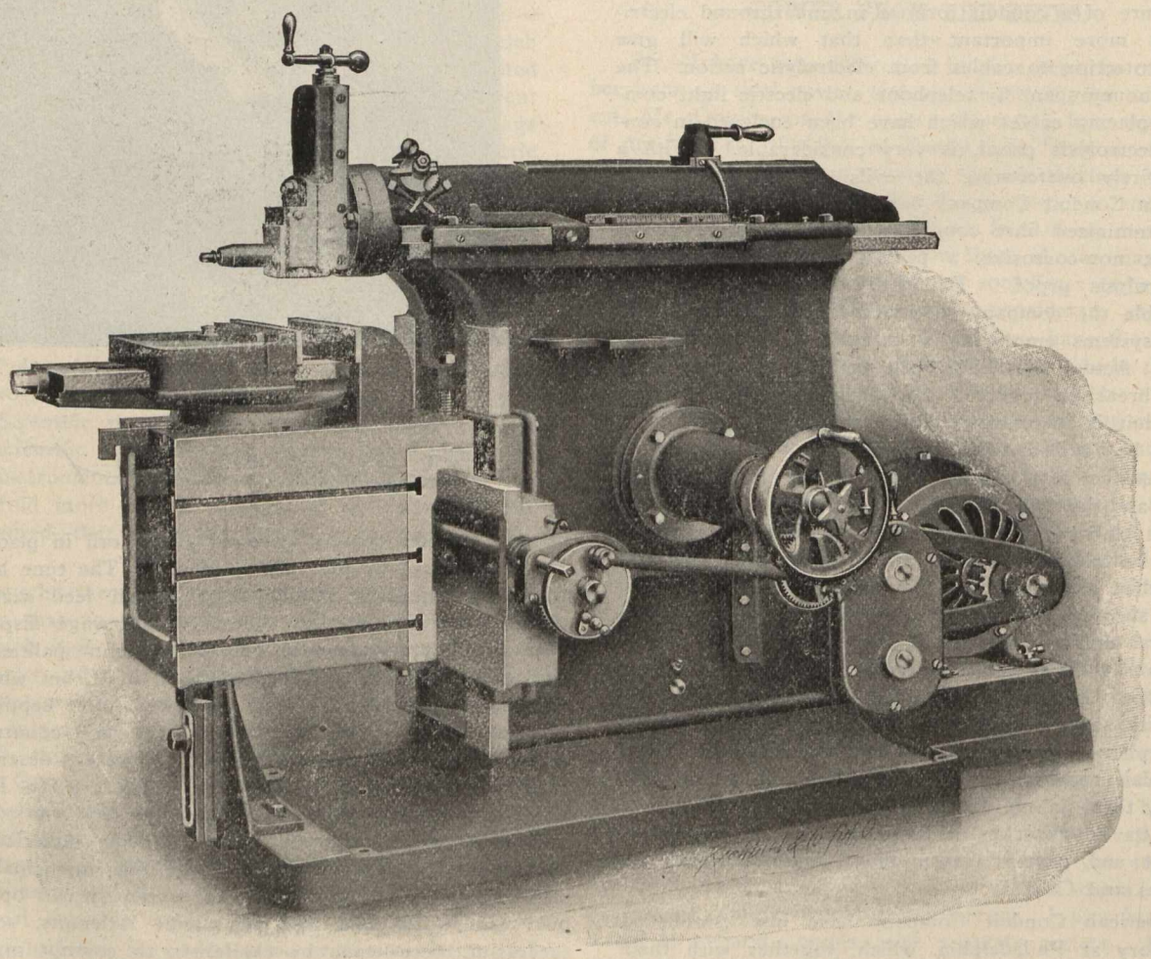


using a heavier type of grooved girder rail in place of the T rail preferred by the railway officials. The time had come when municipalities should insist on all feed wires being placed underground. The question of sewage disposal had been brought prominently before the municipalities. Every city, of course, was a special study in itself, but where suitable soil was available, land treatment, after septic action, was the most satisfactory method for this country. The prevention of the unnecessary use of water deserved the earnest consideration of municipal officers. In European cities forty to fifty gallons per head, per day, was considered sufficient for all purposes while in some American cities 150 to 200 gallons was used. Regarding municipal ownership there was no doubt that every city should operate its own waterworks and lighting plant. Attempts, sometimes successful, were made by capitalists to corrupt municipalities in order to obtain franchises. This would be abolished by municipal ownership. The frequent change of officers, caused by the introduction of politics into municipal government in American cities, was much to be deplored. The Canadian system of appointing officials was more satisfactory. An official could not be a good engineer and in addi-

tion devote his time to politics. At the first session Mr. George M. Ballard spoke on "Municipal Taxation." He recommended that the laws permitting exemptions should be repealed because taxes should be assessed against all alike. Real estate should be first assessed so that proper equalization might be determined and then betterments could be considered. All personal property should be taxed. Street Commissioner John Jones, of Toronto, chairman of the committee on the disposal of garbage, and on street cleaning, discussed the methods employed in Toronto for destroying garbage. He stated that a garbage destructor, costing $5,000, was being used, the capacity of which is sixty tons, and the cost of operation 20 cents per ton. Superintendent of Heney Park, G. A. Parker, of Hartford, Conn., and chairman of the committee on parks, insisted that parks are absolute necessities in city life, and that the park area in cities is entirely too small. He called attention to Ottawa, Ont., as a city of model parks. A number of other papers were read, including "Sanitation of Public Buildings," by Professor Burridge, of Purdue University; "The Records of the City Electrician," by A. S. Hatch, engineer of the Lighting Commission of Detroit; "Have Improvements in Arc Lighting Kept Pace with Other Municipal Improvements?" by H. W. Hillman, of the General Electric Company; "The Perviousness of Sewers," by Professor Folwell, of Easton, Pa. G. M. Ballard, of Newark, was elected president for the ensuing year. The other officers include E. G. Barrow, Hamilton, Ont., 3rd vice-president, and Alcide Chausse, Montreal, Que., member of the financial committee.

## THE "AMERICAN" SHAPER.

The accompanying illustration shows the new 28-inch "American" shaper, motor driven through speed box, just brought out by the American Tool Works Co., of Cincinnati, O. The motor employed may be of any type, constant or variable speed, single or multiple voltage. It is mounted on a substantial extension to the base at the rear of the machine, and may be readily connected to the speed variator by gear or silent chain. The "American" speed variator, taking the place of the cone pulley is of simple and powerful construction, requiring only six gears for the mechanical speed changes. These changes of speed are obtainable instantly while the shaper is in full operation, by an improved form of patent clutch and lever mechanism, the levers being conveniently located. The number of speeds thus obtained is of course doubled by means of the back gears. The whole is encased in a neat and symmetrical box, with provision for easy access to working parts, and ample means for lubrication. The necessary adjustment for any desired speed can be readily determined by reference to a convenient index on gear box. This machine is also suited to belt drive from countershaft, through single pulley mounted on an extension of the upper shaft in the gear box, and the unusual flexibility of this construction makes it a simple matter to convert a machine thus installed as a belt driven shaper, into a motor driven shaper at any future time. The stroke of the ram is positive, and its length may be changed at will, without stopping the machine. Rocker arm is pivoted near the base line, giving the ram an almost uniform rate of speed its entire stroke, and providing an exceedingly quick return. Cross feed is variable and automatic, with wide range of feeds, and readily adjusts itself to any elevation of the rail. Reverse of feeds is easily accomplished, without stopping the machine. This shaper was designed for strength and capacity for continuous hard service at fast speeds and heavy feeds. Further information will be cheerfully furnished by the makers.



## THE BERLIN-ZOSSEN ELECTRIC HIGH SPEED RAILWAY.

In view of the record speeds in electric traction recently obtained on the Berlin-Zossen military railway—the highest recorded being at the rate of 130 2-5 miles per hour—the following details supplied by the "Electrical Engineer," London, England, will be of interest. The first experiments on this railway were made two years ago, but since then the track from Marienfeldt to Zossen has been relaid with new steel rails weighing 86.1 lb. per lineal metre, resting on heavy spruce ties 22-in. from centre to centre, and heavily ballasted

with broken basalt. The rails are set on each tie in a steel chair, strongly bolted down, and are joined perpendicularly by bevelled joints 7-in. in length, held firmly together by bolts passing horizontally through the fish-plates, so that the effectiveness of a continuous rail is practically secured. The old light rails, which failed in 1901, and were taken up, have been laid down flat as guard rails, resting horizontally on special cast-iron chairs in such a way that the flat bottom flange of the rail stands vertically along the inside line of each heavy rail, and about 2-in. distant from the inner edge of its face. The track is a nearly level air-line throughout its length, except one curve of 2,000 yards radius near its southern extremity, and is up to the highest standard of modern railway construction. The motors have been improved, but the cars are the same as when first constructed. Each is 72.18 feet in length, and weighs about 200,000 lbs. avoirdupois. Of this weight 48 metric tons comprise the body and running gear, and 42.5 tons are made up by the motors, transformers, and other details of the electrical equipment. Each end of the car rests on a six-wheel bogie truck of the American type, and the motors are four in number, one attached to the front and rear axle of each truck, the middle pair of wheels in each group running free. The wheels are 49-in. in diameter, and are equipped with pneumatic brakes of the standard type. The transformers, which are hung beneath the middle section of the car, weigh 12 tons, besides which a storage battery of 631 lbs. weight supplies the current for lighting purposes.

## NOTES ON THE STEAM TURBINE.*

By Prof. Homer M. Jaquays, of McGill University.

The turbine, the oldest type of steam engine, has always attracted more than an ordinary amount of attention, but the results of the epoch-making events of 1884 and 1889, when patents were awarded the Hon. Charles Algernon Parsons and Dr. Gustaf De Laval, respectively, have increased this interest to an almost unlimited degree. Trevithick, Pilbrow, Wilson, and possibly others, grasped the salient features of the modern turbine; but it needed modern workship facilities with the attendant accuracy of workmanship and attention to detail, to make the turbine a commercial success. When we realize that it is not twenty years since the application was made for the first letters patent for the Parsons turbine, and that it was as late as 1891 that the first condensing turbine was produced, we cannot but wonder at the success it has achieved, and the world-wide interest it has excited. Previous to the last decade, conservative engineers in general undoubtedly looked askance at rotary engines and turbines; but it needs only a glance at the modern turbine to perceive mechanical features which must meet with approbation, and a closer examination cannot fail to call forth admiration for the ingenuity displayed and the persevering attention to detail in every part.

The modern parallel flow turbine is too well known to need a detailed description, but it will not be amiss to insert here the general principles of its chief types. They all depend for their action upon the conversion of the kinetic energy, caused by the expansion of the steam into work done on the rotating turbine shaft. In the De Laval turbine the expansion of the steam takes place in one or more nozzles before it reaches the turbine blades. In the Parsons this expansion takes place during the passage of the steam through the turbine, while in the Curtis turbine we have the application of both these principles. The De Laval, with its one row of blades, must, in order that the velocity of the steam leaving the blades be not excessive, have a very high peripheral velocity. In the Parsons and Curtis turbines, however, the employment of many rows of stationary and rotating vanes makes it possible to diminish the speed of the turbine shaft, without reducing the efficiency.

As regards the velocity of the turbine blades, it is not difficult to find the one that is most efficient. Suppose $V_1$ be the absolute velocity in feet per second of the steam as it strikes the vanes and $V_2$ the absolute velocity of the steam leaving the vanes, the greatest amount of energy that can be given to the turbine per pound of steam is $\frac{V_1^2 - V_2^2}{2g}$ foot pounds, and in order that this should be a maximum, $V_2$ must equal nothing. This is the case when the velocity of the vane is one-half the velocity of the impinging jet, and when the direction of the motion of the vane is parallel to that of the impinging and leaving jets.

This condition cannot be realized in steam turbines, though it may be noticed in passing that a close approximation to it is obtained in the case of the Pelton water wheel. But the velocities dealt with when working with steam are immensely greater than can ever be experienced with water. Thus, with a head of 200 feet, the velocity of the water entering the turbine could not exceed 113 feet per second. In the case of turbines of the De Laval type, however, where the steam expands in a diverging nozzle from initial pressure to condenser pressure, it is estimated that velocities of 4,000 feet or more per second must be employed. This velocity can, of course, be regulated by the form of nozzle. But for economical working, as large a proportion as possible of the heat energy of the steam must be changed into the kinetic energy of the gas, the velocity of which, since it has a large specific volume, must be very high. It is stated above, that for maximum efficiency the velocity of the vane should be one-half the velocity of the impinging jet. But a vane velocity of 2,000 feet per second would, of course, cause such centrifugal forces in the turbine wheel as no known material could safely bear. Turbines, with a single row of vanes using high pressure steam, must consequently run at a speed lower than the most efficient—a peripheral velocity of 1,000 feet per second being about the limit. The introduction of many rows of moving and stationary vanes at once overcomes this difficulty. The steam loses some of its velocity at each row, and so, on this principle, turbines have been made that run efficiently at speeds not much in excess of those of some high-speed reciprocating engines.

Figure 1 shows the working parts of a De Laval turbine, and Figure 2 is a sectional plan of the same. The steam enters the nozzle from the chamber D, where it is completely expanded, passes through the turbine bucket F to the exhaust chamber G. The important features are the diverging nozzle referred to above, the fact that there may be considerable clearance between the wheel, casing and nozzle, the flexible turbine shaft with its flexible bearing, the

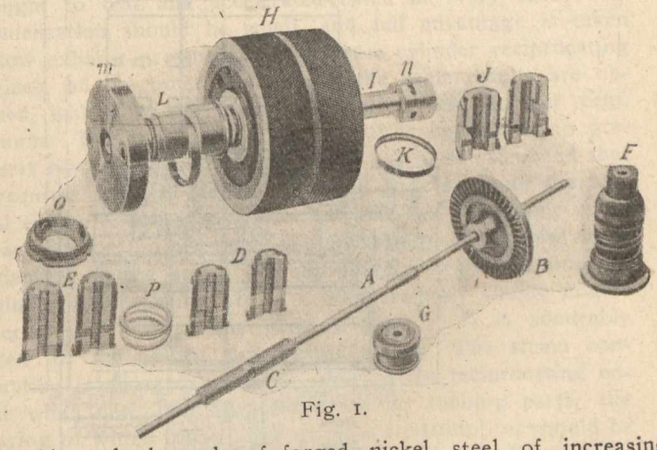



Fig. 1.

turbine wheel, made of forged nickel steel of increasing thickness from the periphery to the centre to resist centrifugal force; above all, the high velocity of the turbine wheel, and the gear wheels required to reduce this velocity usually in the ratio of about ten to one. It is interesting to notice in passing some of the forces acting on this turbine. Suppose in a 10-H.P. turbine the speed of the turbine shaft is 24,000 revolutions per minute and the diameter of the turbine wheel 4.8 inches, the torque on the flexible spindle will be about 26 lbs. inches, and the total tooth pressure approximately 50 lbs.

Figure 3 shows a longitudinal section of the Parsons turbine, as manufactured by the Westinghouse Machine Company. In this the steam enters at A, passes through the stationary to the rotating blades through the high pressure, intermediate and low pressure cylinders, exhausting at B. As stated above, because of the many rows of stationary and

* From a paper read before the Canadian Society of Civil Engineers.

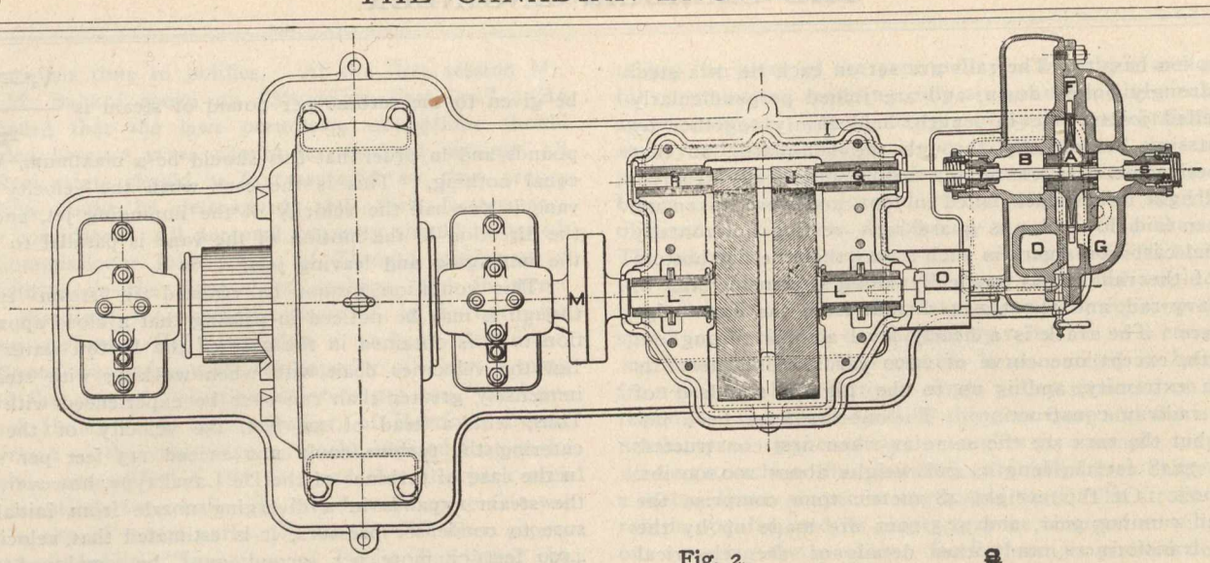



Fig. 2.

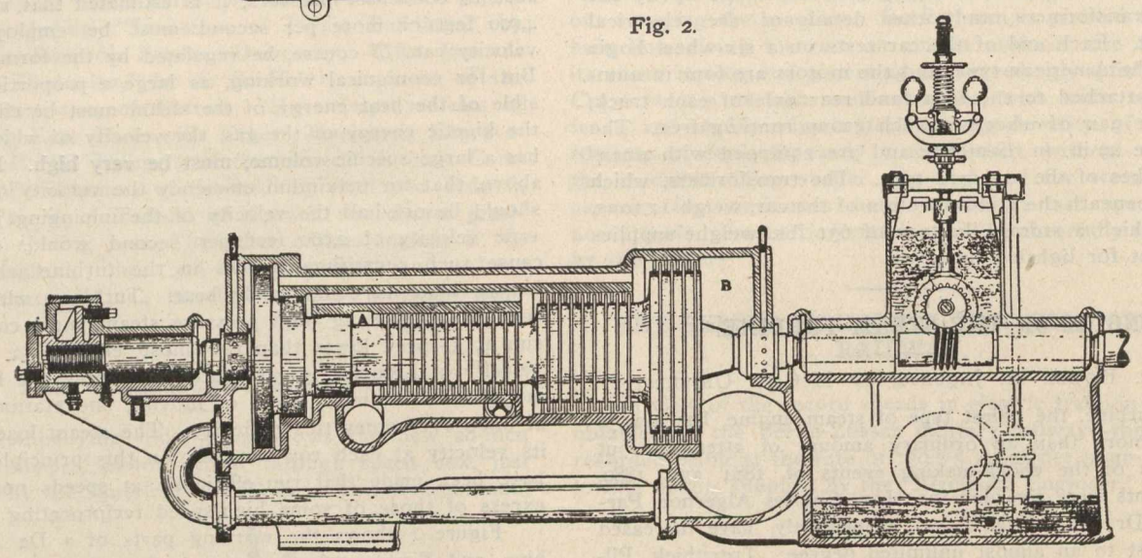



Fig. 3.

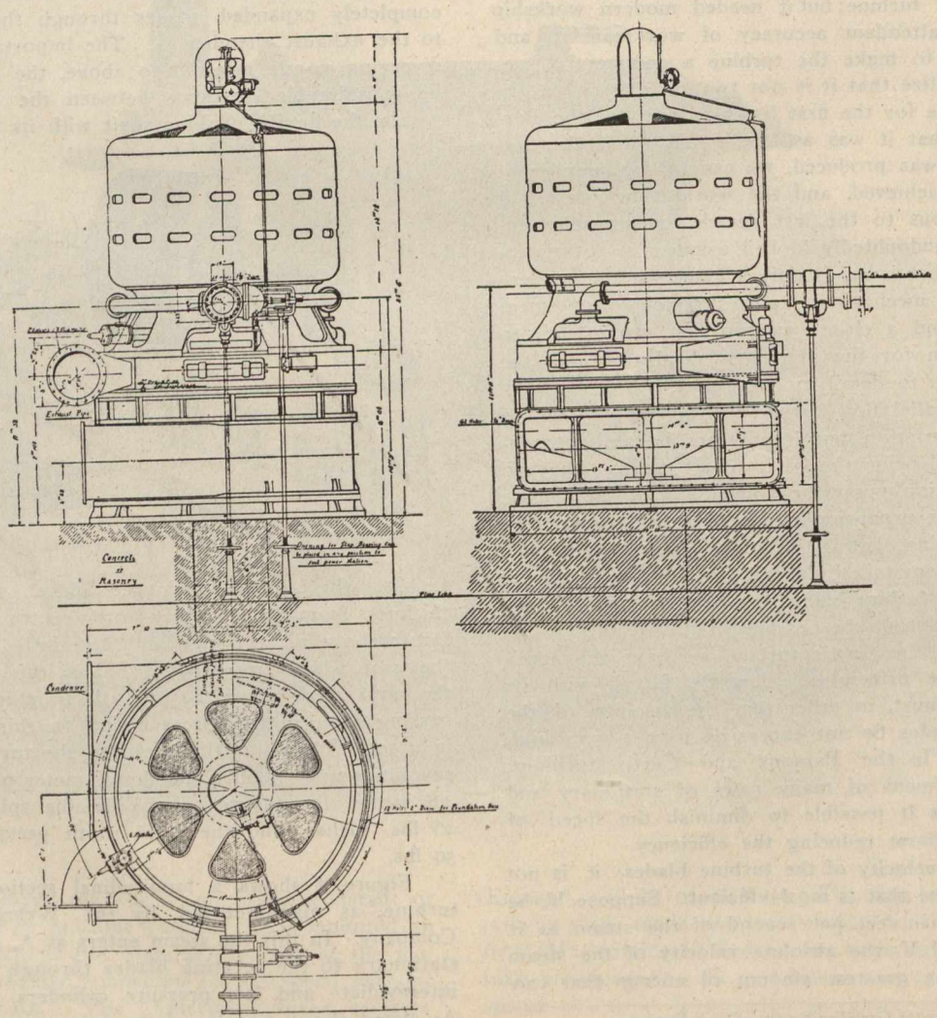



Fig. 4.

rotating vanes and the reduction of speed with each pair of vanes, the speed of the Parsons turbine can, by multiplying the vanes, be reduced to almost any amount. The end thrust is counterbalanced by three rotating pistons placed on the turbine shaft. Many of the details of the Parsons turbine are worthy of special study. The method of preventing leak past the balancing piston and the manner of getting the turbine shaft through the case are examples.

The Curtis turbine, Fig. 4, unlike the two types described, has a vertical shaft in sizes above 500 kilowatts. It is perhaps best described in the maker's own words:

"Each stage or element of the Curtis turbine essentially consists of a group of expanding nozzle sections, which delivers steam to the first of a group of wheels or rings of buckets. Between the successive rings of buckets rows of stationary buckets, called "intermediates" are placed in the region opposite to the group of nozzles, the function of these intermediates being to reverse the motion of the steam received from one set of moving buckets, and to deliver it against the following set of moving buckets in an effective direction. The steam from one group of nozzles may thus be passed by the action of successive intermediates through several rows of moving buckets, the number of such rows associated with a single group of nozzles being governed by various mechanical and theoretical conditions. The group of nozzles imparts motion to a column of steam, most of the energy of the steam expansion being transformed into this motion. This motion is then fractionally abstracted by the passage of the steam through the successive rows of moving buckets.

"The above described circle of operations takes place in what is known as one stage of the Curtis steam turbine, and it is generally desirable to use two or more of such stages, in order that the expansive force of steam may be effectually utilized. Where a plurality of stages is used, the turbine conditions are so arranged that all the stages, under normal conditions, will perform approximately equal amounts of work. All the losses and efficiencies of one stage take the form of heat in the steam, and are therefore more or less available as motive force in the succeeding stages.

"In our first commercial machines we adopted two such stages, three or four rows of moving buckets being used in each stage. In some of our later machines we have adopted four stages, with two rows of moving buckets in each stage. Under certain other conditions, other numbers of stages and arrangements of buckets will doubtless be adopted."

Parsons turbines have been running in England for over twelve years, a sufficient length of time to permit of some idea being formed as to their durability.

At Newcastle, a Parsons machine ran for 36,000 hours without interrupted service, and at the end of the run there was no perceptible wear on the blades. The oldest Westinghouse-Parsons machine has been running for four years only. The repairs, however, during this time are said to have been light and of a minor character, with no perceptible wear on the blades.

At the present time there are in England from 600 to 800 turbine plants either actually installed or sold. These aggregate 200,000-h.p. The largest unit installed is 3,500-h.p. A special feature might be noted here in this connection, that many of the plants in which the first installations were made have added further turbine horse-power. On the continent, Messrs. Brown, Boveri & Co., of Baden, Switzerland, manufacture the Parsons turbine. At the end of 1902 they had sold twenty plants, aggregating 29,000-h.p., the largest unit being 3,000-h.p. On this side of the Atlantic, the Westinghouse Machine Company, of Pittsburg, have made, and have in service, turbines to the amount of 6,500 kilowatts, while upwards of 5,000 kilowatts more have been shipped. The total turbine power already installed and in process of erection amounts to 110,000 kilowatts. Fifty-seven units will be in operation before the end of the next nine months.

There are, unfortunately, no figures at hand giving the horse-power of the De Laval turbines installed later than the year 1896, when it was said to be 23,000. Since that time some 13,000 I.P. has been installed in the United States alone.

Recent large contracts for and installation of Parsons and Westinghouse-Parsons turbines include the following: For the Philadelphia Rapid Transit Co., Philadelphia, Pa., 3 units 5,000-K.W. each. De Beers Consolidated Mines, Kimberley, South Africa, 2 units, 1,000-K.W. each. Metropolitan District Ry., London, England, 8 units, 5,000-K.W. each. Metropolitan Railway Co., London, England, 3 units, 3,500-K.W. each. Cleveland, Elyria & Western Ry., Cleveland, Ohio, 2 units, 1,000-K.W. each. West Penn. Ry. & Ltg. Co., Pittsburg, Pa., 3 units, 1,000-K.W. each. Rapid Transit Subway Construction Co., New York, N.Y., 3 units, 1,250-K.W. each. Penn. R. R. Long Island Power House, 3 units, 3,500-K.W. each, and many others.

For the Metropolitan Railway Co.'s plant, the turbines are constructed by the Parsons Steam Turbine Co., and are guaranteed to have a combined efficiency of 17 lbs. of steam per kilowatt hour, delivered at full load, and 20¼ lbs. of steam for each kilowatt hour, delivered at half load, the boiler pressure being 160 lbs. per square inch, with the steam superheated 180 deg. F., 90 per cent. vacuum in the condenser.

Recent large contracts for and installations of Curtis turbines include: Commonwealth Station, Chicago, 1 unit, 5,000-K.W. Lane Cotton Mills, New Orleans, 3 units 500-K.W. each. Fulton Bag and Cotton Mills, Atlanta, Ga., 2 units, 500-K.W. each.

In all, 200,000-H.P. of Curtis turbines are said to be under contract.

These figures show that the turbine must now be seriously considered a rival of the reciprocating engine. For, while it is true that in this country it is used almost entirely for driving electric machinery, yet in England it has already been employed as a blowing machine (the air compressor being a counterpart of the turbine), for driving centrifugal pumps with high lifts, for ventilating purposes, and for marine work. In these various positions its steady growth is the best indication of its performance; and it need not be restricted to these alone, for it is excellently adapted to other services, where its high speed is not a positive disadvantage.

Comparing the steam turbine with the reciprocating engine, it is seen that the former has the following points of advantage: The turbine has no valve gear, no vibration, is very light, and requires only sufficient foundation to bear its weight. It is the more simple of the two. The torque on the shaft is uniform, and there are no moving parts to be brought to rest and accelerated twice in every revolution. Condensation should be small, and full advantage is taken of low exhaust pressures. With three cylinder reciprocating engines, on the other hand, about the same results are obtained, with a 70 per cent. 80 per cent. and 90 per cent. vacuum. The turbine is compact. It is impossible to give figures of general application, but it has been calculated that it requires about 80 per cent. of the floor space of the vertical engine of the same power and one-half the engine room capacity, about 40 per cent. of the floor space required by a horizontal engine and a correspondingly smaller amount of engine room capacity. It is a comparatively simple matter to erect and test at the maker's plant. It is admirably suited for the use of superheated steam. The steam consumption is about the same as that of the reciprocating engine when new, but since there are no rubbing parts, the wearing of which causes leakage, this consumption should be approximately constant throughout the life of the turbine. Its consumption varies less than that of the reciprocating engine over wide ranges of loading. No cylinder lubrication is required by the turbine, in consequence of which the exhaust is pure, a matter of considerable importance where water is dear, while difficulties that are unavoidable in extracting the oil are not encountered. Incidentally because of this, less work is required in the boiler room.

The turbine is, because of the uniformity of its driving force specially suitable as a prime mover for such a system as alternators running in parallel. With it there is no tendency to produce these periodic fluctuations of speed which occur during every revolution of a reciprocating engine. The problem of speed regulation is consequently much simplified. To effect this, it is only necessary to supply a governor, which will keep down fluctuations of speed due to a sudden change of load, prevent surging, and give the drop in speed

from no load to full load that is necessary for parallel operation.

It is worthy of notice that all Westinghouse-Parsons turbines installed are running alternators in parallel, and their operation in this connection is guaranteed to be satisfactory.

Looking at the disadvantages, it must be noticed that, with some types of turbines, it is difficult to get the shaft through the case. All, for reasons referred to above, must have excessive speeds that do not permit of belt drives. Where many rows of vanes are used, the clearances must be small, causing expense because of the accurate workmanship required. In the De Laval type, however, the clearances may be very considerable—are, in fact, from two to five millimetres. It would be surprising if, for a time, the initial cost of turbines were much below that of reciprocating engines. The experimental work of years undertaken by the producers has undoubtedly involved great expenditure, and it is only right that they should receive remuneration in proportion to the incurred expense and to the risk involved. Speaking generally, the first cost of a turbine and its alternator will not differ much from that of a cross compound Corliss engine with its alternator of good manufacture. When, however, the cost of foundations, engine room capacity, and floor space is taken into account, any advantage in price is probably with the turbine. The cost of attendance, repairs, oil, etc., should be less in the case of a turbine than of a reciprocating engine.

As regards economy, it will be seen from the following tables of results of trials that the consumption is not much different from that of the best reciprocating engines when running at most efficient loads. At light loads the turbine ought, from its construction, to have an advantage over the reciprocating engine.

The turbine is admirably adapted to the use of superheated steam, the smaller fluid friction, due to the use of a rarer gas and the elimination of water, having a marked influence on the economy. Just how great a reduction in the consumption superheating will ultimately effect is not known, but the trials already made to determine this show very satisfactory results.

The best economy recorded in the annexed results of Parsons turbines occurs in the trials of a 1,000 kilowatt machine, built by C. A. Parsons & Co., for the Newcastle and District Electric Lighting Company. The trials were conducted by Mr. Hunter, engineer for the company. The vacuum was 26.5 inches, the initial steam pressure 145 lbs. per square inch (gauge), and the superheat, 237 deg. F. The lowest consumption recorded, 17.7 lbs. of steam per kilowatt hour, is equivalent to 13.2 lbs. per E.H.P. per hour, or expressed in B.T.U. is 268 B.T.U. per E.H.P. per minute. Taking the combined efficiency of turbine and dynamos (there were two placed tandemwise), as 83 per cent., the calculated consumption of steam per I.H.P. per hour is 11.0 lbs. This corresponds to a thermal consumption of 223 B.T.U. per I.H.P. per minute. This same turbine using steam at 138 lbs. per square inch initial pressure (gauge), superheated 71 deg. F., with 26 inches vacuum in the condenser, took 21.5 lbs. steam per kilowatt hour. This corresponds to 16 lbs. per E.H.P. per hour, or 300 B.T.U. per E.H.P. per minute.

The best results at hand of trials on a Westinghouse-Parsons machine show a consumption of 12.4 lbs. of steam per E.H.P. per hour. Taking the efficiency of the combined plant, as above, the calculated steam per I.H.P. per hour is approximately 10.3 lbs. This corresponds to 246 B.T.U. per E.H.P. per hour. These trials were made on a 1,500 kilowatt machine, with an initial steam pressure of 150 lbs. (gauge), 140 deg. F. superheat, and a vacuum of 28 inches.

The trials giving this very low consumption were made by the Westinghouse Machine Company, who vouch for their accuracy, and the results are substantiated by three distinct tests.

The trials for the 1,000 kilowatt turbo-alternator, built by C. A. Parsons & Co., for the city of Elberfield, were made by W. H. Lindley and Professors Schroter and Weber. A complete account of these trials, which were very exhaustive, may be found in the Revue de Mécanique for November, 1900. The best consumption recorded—19.43 lbs. per kilowatt per hour—is equivalent to 14.43 lbs. per E.H.P. per hour, or, assuming an efficiency of 83 per cent. for turbine and alternator, the calculated steam per I.H.P. per hour is 11.8 lbs. The steam pressure was 129 lbs. per square inch (gauge), with 18.4 deg. F. superheat and the vacuum 28.2 inches. The consumption expressed in B.T.U. is 270 B.T.U. per E.H.P. per minute and 264 B.T.U. per I.H.P. per minute, a result agreeing very closely with the previous one.

In the trials made by Professor Ewing on the 500 kilowatt Parsons turbo-alternator, at the Cambridge Electric Supply Co.'s plant, with a steam pressure of 145 lbs. per square inch (gauge), vacuum 25.4 inches, the consumption was 24.4 lbs. per kilowatt per hour, corresponding to 18.2 lbs. per E.H.P. per hour, or 274 B.T.U. per E.H.P. per minute. With the same assumption as above, the calculated consumption per I.H.P. per hour is 15.1 lbs., corresponding to 225 B.T.U. per I.H.P. per minute. It is to be noted that in these trials the turbine was driving its own air and circulating pumps. The trials were made after the turbine had been in operation for one year. In the maker's tests, when the turbine was not running the air and circulating pumps, the consumption was 24.1 lbs. per kilowatt per hour—i.e., practically the same as after one year's operation.

The guaranteed efficiency of the turbines for the Metropolitan Railway Co.'s plant, referred to above—17 lbs. of steam per kilowatt hour—is equivalent to 12.7 lbs. per E.H.P. This corresponds to a consumption of about 10.5 lbs. per I.H.P. per hour, or 213 B.T.U. per I.H.P. per minute.

There is very little data at hand concerning the economy of the Curtis turbine. A test made by the makers on a 600 kilowatt machine shows a consumption of 19 lbs. of steam per kilowatt hour. The initial steam pressure being 140 lbs. gauge, the vacuum 28.5 inches and no superheat. This is equivalent to 14.2 lbs. per E.H.P. per hour, or, expressed, in B.T.U., 269 B.T.U. per E.H.P. per minute.

In trials on a 10-h.p. De Laval turbine at Purdue University by Professor Goss, the best consumption recorded is 47.8 lbs. of steam per B.H.P. per hour, corresponding to 805 B.T.U. per B.H.P. per minute. The initial pressure of the steam was 138 lbs. per square inch (gauge), and the brake horse-power of the turbine, 10.33.

In a trial on a 50-h.p. De Laval turbine by Professor Cedarblom, of the Royal Polytechnic College, at Stockholm, Mr. Andersson, assistant at the Royal Polytechnic College, at Stockholm, and Mr. Uhr, inspector of the Board of Trade, Stockholm, a consumption of 19.78 lbs. of steam per B.H.P. per hour was obtained. The initial pressure was 122.3 lbs. per square inch (gauge), and the vacuum 26.4 inches. The thermal consumption is 352 B.T.U. per B.H.P. per minute.

In trials on a 300-h.p. De Laval turbine by Dean and Main, an average consumption for six trials is recorded of 14 lbs. per B.H.P. per hour, corresponding to 272 B.T.U. per B.H.P. per minute. The initial steam pressure was 207 lbs. per square inch (gauge), the vacuum 27.2 inches and the superheat 84 deg. F.

All things considered, it looks as if the steam turbine had made a permanent position for itself as a prime mover, and that it only needs time to extend its sphere of action. Probably the steam engine is the prime mover for nine-tenths of all the power that is developed, and any improvement producing a greater economy in its operation will have a powerful commercial influence. The reciprocating steam engine has apparently nearly reached its limits of economy. Although the turbine is not a perfect heat engine, it probably will when those improvements are applied that experience alone can suggest, prove itself a more efficient machine than the reciprocating engine, and will mark one more step in the advancement of steam engineering.

There is a wide difference between the heat engines at present in commercial use and the perfect heat engine; and although the thermal efficiency of the turbine is not as great as some internal combustion engines, the turbine, as it stands to-day, is a very simple and highly efficient steam engine. It is peculiarly adapted to the performance of certain kinds of work, and there is every reason to expect that those bright prospects for the future, which are indicated at present, will be more than realized.

Table 6.—Trials of a 1,000 K.W. Parsons turbine driving dynamos for Newcastle & District Electric Lighting Company's Power Station. Trials made by Mr. Hunter, engineer to Newcastle and District Lighting Company.

| No of Test. | R.P.M. | Press. at Stop Valve lbs. per sq in. Gauge. | Vacuum in Turbine Cylinder. Inches of Mercury. | Electric Output, K.W. | Consumption of Steam. lbs., per hr. | lbs. per K.W. per hr. | Superheat °F. |
|---|---|---|---|---|---|---|---|
| 1 | 1690 | 138 | 26 | 1011.6 | 21,734 | 21.48 | 71 |
| 2 | 1680 | 140 | 26 | 909.0 | 18,610 | 20.47 | 86 |
| 3 | 1700 | 142 | 26.2 | 894.6 | 17,760 | 19.85 | 128 |
| 4 | 1660 | 144 | 26.3 | 890.7 | 17,020 | 19.1 | 132 |
| 5 | | 144 | 26.3 | 882.9 | 17,171 | 19.43 | 135 |
| 6 | 1700 | 145 | | 874.0 | 16,983 | 19.42 | 137 |
| 7 | | 145 | | 901.1 | 17,500 | 19.29 | 137 |
| 8 | 1680 | 146 | 26.3 | 896.7 | 17,302 | 19.11 | 136 |
| 9 | 1640 | 142 | 26.4 | 862.2 | 16,479 | 19.15 | 136 |
| 10 | | 142 | 26.6 | 787.2 | 16,800 | 18.96 | 133 |
| 11 | 1640 | 146 | 26.3 | 944.2 | 17,903 | 18.78 | 131 |
| 12 | 1660 | 140 | 26.3 | 986.6 | 18,434 | 18.52 | 142 |
| 13 | 1710 | 135 | 26.3 | 942.5 | 17,559 | 18.52 | 146 |
| 14 | 1710 | 135 | 26.4 | 942.6 | 17,460 | 18.52 | 182 |
| 15 | | 140 | 26.5 | 878.1 | 15,857 | 18.06 | 195 |
| 16 | 1710 | 146 | 26.6 | 863.3 | 15,493 | 17.94 | 221 |
| 17 | | 145 | 26.5 | 897.8 | 15,922 | 17.73 | 237 |

Barometer = 30 inches.

Table 8.—Tests on a 300-h.p. De Laval Turbine. Conducted by Wilh. Jacobson.

| No of Test. | R.P.M. | Press at Stop Valve lbs. per sq. in. Gauge. | Vacuum in Turbine Cylinder. Inches of Mercury. | B. H. P. | Consumption of Steam. Lbs. per hr. | Lbs. per B.H.P. per hr. | Superheat °F. |
|---|---|---|---|---|---|---|---|
| 1 | 754.6 | 151 | | 342.1 | 5,270 | 15.4 | 20 |
| 2 | 750.0 | 147 | | 297.8 | 4,590 | 15.5 | 17 |
| 3 | 760.0 | 143 | | 252.6 | 3,960 | 15.7 | 20 |
| 4 | 753.0 | 147 | | 214.3 | 3,820 | 15.5 | 17 |
| 5 | 750.0 | 154 | | 165.0 | 2,640 | 16.0 | 10 |
| 6 | 762.0 | 162 | | 120.5 | 1,988 | 16.5 | 4 |
| 7 | 762.0 | 162 | | 74.5 | 1,476 | 19.8 | 4 |
| 8 | 762.0 | 165 | | 30.8 | 663 | 21.5 | 5 |

Remarks.—Installed in a paper and cellulose factory at Pötschmühle, Bohemia.

Exhaust at atmospheric pressure.

Table 1.—Trials of a 24-K.W. Parsons Turbo-Alternator.

| Number of Test. | R. P. M. | Pressure at Stop Valve, lbs. per sq. in. Gauge. | Vacuum in Turbine Cylinder. Inches of Mercury. | Electric Output, K. W. | Consumption of Steam. Lbs. per hour. | Lbs. per K.W. per hour. | Superheat °F. |
|---|---|---|---|---|---|---|---|
| 1 | 4990 | 80 | 28.8 | 24.7 | 712 | 28.8 | |
| 2 | 4630 | 77 | 29.0 | 11.8 | 400 | 33.9 | |
| 3 | 4570 | 74 | 29.1 | 5.15 | 235 | 45.6 | |
| 4 | 4900 | 78 | 26.0 | 23.8 | 798 | 33.5 | |
| 5 | 4780 | 79 | 0 | 19.7 | 1350 | 68.5 | |

Barometer = 30 inches.

Table 2.—Trials of a 50-K.W. Parsons Turbo-Alternator for the Blackpool Corporation.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 5044 | 126 | 28.0 | 52.7 | 1480 | 28.0 | |
| 2 | 4880 | 132 | 28.5 | .. | 320 | .. | |

Barometer = 30 inches.

Table 3.—Trials of two 100-K.W. Parsons Turbo-Dynamos (d. c.) for West Bromwich.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1 | 3500 | 129 | 27.8 | 123 | 3144 | 25.5 | 54 |
| 2 | 3520 | 134 | 27.7 | 122 | 2913 | 23.8 | 64 |

Barometer = 30 inches.

Table 4.—Trials of a 500-K.W. Parsons Turbo-Alternator at the works of the Cambridge Electric Supply Company in January, 1901. Turbine in operation one year. Trials conducted by Prof. Ewing.

| Number of Test. | R. P. M. | Pressure at Stop Valve, lbs. per sq. in. Gauge. | Vacuum in Turbine Cylinder. Inches of Mercury. | Electric Output, K. W. | Consumption of Steam. Lbs. per hour. | Lbs. per K.W. per hour. | Superheat °F. |
|---|---|---|---|---|---|---|---|
| 1 | 2670 | 148 | 25.7 | 518.0 | 12,970 | 25.0 | |
| 2 | 2741 | 145 | 25.4 | 586.0 | 14,320 | 24.4 | |
| 3 | 2630 | 151 | 27.2 | 273.5 | 7,730 | 28.3 | |
| 4 | 2590 | 151 | 27.8 | 160.5 | 5,320 | 33.1 | |
| 5 | 2580 | 121 | 28.1 | 0 | 1,850 | .. | |
| A | 2880 | 145 | 25.1 | 535.0 | 13,350 | 25.0 | |
| B | 2800 | 150 | 26.2 | 300.0 | 8,270 | 27.6 | |

Trials 1 to 5 Barometer 29.93 inches.

Trials A and B Barometer 29.99 inches.

Turbine driving its own air and circulating pump.

In test by makers, when new, machine showed load 526.4-K.W. consumption, 24.1 lbs. steam per K.W. hour. Conditions of steam pressure and vacuum about same as in tests at Cambridge.

Table 5.—Trials of a 1,000-K.W. Parsons Turbo-Alternator, for Elberfeld Corporation, at the makers' works, in January, 1900. Trials conducted by W. H. Lindley, Prof. Schröter, and Prof. Weber.

| | | | | | | |
|---|---|---|---|---|---|---|
| I. | 134 | 28.5 | 994.8 | 20,024 | 20.15 | 20.0 |
| II. | 129 | 28.2 | 1190.1 | 23,067 | 19.43 | 18.4 |
| III. | 139 | 28.4 | 745.3 | 165,924 | 22.31 | 14.4 |
| IV. | 132 | 28.5 | 498.7 | 125,180 | 25.20 | 52.5 |
| V. | 129 | 28.5 | 246.5 | 83,028 | 33.76 | 30.6 |
| VI. | 132 | 28.7 | 0 | 40,568 | .. | 24.0 |
| VII. | 134 | 29.0 | 0 | 26,026 | .. | 24.3 |

For full particulars of these exhaustive trials see Revue de Mécanique, November, 1900.

No load alternator excited.

No load without excitation.

Table 7.—Trials of a 10-h.p. De Laval Turbine. Trials conducted by Prof. Goss.

| Number of Test. | R.P.M. | Press. at Stop Valve, lbs. per sq. in. Gauge. | Vacuum in Condenser Inches of Mercury. | B.H.P. | Consumption. Lbs. per hour. | Lbs. per B.H.P. per hour. | Superheat |
|---|---|---|---|---|---|---|---|
| 1 | 2138 | 130 | | 0.00 | 120.8 | .... | |
| 2 | 2545 | 130 | | 1.63 | 210.3 | 128.6 | |
| 3 | 2038 | 130 | | 2.36 | 230.8 | 99.8 | |
| 4 | 2118 | 130 | | 2.97 | 254.6 | 85.7 | |
| 5 | 1917 | 130 | | 3.46 | 275.5 | 79.6 | |
| 6 | 2072 | 130 | | 4.38 | 313.0 | 71.5 | |
| 7 | 2128 | 130 | | 5.10 | 328.5 | 64.4 | |
| 8 | 2576 | 130 | | 7.52 | 403.0 | 53.6 | |
| 9 | 2453 | 130 | | 8.24 | 422.8 | 51.3 | |
| 10 | 2411 | 130 | | 10.33 | 491.8 | 47.8 | |
| 11 | 2584 | 130 | | 0.00 | 121.4 | .... | |
| 12 | 2112 | 130 | | 3.95 | 267.8 | 67.8 | None. |
| 13 | 2125 | 130 | | 4.77 | 286.0 | 60.0 | |
| 14 | 2490 | 130 | | 6.50 | 346.3 | 53.3 | |
| 15 | 2546 | 130 | | 0.00 | 99.3 | .... | |
| 16 | 2049 | 130 | | 1.95 | 162.6 | 83.4 | |
| 17 | 1909 | 130 | | 3.43 | 222.9 | 65.0 | |
| 18 | 2412 | 130 | | 3.87 | 229.6 | 59.3 | |

Exhaust at Abm. Press.

Trials 1 to 10 were made with four nozzles in operation.
Trials 11 to 14 were made with three nozzles in operation.
Trials 15 to 18 were made with two nozzles in operation.

## A TRACKLESS TROLLEY.

Active interest in trackless trolleys has been revived by the demonstrations on an experimental line recently constructed at Scranton, Pa. The line was 800 feet in length, and the ground traversed by the coach, exhibited conditions such as would be met with on many country roads. Nevertheless, the progress, ease of manipulation, and comfort in riding were all that could be desired.

In outward appearance, the trolley coach resembles an omnibus, having a trolley-car platform, with step on either side, at the rear, and a seat for the motorman in the front.

Briefly stated, the object sought is to provide means whereby passenger coaches might be propelled through the streets, without the use of tracks, by means of electric current furnished from a main generating station, and continuously supplied to the motors on the coach truck through feed and return wires run above the coach. The trolley is designed to permit the coach to turn out a distance of 15 feet to either side of the road, and thus to avoid interfering with either light or heavy traffic. At the same time it will enable the motorman to thread his way through congested thoroughfares crowded with all kinds of vehicles as readily as could be done with any other type of ordinary conveyance.

Since the trackless trolley system obviates the use of running rails it is especially adapted for asphalt pavements in residential localities; also, in small towns and villages, and for temporary service to summer resorts. Another field of usefulness is in joining villages whose traffic is not sufficient to warrant the expense of the installation of track lines or for meeting the requirements of outlying districts where feeders to main-track lines would be desirable. Moreover. the system permits the operation of combination passenger and freight lines, the trolleys of the slow freight cars merely being pulled off the wires at any point to allow the faster passenger coaches to pass. Furthermore, by means of a removable line extension the freight cars may be run off 100 feet or more from the trolley line to distant stores or warehouses.

When operated in localities where there is a considerable fall of snow in winter, it is suggested that instead of piling up the snow on the sides of the road, a snow roller may be used for packing down the snow, and thus insuring good sleighing.

No data as to the cost of operation in comparison with street car lines can as yet be given. The cost of installation of the trolley wires and supports is about $1,600 per mile, while the cost of coaches, having a capacity of twenty passengers seated and fifteen standing, with motors and trolleys complete, is about $2,600 each.

The inventor of the system is A. B. Upham, president of the American Trackless Trolley Company, of Boston.—Street Railway Journal.

## CANADIAN SOCIETY OF CIVIL ENGINEERS.

The first meeting of the Electrical Section was held on 15th October. W. A. Duff was appointed secretary. Dr. R. B. Owens, Professor in the Electrical Department of McGill University, president of the section, occupied the chair. Dr. Owens gave an outline of the work of the section to be followed during the coming winter and called attention to the important bearing of the subjects on engineering advancement generally, and the needs and development of Canada in particular. The subject of the evening, "The Electrical Equipment of some Canadian Hydro-Electric Power Plants," was introduced, and R. S. Kelsch, of Montreal read his paper entitled "The Reorganization of the Lachine Rapids Hydraulic & Land Co.'s Station." A discussion followed and the opinion seemed unanimous that the Lachine Company and Mr. Kelsch were to be congratulated upon the success of their work. The paper and discussion showed how satisfactorily a power-house could be controlled by one man at one point, while the apparatus to be controlled covered a very large area. The discussion also covered such points as the need and operation of time-limit devices and reverse current relays; the uses of fuses and circuit breakers on generator and feeder panels; the question of synchronizing in such a plant and the ease of its accomplishment; the question of satisfactory governing of the waterwheels; the operation of high tension oil switches on short circuit; the safety to be gained by use of lightning protective apparatus; the use of such on line and in station and both; the difficulty of sudden excessive rises of potential, their causes, magnitude, results and precautions necessary; the question of high voltage insulation, test of apparatus and material, and proper factor of safety to be employed.

At the second meeting a paper was read by P. M. Lincoln, of the Westinghouse Electric & Mfg. Co., and late electrical engineer for the Niagara Falls Electric Plant. The subject matter of the paper was a comparison of A. C. and D. C. systems of electric traction with special reference to the application of the single phase A. C. motor, to the Washington, Baltimore & Annapolis Electric Railway, by the Westinghouse Co. A. H. Armstrong, of the General Electric Co., Schenectady, then read his paper which was a comparison between steam and electric methods in heavy railroad work. Both papers were made more clear by a number of large sized diagrams of performance curves, which could be seen by everyone. The amount of labor needed to collect and prepare the data, etc., presented by these curves seemed enormous, one member remarking that the companies must have had a thousand men working for months on these curves. A prominent visitor remarked that he was particularly struck with the foresight and advance of the General Electric Co. In his opinion all steam roads would eventually be connected to electric ones, and this company had already spent much time and thought on what was now thirty or forty years in advance of us.

Professor Herdt's paper on "Polyphase Equipments of European High Speed Electric Railways," having been printed and distributed, was taken as read and the meeting thrown open to discussion. The meeting was told that there was no secret as to the principle used to prevent sparking in A. C. commutator motors, while, of course, the details of the design were rightly considered private. The question of best trolley voltage and location of transformers in the single phase A. C. system were discussed, and the reasons given for the method employed by the Westinghouse Co. on their road. The question of the use of induction motors instead of the commutator type was brought up and reference made to the work in Germany and Italy. The question of running lights from the same circuits with the railway motors was also discussed, and it was shown to be impossible in the case of heavy railroading, though perhaps possible in the case of a number of smaller units on long distances. and quite practicable in the case of city service, such as in Montreal. Mr. Lincoln's paper showed very careful estimates of cost both of construction and operation, showing a substantial advantage in favor of the single phase A. C. system in the ideal case taken, viz., a line sixty miles long with power station centrally located, transmission to substations at 20,000 volts, a trolley voltage of 3,000 reduced on the cars to a suitable low voltage at the motors, a proper starting effect being produced by varying this voltage to the motors by means of inductor regulators.

Mr. Armstrong's paper showed what a saving could be effected by the application of electric motive power to heavy trains of 1,000 and 1,500 tons, and was exceedingly instructive in this respect. The interest in both papers was very evident; the fact that the many prospective urban and interurban railway systems cannot afford to ignore an A. C. system, so carefully worked up, and promising such marked advantages over its old competitor and the fact that so many people believe (and hope for their own comfort), that steam will eventually be replaced by electricity on trunk lines are evidence of the great importance of the meeting. The discussion was taken part in by Prof. Owens, E. H. McHenry, chief engineer of the C.P.R.; P. G. Gossler, and Messrs. Lincoln, Armstrong and Herdt.

The first meeting of the mechanical section of this society was held October 22nd, with A. W. Robinson, president of the section in the chair. In his opening remarks, Mr. Robinson said the work of the mechanical engineer was so interwoven with that of the civil, mining, and electrical engineer that they could not exist without him. The country was yet young, and our resources were mainly of the field, forest and mine, but in their development the skill of the engineer found its greatest opportunity in accomplishing the greatest result for the least money. A great deal had already been accomplished in connection with transportation, the development of water-powers and in manufacturing industries, and those works should be recorded in their transactions. He hoped that the division of the society into sections would strengthen it, and that its transactions would be enriched by records of distinctively Canadian works.

A paper by Prof. H. M. Jaquays, "Some Notes on the Steam Turbine," illustrated by lantern slides, appears elsewhere.

At the meeting of the Mechanical Section on 26th November, a paper was read on "Modern Workshop Design," by A. Pringle, Montreal.

The first meeting of the Mining Section was held on 29th October. Dr. Porter, chairman of the section, presided. J. W. Robertson was appointed secretary.

Dr. Porter referred to the difficulty of conducting a Mining Section, where mining engineers do so little of their work in cities, but he was glad to say that five meetings had been arranged for the season, and at least one paper would be read at each. He hoped to get something done towards making abstracts of papers that appear in the technical press; and he had just completed for McGill University an index and bibliography of mining and metallurgy, with a partial index of books in the Canadian Mining Institute and in the libraries of friends who had offered the use of their books. These will be available to all members of the society. It was also hoped that the students' engineering societies of the Canadian universities would be brought into affiliation with the Canadian Society of Civil Engineers—a matter in which all sections are interested. It was further hoped that mining student meetings would be held at which prizes would be offered for students' papers of merit. The chairman then gave a review of the progress of mining engineering during the past year. Among other developments, through electricity, successful electric rock drills had at last been produced, though they had not yet proved their superiority to compressed air drills. They are likely to become popular soon for light work. Electric coal cutters are now to be had both of the chain and disc type, and are liked when the coal has a flat floor and gas is absent; but when the floor is irregular or when sulphur balls occur the compressed air pick is still preferred. Electric pumps are also proving satisfactory for pumping from outlying territory to the main pumps. The difficulties in using electricity in fiery mines, however, have not yet been overcome. For haulage underground the battle still rages between compressed air and electric locomotives, the friends of compressed air seeming to have the best of the case, as these locomotives can go into any part of a mine, while gathering their cars, whereas electric locomotives most remain in touch with the source of power. This drawback is now being overcome by a reel attachment, which pays out a cable from the trolley line. An interesting development is that the ancient method of bailing is coming into use again for pumping flooded mines, as well as ordinary pumping. Its advantage is that the bailers can be used on the main hoist. The bailers have valved bottoms, preferably inclined to lessen the shock in entering the water, and they are discharged either by opening the valve or by tipping at the surface. He announced a paper on electric smelting, by Dr. Stansfield, who would use two or three electric furnaces as a demonstration. He noted the rapid introduction of gas engines in connection with blast furnaces and other metallurgical work. The advances made in ore dressing would be dealt with in a later paper; but he would refer to the Elmore or oil process of concentration. This depends on the peculiar selective action of grease in picking out grains of certain metallic minerals from crushed ore. When first announced some years ago, experts were incredulous, but the success of a number of plants in different parts of the world shows that it will advance in use.

The first meeting of the General Section was held on 5th November at 8 p.m., W. McLea Walbank, the chairman, presiding, and in his opening remarks said the general engineer was to the electrical, mining and mechanical engineer as the general practitioner was to the medical specialist. It was the foundation on which the work of the specialist was built.

A paper by E. Mohun, of Victoria, B.C., on the sewage disposal system of the provincial Jail, Victoria, was then read and discussed, and was followed by a description of the fireproof grain storage elevator of the Canadian Northern Railway at Port Arthur, by R. M. Pratt. Questions were asked as to the lateral pressure of grain in a deep bin, as compared to the pressure of a liquid of the same specific gravity, and if the pressure is greater per square inch in a tank of large or small diameter. These questions would likely be answered in a paper to be read by J. A. Jamieson at the meeting of December 10th.

Thomas C. Keefer, of Ottawa, a past president, and Lieut.-Col. Sir Percy Girouard, chief of the Imperial Railway System in the Transvaal, have been elected honorary members of the society.

At the meeting of the general section on December 10th, a paper, "The Presence of Grain in Deep Bins," will be read by J. A. Jamieson, C.E., Montreal.

A business meeting of the society was held on 12th November at 8 p.m., K. W. Blackwell, president, in the chair. The following programme for the annual meeting was announced:

Tuesday, January 26th, a.m.—Business meeting. Luncheon in the building. Papers in the afternoon and evening.

Wednesday, a.m.—Visiting the works of the Locomotive and Machine Company, C.P.R. shops, and Shawinigan transformer station, with luncheon at the Locomotive and Machine Co. shops. Dinner in the evening.

Thursday, a.m.—Conclusion of business. Reading of presidential address. Tea in the rooms in the afternoon.

## NEW CORPORATIONS.

The Dominion Contractors' Co.; $120,000; Montreal; J. D. Porcheron, and others.

Siche Light Co.; $100,000; Montreal; T. F. MacKay, and others.

Mill Stream Lumber Co.; $20,000; Quebec; C. E. Taschereau, and others.

Dominion Dump Car Co.; $2,500,000; Ottawa; H. S. Hart, of Chicago, and others.

The Ledoux Carriage Co.; $250,000; Montreal; Chas. Ledoux, and others.

Williams Iron Mines Co.; $3,000,000; Sault Ste Marie; J. E. Burchard, of St. Paul, and others.

The Sprouted Food Co.; $100,000; Toronto; J. N. Lake, and others.

Automatic Ventilating Closets; $60,000; Toronto; Harold B. Robinson, and others.

Glengarry Mills; $50,000; Toronto; A. W. McDougald, and others.

The Bradley Torpedo and Oil Company; $30,000; Petrolea; W. J. Bradley, and others.

The Iron and Steel Company of Canada; $300,000; Belleville; C. E. Carbonneau, of Paris, France, and others.

The Black Cat Gold Mining Company; $2,000,000; Toronto; Frank W. Whitaker, of Hamilton, and others.

The Clifton Natural Gas Company; $40,000; Niagara Falls, Ont.; D. A. Coste, and others.

The George Wilson Building & Contracting Company; $40,000; St. Catharines; Geo. Wilson, and others.

The Preston-Bell Furniture & Lumber Company; $95,000; Fort Frances; W. A. Preston, and others.

The Owen Sound Distilling & Cattle Feeding Co.; $500,000; Owen Sound; W. H. Prittie, and others.

The Odorless Oil Stove & Burner Company; $50,000; Toronto; John H. Stone, and others.

The Hussey Mower Co.; $300,000; Toronto; R. W. Hussey, of Knightstown, Indiana, and others.

The Snyder Bros. Upholstering Company; $35,000; Waterloo, Ont.; H. M. Snyder, and others.

The Croft Lumber Co.; $40,000; Huntsville, Ont.; Geo. Paget, and others.

The Ontario, Alberta Ranch & Packing Co.; $500,000; Toronto; A. C. Cornell, and others.

The J. E. Wilkinson Co.; $40,000; Toronto; to carry on business as a manufacturer of and dealer in dentists', platers' and jewellers' supplies and wares, and, for that purpose, to assay, smelt, refine, manufacture and deal in gold, silver, platinum and other metals and their alloys and bye-products; J. E. Wilkinson, and others.

The Shakespeare Gold Mining Company; $2,000,000; Shakespeare, Algoma District, Ont.; W. E. Seelve, and others.

The Ben-Hur Manufacturing Company; $25,000; Hamilton; to manufacture specialties in wooden ware, hardware, wire work or other material; Thos. Burrows, and others.

The Dreanite Explosive Company of Canada; $200,000; Toronto; J. T. Eastwood, and others.

The Reliance Knitting Co.; $40,000; Toronto; A. J. Moreland, and others.

Cullen Johnson Brass Manufacturing Company; $40,000; Toronto; F. N. Cullen, and others.

The Saint Catharines Box & Lumber Company; $75,000; St. Catharines; Martha Wilson, and others.

Royal Furniture Co.; $20,000; Woodstock, N.B.; Alex. Henderson, and others.

Western Machinery & Iron Co.; $40,000; Winnipeg; Hon. R. P. Roblin, and others. A factory will be run in connection, wherein horse shoes and other blacksmiths' supplies will be manufactured.

La Fonderie de Thetford; $30,000; Kingsville, Que.; to carry on business as founders, machinists and engineers; Joseph Lemieux and others.

And the following British Columbia Co.'s: Standard Lumber Co., $50,000; Cranbrook Sash & Door Factory, $40,000; Monashee Gold Mines, $1,000,000; Sharpless Mining & Milling Co., $300,000; Western Steamship Co., $150,000; Associated Silver-Lead Mines, of B.C., unlimited capital in shares of $1 each; McRobie Fire Extinguisher Mfg. Co., $40,000; M.S. Dollar Co., $180,000, tor un SS. M.S. Dollar.

# Light, Heat, Power, Etc.

Dauphin, Man., is offering its light and telephone franchises for sale.

The Bell Telephone Company has bought out the local company, at Carman, Man.

Wingham, Ont., ratepayers have carried a by-law to purchase Mr. Walter Green's electric light plant for $28,000.

Calgary, N.W.T., is getting a report on the feasibility of bringing power from Kananaska Falls to Calgary. The distance is about fifty-five miles.

The Marconi Wireless Telegraph Co. is opening a branch office in Vancouver and will shortly install some of its apparatus on the coast. Vancouver Island and the mainland will be first connected.

The Canadian General Electric Co. have the contract for the lighting system, at Havelock, Ont., and the work is to be completed by December 31st. The William Hamilton Co., of Peterboro, supply the water-wheels..

The Renfrew town council propose to install a 75-h.p. motor to run the water-works pump.

W. J. O'Leary & Co., of Montreal, are installing an electric lighting plant in the town of Richibucto, N.B.

A co-operative telephone line will be built from Aylmer to Mapleton, Ont. N. Booker and Dr. Augustine, Aylmer, are the committee.

The Hamilton Cataract Power, Light and Traction Company is substituting aluminum for copper conductors on one of its lines between the generating station at DeCew Falls and the receiving station, a distance of 33 miles.

The Canadian Pacific Railway have put into operation a system of simultaneous telegraphy and telephony over the same circuit between Montreal and Ottawa. If it proves a success it will probably be adopted all over the system.

The property owners of Renfrew have decided by a vote of 57 to 131 not to purchase the plants of the two electric lighting companies. Many citizens declared that they were not opposed to municipal ownership, but they did object to buying two plants.

Alexander Sarrasin, a lineman in the employ of the Ottawa Electric Company, was killed by contact with a live wire on November 4th. The jury found that the fatality might have been avoided if the company had enforced their rules about employees wearing suitable gloves, while handling wire.

The Canadian Telephone and Telegraph Co. have completed their organization with headquarters at Ottawa, Ont., where they will construct a rival telephone system if they get a franchise. The directors include R. Bickerdike, M.P., Montreal, vice-president; W. F. McCreary, M.P., Winnipeg; G. Fowler, M.P., Sussex.

A number of local capitalists in Hamilton are contemplating the erection of a central heating station for the purpose of heating houses by a modern hot water system. A local architect has been engaged to get out plans and prepare estimates for warming the central portion of the city.

The question of city ownership of the electric light plant is just now one all-absorbing topic in Sherbrooke. At a recent meeting of the council, the contract was awarded for the civic installation of a crib dam at Westbury Basin. It is estimated that the dam, when completed, will cost $50,000, the tender for the work itself being $38,000.

Henry Weston, car foreman at the C.P.R. shops, Perth, has invented a system for lighting and ventilating passenger cars, by means of electricity, generated by power from the axles of the coach. The dynamo is operated by compressed air causing the pulley on the dynamo to engage with that on the car axle. A pneumatic governor is used to regulate the pressure of air that will be required to run the dynamo. Storage batteries are used to furnish current when the dynamo is not generating.

The Dominion Government will lay a cable over three ranges of mountains, strong enough to withstand the heavy snowfalls. The lines are constantly broken, and it is difficult to find the ends in the snow. Last winter the experiment was tried of laying a cable over the mountains, allowing it to be covered by the snow, and although not a complete success, it demonstrated the fact that with a proper wire there would be little trouble. A heavier and properly-insulated cable is now being prepared, of sufficient length to extend over three ranges of mountains, where the present trouble is experienced.

The report of the British Columbia Telephone Company, for the year ended June 30th last, states that the expenditure for improvements and extensions during the past year has amounted to $36,670, and the purchase of the plant of the Columbia Telephone and Telegraph Company has involved a further expenditure of $38,340. A new switchboard is being installed in the Victoria Exchange on the central energy system. This will necessitate the purchase of new instruments for all subscribers there, involving a total expenditure of $75,000. At the last session of the Provincial Legislature, an act enabling the company to lay a cable connecting the mainland and Vancouver Island was obtained; the cost of the cable and land lines necessary will be about $175,000.

Raymond and Lethbridge, N.W.T., and intervening points are now connected by telephone. The local system is nearly completed, and will include Cardston, Magrath, Spring Coulee and Stirling.

Samuel Gidney has purchased the Westport and Digby Telephone Co. Exchanges are being installed at Westport, Freeport and Tiverton. Digby Neck, Brier and Long Islands are to have up-to-date telephone service.

Owing to increase of business, the Cataract Power, Traction & Light Company, Hamilton, Ont., has let a contract to F. H. Dickenson, of Hamilton, for a series of extensions, the first of which will be the enlarging of the power-house at DeCew Falls.

In Norway, peat is converted into coke by first drying it, and then placing it in receptacles heated by electricity. The coke is very firm and of a deep black color. The gas from the coking receptacles is used for heating the air in the drying rooms.

In two years the output of the Toronto Consumers' Gas Co. will probably reach the full capacity of the plant. So said the manager at the last annual meeting. Gas is supplied at 80 cents, net, per 1,000 ft.—the lowest rate of any city in Canada.

The construction of the Water and Electrical Power Development for the Hamilton Cataract Power, Light & Traction Co., Ltd., near St. Catharines, is rapidly advancing, the excavation for power-house and tail race being completed, and the concrete foundations for the power-house and machinery well under way. This company is developing about 40,000-h.p. under a head of about 270 feet. R. W. Leonard, recently chief engineer of construction Montreal and Ottawa Railway for C.P.R., is resident engineer.

The "Ironmonger" said: "It was early recognized that there was a large field for the employment of Nernst lamps in the lighting of side streets. Recent tests made at Maidstone, England, show that this type of lamp may be relied upon for street-lighting work. In the matter of economy in current-consumption there was never any question, so the important point to be decided was the lasting power of the lamps. In this connection it was found that eighteen ¼-ampere lamps—six of 230, six of 235, and six of 240 volts—gave an average life of over 1,000 hours; results equal to those of ordinary lamps."

In connection with the New York terminal equipment of the Pennsylvania Railway's conversion to electric traction, the Westinghouse Machine Co., of Pittsburg, Pa., have a contract for three steam turbines of 7,400 electrical horsepower capacity each. They will drive 5,500 kilowatt, three-phase alternating generators in parallel, and their overload capacity will be 11,000-h.p. They will operate at 200 lbs. steam pressure at the throttle, 28-in. vacuum, and 175 degrees F. superheat. There are eleven "Westinghouse" turbines of about the same size under construction for heavy electric railways.

The increase in the business of the Packard Electrical Co., of St. Catharines, Ont., and Montreal, has necessitated enlargements of their factory equipment devoted to this branch of the business. Even with this increase, the company is barely able to meet the increased demands, but further additions are contemplated which will enable the company to fill all orders quickly. The meter department of this company is running overtime and indications are that it will be necessary to do so for many months. One order alone, for export, calls for the delivery of 8,000 type "G" Packard Recording Watt Meters.

The correspondent of the New York Sun, in London, ventures the following prediction: Within three months direct telegraphic communication, without intermediate repeating stations, will be established between New York and London, and telegrams will be exchanged at a speed of more than four times the previous capacity of any cable. He further expects that within a year it will be feasible to telephone between New York and London. He states that the problem of cheap and rapid long distance communication has been solved, and that the credit for this invention belongs to England.

The Bell Telephone Co. will erect a new exchange building in Winnipeg next year.

Important changes are being made in the Marconi towers at Table Head. Poles fifteen feet in length have been placed on top of the towers, and additional wires have been strung.

A company of Kingstonians have secured control of the Mississippi Falls, fifty-five miles from Kingston. It is said that eight or ten thousand horse-power can be obtained, and sold at from $15 to $20 per horse-power per annum. The fall is 85 feet.

The telephone committee, at Ottawa, suggest that an offer be made to the lately formed Canadian Telephone and Telegraph Company. There is no disposition to prevent this company doing business. If the city's offer is accepted, they will deal with them. Otherwise, an agreement with the Bell is likely to be made.

The Mexican Light and Power Company, a syndicate of Canadian capitalists will furnish the City of Mexico and the mining districts of El Oro and surrounding country with light and power, from Necaxa, 100 miles away, where 45,000 horse-power are to be generated from a waterfall. Contracts for the machinery have been let.

## Industrial Notes.

The Brantford cutlery works have closed. Competition from the States is given as the cause.

The Dowd Milling Co. contemplate erecting a new flour mill at some point between Winnipeg and Fort William.

The Port Huron Iron Works, with factories at Hamilton and Walkerville, Ont., will open a branch at London, Ont.

The Record Foundry and Machine Co., of Moncton, N.B., are building a factory in Montreal, for their Ontario and Western trade.

South Wales tin platers have ordered 100,000 tons of steel bars from the United States Steel Corporation. The price is given at $20 a ton.

The Canada Furniture Manufacturers will probably erect an extensive export factory in Woodstock, Ont., which will employ 100 additional workmen.

The Crown Elevator Co. are erecting a plant, at Winnipeg, Man., comprising a 250,000-bushel elevator and storage bins of 2,000,000 bushels' capacity, at a cost of $150,000.

The Lunkenheimer Company, Cincinnati, Ohio, manufacturers of valves and steam specialties, have opened up a branch office in Paris, France, located at No. 24 Boulevard Voltaire, where a stock of the company's goods is to be kept.

The first of the ten large rotary kilns of the International Cement Company was installed by Lord Minto on November 19th, at Ottawa. The plant has cost $750,000 up to date. The company own 110 acres of clay and 220 acres of limestone rock. The buildings cover seven acres, and include storage capacity for 150,000 barrels.

As mentioned last month, the Fairbanks Company, in order to cope with rapidly increasing business, have opened a branch in Toronto, from which orders to all points west of Kingston and south of the C.P.R. main line will be shipped. The Montreal house will continue to handle all business from points on the C.P.R.

Work is fast nearing completion upon the new power plant of the B. F. Sturtevant Co., at Hyde Park, Mass. This bids fair to be one of the most complete plants of its kind in the country, special care having been taken to secure the highest efficiency and the most modern equipment. The plant will comprise four water tube boilers, with stokers supplied by Sturtevant forced draft, an economizer with Sturtevant induced draft, and a complete outfit of Sturtevant generating sets, together with condenser, air compressor, etc. The Sturtevant exhaust head is used for separating the water and oil from the exhaust steam.

Williams & Wilson, Montreal, Que., ordered from J. C. Wilson & Co., Glenora, Ont., a 38-inch vertical "Little Giant" turbine for the Ogilvie Milling Co.'s mill in that city.

It was reported in last issue that the Brant Milling Co., Brantford, Ont., had placed an order with J. C. Wilson & Co., Glenora, Ont., for a 10-inch "Little Giant" turbine. We now learn that the company has since ordered another, an 8-inch wheel with brass buckets, which will make the seventh "Little Giant" installed in these mills.

J. C. Wilson & Co., Glenora, Ont., have just received export orders for three "Little Giant" turbines, a 33-inch, 21-inch, and 10-inch for shipment to Great Britain. The manufacturers inform us that the demand from abroad for this particular wheel is constantly increasing, and their order book indicates shipments to various parts of the Old World.

The J. Stevens Arms & Tool Company, of Chicopee Falls, Mass., owing to the rapid growth of their fire-arms business, have sold their machinists' tools' patents and good-will to the L. S. Starrett Co.. of Athol, Mass. The additional space thus gained will enable the company to increase the output of their fire-arms and automobile departments, making them one of the largest manufacturers of these articles in the United States.

Chapman Double Ball Bearing Co., of Canada, Limited, are now installing machinery at 39 Pearl St., Toronto, for their new factory. They are preparing special tools necessary for turret work. The intention of the company is to manufacture a line of ball bearings for all classes of machinery. The head office of the firm will be at 39 Scott St., Toronto; W. J. Young is general manager, and E. R. Simpson, superintendent.

The International Steam Pump Co., of New York, is bringing out a new type of high-head pump, known as the "multi-stage," that is, the water from one impeller is passed through another impeller, and so on, up to four or five stages in the high-head pumps. These impellers are all placed upon one shaft and the water circulates in the casing of the pump, there being no outside pipe connections except the inlet and outlet. The impellers and the chambers into which the water is discharged from the impeller have been designed after a long series of experiments, and it is to the proper proportions of these parts that the pump owes its efficiency. The centrifugal pump is really the converse of the impulse turbine water-wheel.

# Railway Matters.

The C.P.R. has absorbed the Ottawa, Northern, and Western Railway.

W. G. Trethewey is negotiating with the town of Edmonton, N.W.T., for a street railway franchise.

The C.P.R. has placed an order with a Vancouver mill for 2,000,000 feet of lumber to be used in the construction of its new shops at Winnipeg.

The Canada Atlantic Railway has handled on its upper lake boats and thence to Coteau Landing and Montreal this season more than 8,500,000 bushels of grain.

The C.P.R. is installing a water-softening plant at Moose Jaw, Assa., at a cost of $30,000, owing to the presence of alkali in the water used by the locomotives.

The T., H. and B. Railway has placed an order with the Locomotive and Machine Company, of Montreal, for four locomotives, two of which are to be delivered in December.

The extension of the Orford Mountain Railway from Eastman to Potton, through the Missisquoi Valley of East Bolton, Que., has began. The old roadbed will be utilized as far as possible.

The Midland Railway, running for sixty miles from Windsor to Truro, N.S., is to be extended thirty miles, to Brule, a harbor on the Strait of Northumberland. The directors include P. Lyall and W. Strachan, of Montreal. This road will, it is claimed, give a shorter route from Prince Edward Island.

It is proposed to build an electric belt line from Windsor to Tecumseh, Ont.

The C.P.R. has let a contract for an addition to its shops at Calgary. The cost will be $30,000.

Plans are completed for the extension of the Toronto, Hamilton and Brantford line to Woodstock, twenty-five miles.

The Seattle-Tacoma Electric Railway Co. has decided to extend its line to Vancouver, B.C., next year, in competition with the Great Northern.

Kittamaat, 100 miles south-east of Port Simpson, may be the Grand Trunk Pacific terminus. It is at the head of a deep, well-sheltered inlet, and is in every way fitted for a railway terminus.

A device for carrying the smoke from the locomotive to the rear end of the train through a closed conduit running along the top of the carriages is to be tested on the Berlin-Zossen Railway, Germany.

The north and south ends of the Bay of Quinte Railway extension, connecting the villages of Bridgewater, Queensboro, and Allen Settlement with the Central Ontario Railway, at Bannockburn is completed.

As a result of Government's transcontinental policy, the Ontario Government will extend its line 80 miles north from New Liskeard, and the C.P.R. will probably build 100 miles north of Maniwaki, Ont., on the Gatineau branch.

The deal between the Southern Traction Company, London, Ont., and the English syndicate, which is financing the scheme to build an electric railway, has been closed and the money placed at the disposal of the local company.

The G.T.R. Co. is constructing a roundhouse and machine shop at Allandale. The cost will be $60,000. The roundhouse will contain 25 stalls for locomotives. The machine shop is to be 50 x 114 feet. Both will be built on concrete blocks.

The Scarboro Electric Railway is to be extended to Highland Creek, a distance of five miles. The road already constructed will be overhauled and improved. The extension of the Metropolitan Railway from Newmarket to Jackson's Point will proceed forthwith.

Stratford, Ont., will give a 50-year franchise for a radial railway from that town to Mitchell and St. Mary's, with the option of purchase in twenty-five years. The company, which is represented by H. M. Sloan, of Chicago, and Dr. McKay, of Ingersoll, Ont., can also supply light and power.

The Mersey tunnel, in Liverpool, England, shows a 37 per cent. increase in traffic since steam was superseded by electricity. With steam there were 283 trains a day. Now there are 750. In the first week of service there was an increase of 37,619 over the number carried in the last week of steam service.

The new double track section of the Grand Trunk between Wyoming and Sarnia, was used for traffic purposes on November 22nd. By the end of the year it is expected that the Grand Trunk System from Chicago to Montreal will be double tracked, except between Kingscourt and London, and from Waubuno to Junction Cut, west of London, Ont.

The C.P.R. is in the market for 30,000 tons of steel rails, heavy sections. The requirements specified are rigid respecting analysis and tests, and few, if any of the American mills, can fully meet them unless modified. German mills can meet the specifications, and the order may go there. If specifications are revised, American mills will be keen competitors for the contract.

The annual report of the Montreal Street Railway for the year ending September 30th, 1903, shows gross earnings for the year of $2,222,787, as compared with $2,046,208 for 1902. The net earnings were $905,939, as against $911,032 for 1902. During the year the company paid to the city $121,209, covering all taxes, and $47,168 on account of snow clearing. The number of passengers carried was 54,592,014, as against 49,947,467 in 1902. In order to improve the condition of its employees, the company has assisted in the establishment of a mutual benefit association to provide life insurance, relief in case of sickness or accident, and to pension those who have served faithfully for a stated period.

The Canadian Northern will start a line from Toronto to Sudbury in the spring. It is proposed to cross the Grand Trunk Pacific line and continue to James' Bay. The work will take two or three years.

Application will be made at the next session of Parliament for a concession to build a railway from Spence's Bridge in a southeasterly direction through Nicola, Aspen's Grove, Otter Flat, Granite Creek, and Princeton, to a point on the International boundary near Midway. Sinclair & Co., Vancouver, B.C., are said to be interested.

Montreal city council have rejected the offer of the Montreal Street Railway Company for an extension of the franchise. Had the company offered a straight 3-cent fare, its proposition would probably have been accepted. The company offered to sprinkle and sweep the streets, to cart away all surplus snow, and to give ten workmen's tickets for a quarter. The ten-ticket concession was estimated at $92,000 a year. The company agreed also to expend $156,000 on pavements.

The report of the British Columbia Electric Railway for the year ended June 30th last states that business has largely increased in all departments and the profits made during the year show a corresponding increase. The construction of the Vancouver power installation by the Vancouver Power Company, Limited, which commenced in July, 1902, has proceeded satisfactorily. The general manager reports that he expects the Power Company will be in a position to deliver 2,000 e.h.p. by about the beginning of December. On the advice of the engineers, the scheme, as originally designed, has been enlarged so as to provide for the supply of an initial 9,000-h.p., with power of expansion to 30,000-h.p., instead of an initial 6,000-h.p., with expansion to 15,000-h.p. The size of the tunnel has been increased by 25 per cent., and machinery and transmission plant of greater electrical capacity are being provided. This enlargement of the original scheme will involve an additional expenditure of about $300,000, but the directors are satisfied that the importance of being fully prepared to meet the rapid increase in the demands for electrical power in Vancouver and New Westminster justifies the increased expenditure. The directors have for some time past been carrying on negotiations for the purchase of the undertaking of the Vancouver Gas Company, which if brought to a successful issue, should materially add to the value of the company's lighting business.

## Marine News.

The R. & O. steamer "Montreal" will be reconstructed this winter at Sorel.

The first turbine-driven warship "Amethyst," is 3,000 tons, 360 feet long, and 40-ft. beam. Speed, 23 knots.

The Northern Navigation Company's steamer "Atlantic" was burned on November 9th, in Georgian Bay. Fully insured.

The Lake Ontario Steamship Co. has ordered a 260-foot turbine steamer, with 33-foot beam, for the Toronto-Hamilton service next spring. Capacity, 1,500 passengers.

The Montreal Transportation Company's new steel tug is completed at Collingwood. Its length is 178 feet Draught, 12 feet.

H. H. Ross, of Medicine Hat, has made a voyage from that place to Grand Rapids, on the Saskatchewan, in an 85-foot steamer.

Port Colborne harbor will be deepened to 22 feet from the Welland Canal locks to the lake. This will entail the removal and rebuilding of the harbor piers.

A turbine steamer 300 feet long, 40-ft. beam, with a speed of 25 knots, has been ordered for next season's cross channel service, by the South Eastern Railway, England.

Hickler Bros, of Sault Ste. Marie, have the contract to take out 200,000 cubic yards of material at the west end of the Soo Canal. This will make depth of water equal to that of the American canal entrance.

The Folgers, of Kingston, will build a new steamer in place of the burned Empire State.

The R. & O. steamer, Caroline, which went aground at Tadousac, will be rebuilt at Sorel this winter.

A dry dock 500 feet long, capable of accommodating vessels of 11,000 tons, will be built at Vancouver, B.C.

A pier having 36 feet of water at its head, with a tramway to the mine, has been built at York Harbor, Newfoundland.

The ocean flyers of the North German Lloyd have proved so unremunerative that no dividend can be paid for the current year.

Two American built ships for the Atlantic Transport Line cost $1,875,000, while two similar boats built at Belfast cost only $1,450,000.

John Kennedy, harbor engineer, of Montreal, proposes the erection of a number of iron freight sheds 500 x 96 feet, at a cost of $44,000 each.

A breakwater which will be used as the foundation for an elevator of 1,250,000 bushels' capacity, is being built at Depot Harbor.

The White Star line steamer, Baltic, the largest in the world, was launched at Belfast on November 21st. Her displacement is 39,800 tons.

J. and R. Weir, of Montreal, will build a new steamer for the Ottawa Forwarding Company. Cost, $25,000; length, 107 feet; capacity, 150 tons.

The Montreal Harbor Commissioners will probably acquire a floating crane for lifting heavy weights, locomotives, etc., at a cost of $60,000.

A bill to compel the use of the "Plimsoll" mark, prepared by the American Association of Masters and Pilots, will be introduced at the next session of Congress.

Evans, Coleman & Evans, Vancouver, B.C., are constructing an extension to the wharves of the Ocean Steamship and China Mutual companies, at a cost of $40,000.

The charts of the Sydney Harbor, C.B., will be altered as a result of soundings taken by H.M.S. "Indefatigable," as the water is much deeper than the present charts indicate.

A new company composed of Robert Moulton, of Burgeo, and others, will buy a steamer in Scotland to ply between Halifax, Cape Breton, and Newfoundland, in competition with the existing service.

The Puget Sound Navigation Co. have ordered from Roberts' Shipyard, Tacoma, a steamer to ply between Victoria and Seattle. Cost, $175,000. Engines, triple expansion, 1,150-h.p.; speed, 14 knots. Will berth 175 passengers.

Calcium carbide has been turned to account in Germany for floating submarine boats. By generating gas the water is forced out of a large cylinder, and the boat rises. To sink the boat the gas is allowed to escape and the cylinder fill with water.

Present indications point to a renewal of Atlantic mail contract with the Allan Line. Hugh A. Allan recently said that his company were building two 17-knot turbine steamers of 12,000 tons, which will lessen the time about twelve hours, landing the mails at Halifax in five days, twelve hours; and Rimouski in six days. Mr. Allan does not favor a very fast service for the reason that 23-knotters do not pay.

The Oceanic steamship "Mariposa," on a run from San Francisco to Tahiti, 3,438 miles, using oil as fuel, made 354 knots, with 278 barrels a day, 50 per cent. less weight was required than if coal was burnt, and the engine room staff was reduced from 36 to 20 men. The ship used only 12 of her 18 furnaces, and the entire refuse for the whole trip barely filled two ash buckets.

The Polson Iron Works, Toronto, have completed the first of the two lightships ordered by the Government, for the Bay of Fundy. It is self-propelling, lighted by electricity, and compressed air is used for the fog horn. Automatic relaxing gear and rubber buffers are employed to minimize the risk of the cables parting. The Hon. Raymond Prefontaine, Minister of Marine, inspected the lightship last month, and subsequently announced that he had awarded a contract to the Polson's Company for a fishery protection cruiser, of a speed to surpass any boat on the Upper Lakes.

# Mining Matters.

A large and valuable deposit of limonite has been located at Selma, N.S.

The new ten-stamp mill at the Eva Mine, at Camborne, is in commission.

A fifty-ton smelter is to be installed at the Tip Top mine, near Port Arthur, Ont.

The Intercolonial Coal Mining Company, Westville, N.S., will install a fire brick making plant.

The petroleum section on the west coast of Newfoundland is reported to be showing up favorably.

Frank, B.C., bids fair to be one of the leading coal marts of Canada, and ships over 1,200 tons per day.

A valuable find of slate has been made at Burin, Newfoundland, and a company has been formed to work it.

Work will be kept up at the Nova Scotia Steel Company's mine, Belle Island, all winter. About 500 men are now employed.

The Barachoix Mining Co., it is said, will develop its coal areas at Robison's Head, west coast, Newfoundland, in the spring.

The old ore vein is said to have been rediscovered in the Sultana mine, near Rat Portage, Ont., and it will soon be in full blast again.

J. Cuthbert Welch, formerly of the Canadian Smelting works at Trail, B.C., is now superintendent of the Le Roi smelter, at Northport.

D. Davies has been appointed comptroller of the Crow's Nest Pass Coal Co., with office at Fernie, B.C. His duties include those of purchasing agent.

Several new deposits of copper have been discovered in Newfoundland. It is said that one of the new mines is superior to the Tilt Cove deposits.

The Canadian Coal and Manganese Company is resuming operations on coal areas at Coal Branch, N.B. The work of pumping out the tunnel is now going on.

The Standard Coal & Railway Co. have purchased 50 miles of areas in Cumberland County, N.S. F. W. Hanright, R. H. Brown and other Halifax men will be represented on the board.

The Iowa Mining Co., of Lillooet, B.C., before the end of the year will have the largest gold mining dredge ever built in the province at work on the gold gravels of the Fraser river. Seven more are to be built.

The two new furnaces at the Granby Co.'s works were blown in last month. The International Coal & Coke Co., it is reported, has let a contract for the construction of 104 coke ovens at the Blairmore collieries, in Alberta.

The Engineering and Mining Journal says: "Another cargo of 3,000 tons of iron pyrites from Newfoundland has arrived in New York." "Apparently, the Canadian mines are gaining customers in this country, as imports are on the increase."

The Fairbanks Co. has received an order from the Western Fuel Co., of Nanaimo, B.C., for a 400-h.p. Rand air compressor. The plant is to be completed by January 15th, 1904. The company has also received an order for a similar plant of smaller size for the Imperial Gold Mining Co., of Okanagan.

From December 1st, all wages and salaries of the employees of the Dominion Iron & Steel Company will be reduced from 10 to 33 1-3 per cent. Laborers will be paid $1.26 per diem. A falling market and inability to compete in Canada with the United States Steel Trust is stated to be the cause of the company's action.

The town of Port Hood, in boring for water in the north end of the town, discovered a valuable seam of coal, said to be seven feet thick, on the property of the Port Hood Coal Company. The discovery makes the property one of the most extensive and valuable in Nova Scotia, and ensures the permanent establishment of coal mining at Port Hood for an indefinite period.

Great ledges of tin ore have been found at Cape York, on Behring Sea. Large quantities have been taken out by the crudest methods, and next year hydraulic machines will be taken in.

The works of the Intercolonial Copper Company, at Dorchester, N.B., are to be enlarged, and a more extensive plant put in. The ore at Dorchester is extracted by an electrolytic process.

A New York syndicate, the American Rare Minerals Co., will probably erect a smelter at Kingston. M. Delano, a mining engineer, is said to have the same purpose in view. The old smelter may be utilized.

Two new furnaces have been started at the Granby, B.C., smelter. This makes six now working, and increases the capacity of the plant to 2,100 daily, thus making the Granby the largest copper smelter in Canada.

The new smelting plant of the Canada Copper Company, will be in operation at Copper Cliff, Ont., next April. It is the first of a million dollars to be expended by the company to keep their plant up to date.

R. G. Dodge, and O. J. David, Gouverneur, N.Y., have purchased two hundred acres of land at Bedford, Ont., containing one of the finest mica deposits in Canada it is alleged. Chunks have been taken out over two feet square.

Beneath the town of St. Mary's, Ont., there is said to be raw material enough to supply one of the largest cement factories in the world. A diamond drill test is reported to have shown a depth of sixty feet of fine clay and sixty feet of fine cement stone.

J. B. Miller, of Sault Ste. Marie, who owned a seven-eight interest in the Shakespeare gold mine, near New Webbwood, Ont., sold his property, it is said, to Duluth and Brainard, Minn., capitalists for $676,666. The latter have formed a two million dollar company to develop it.

The Dominion Coal Company will open up three new mines, and engineers are now surveying with a view to determining their most satisfactory location. They will be operated on the slope plan. A 40 per cent. increase is expected, and within three or four years the output will reach the 5,000,000 mark.

The barytes mine, at Collier's Bay, is likely to become one of the most valuable properties in Newfoundland. Two cargoes, aggregating 3,000 tons, have been shipped to Philadelphia and New York, and there are 700 tons more on the surface awaiting shipment. A large pier has been built for ocean steamers. The product is largely used in the United States in the manufacture of paints and for other purposes.

Important discoveries of nickel, cobalt, silver, and arsenic ore have been made in Temiskaming, near the shores of Long Lake and elsewhere. The minerals are amongst the most valuable ever found in Ontario. Prof. W. G. Miller, Provincial Geologist, says: "The deposits certainly contain some of the most wonderful samples of ore that one can conceive of, and as the ore is of so high a grade they should be workable."

# Municipal Works, Etc.

Berlin, Ont., proposes to spend $50,000 on its sewage farm.

Lachine, Que., will put in a new waterworks system to cost $15,000.

Portage la Prairie, Man., will submit a by-law to spend $170,000 on a waterworks and sewerage system.

Lethbridge, N.W.T., will construct a new sewage and waterworks system, to be completed in a year.

Winnipeg, Man., will next spring enlarge its present pumping station and install a new engine.

Levis, Que., will construct a waterworks system costing $287,000. Dussault & Paradis have the contract.

Tenders will soon be called for the National Museum, Ottawa. The Public Works Department have the plans in hand.

The Glen Road Bridge, Toronto, will be rebuilt by the Canada Foundry Company, at a cost of $28,900.

A by-law to issue debentures for $50,000 for an electric lighting plant, at Ottawa, Ont., has had its first reading.

M. P. Davis, who has completed the piers of the Quebec bridge, has received from the Bridge Company a contract which, with others to follow, will amount to $3,000,000.

In Dawson City, during winter, water is sold by nickel-in-the-slot machines, five gallons being obtained for a nickel.

Ottawa, Ont., proposes to construct a municipal conduit system for all power, light, and telephone wires.

## Personal

C. E. Cartwright has been appointed acting engineer to the C.P.R., at Winnipeg, Man.

The death is announced of George McLeod Spotswood, M.E., a Canadian mining expert, in San Francisco.

Charles H. Hines has been appointed chief electrical engineer to the C.P.R., and will supervise all electrical matters, including power and lighting.

W. J. Camp, superintendent of the eastern division C.P.R. telegraphs, has been appointed chief electrical engineer to the whole telegraph system of that company.

Graham Fraser, managing director of the Nova Scotia Steel and Iron Co., will act in advisory capacity only to the Dominion Iron and Steel Company. He has not resigned, as reported.

Reginald C. McArthur, a graduate of the School of Practical Science, Toronto, has been appointed resident engineer for the Western division of the C.P.R., with headquarters at Calgary, Alberta.

A. Fraser, son of Graham Fraser, New Glasgow, has been appointed superintendent of the blast furnaces at Sydney, N.S., to replace J. H. Means, who has gone to the American Steel Co.

Sir Percy Girouard, the Commissioner of Railways in the Transvaal and Orange River Colonies, is the first soldier and the first colonial to receive the freedom of the Ironmongers' Guild, of London, Eng.

H. G. Tyrrell, bridge engineer, formerly of Boston, has been appointed chief engineer of the Brackett Bridge Co., of Cincinnati, Ohio. Mr. Tyrrell, who has worked out some very difficult problems in bridge engineering, is of Canadian birth and education.

In the paragraph of last issue referring to the reorganization of the Westinghouse Electric Mfg. Co.'s Canadian business, it should have been stated that T. C. Frenyear is sales manager for the whole Dominion for the Canadian Westinghouse Co., with headquarters in the Lawlor Building, Toronto.

The King has invested the following Canadians with the Imperial Service Order: Robt. Bell, M.D., LL.D., Acting Director, Geological Survey, Ottawa; Edwin Gilpin, Deputy Minister of Public Works, Nova Scotia; David Ewart, chief architect, Public Works Department, Ottawa.

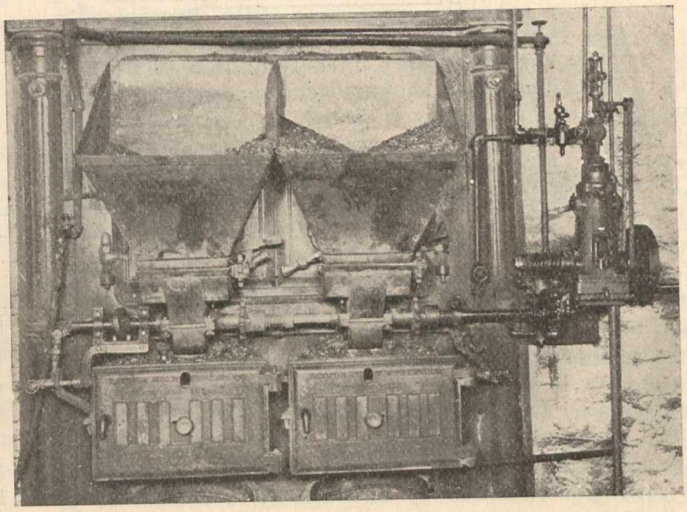
It is stated that E. A. Doucet, chief engineer of the Lake St. John railway, will be the chief Government engineer of the Grand Trunk Pacific Railway. G. A. Mountain, chief engineer of the Canada Atlantic, is also mentioned as Government engineer for the eastern division from Moncton, N.B., to Winnipeg, Man.

### DEATH OF E. W. RATHBUN.

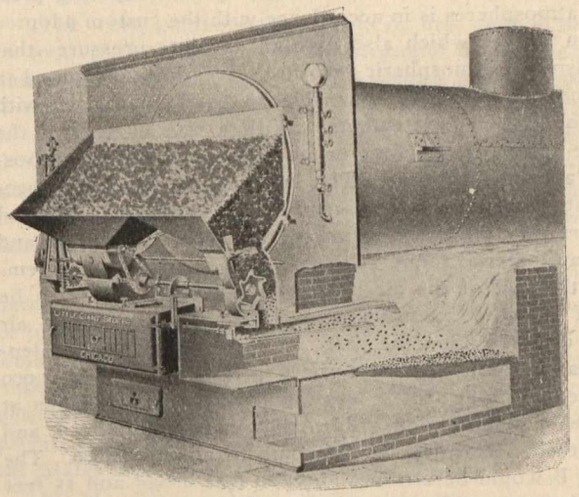
A prominent Canadian "captain of industry" is lost to the Dominion by the death, last month, of E. W. Rathbun, head of the Rathbun Co., of Deseronto. At a turn in the commercial and manufacturing affairs of Canada, when ordinary men were either despondent or were discussing the nostrum of political submission to our United States neighbors, as a remedy for depressed trade, Mr. Rathbun was one of those who fearlessly exploited new ideas and new methods of creating trade. The working out of new processes for making chemicals and by-products from the refuse lumber and saw-dust of his company's large mills, and the development of trade with foreign countries was resolutely and successfully undertaken, and these and the cement works, the roller process flour mills (of which he was the pioneer), and special lines of manufacture in wood, as well as the construction of railways, such as the Bay of Quinte Railway, for the express purpose of supplying his own factories, remain striking monuments to his skill and indefatigable industry. Mr. Rathbun died from an affection of the heart at the comparatively early age of 62.

### LITTLE GIANT MECHANICAL STOKER.

The Chicago Pneumatic Tool Co., Fisher Building, Chicago, have placed on the market a mechanical stoker, which they designed with the object of getting over defects disclosed by other mechanical coal feeders. This stoker can



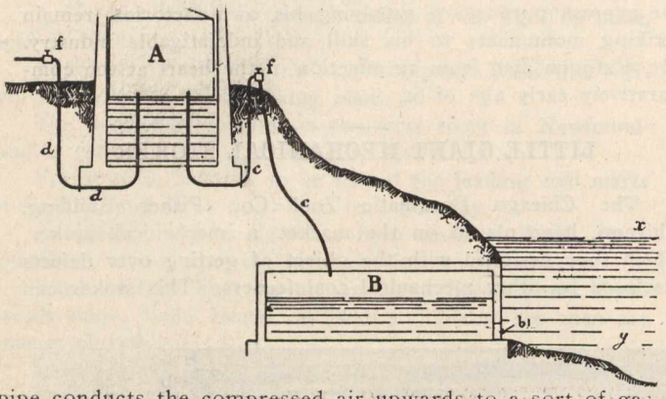
be attached to any boiler front in a few hours, and without damage; and it will work with slack and the cheaper grades of coal. Its main features will be seen by accompanying cuts. The coal, after being dumped in the hoppers, passes over a revolving cogged wheel, which regulates the flow. It then passes into the slowly oscillating spreader, shown in the second engraving. This spreader moving slowly backwards and forwards distributes the coal evenly, permitting only such a quantity to enter as the conditions may require,



and distributing it in such a manner as to cause an even incandescent fire of intense heat. There is no mechanical action that is dependent upon the complete consumption of the coal, no dumping of partly consumed coal in ash pits; the oscillating spreader, it is claimed, distributes the fuel in such a manner that the most remote portions of the grate are covered with as intense a fire as the centre. The makers of this stoker issue a bulletin giving a fuller description, which will be sent to those interested.

## AIR COMPRESSION BY THE TIDES.

The invention for compressing air by the tides referred to in a letter in last issue, by E. C. Ongley, is thus described by the "British Inventor." The essential feature of this invention is to provide an enclosed space on or near the seashore and within reach of the rising tide, in which the air is confined and compressed by water. From this air holder a




pipe conducts the compressed air upwards to a sort of gasholder. The illustration shows the arrangement of the air compressor and the reservoir, in which A is the receiving and storing reservoir. The structure B is enclosed on all sides except where it has an opening at the bottom b. Its floor is on the level with low water, which enters at once and gradually occupies all the space, reducing the volume of confined air which is then under pressure corresponding to the height to which the tide rises in the locality. The low water level is marked y; high water x, the difference in height between the two being the total rise of the tide. The pipe c is supplied with a non-return valve to prevent air from returning to B upon the tide falling. The distribution of compressed air in A would be effected by pipes with valves, f. The pressure exercised on the confined air corresponds to the height to which the tide rises, that is, to the height of the water column raised by tidal energy, a column of 30 feet, exercising a pressure of 15 lbs. on every square inch. The tide rises to various heights along our coast, so that pressure is not everywhere the same. Thus in London it is 19 feet, at Dover 18 feet, Chatham the same, Hull 20 feet, Pembroke 22 feet, Portishead 42 feet, while a little higher than Bristol the tide rises 50 feet. As a water column of 30 feet exercises a pressure of 15 lbs., one of 19 feet would give a pressure of 9 lbs.; the air would then be stored in the air holder (A) with an absolute pressure of $9 + 15 = 24$ lbs. $\div 15$ to give an absolute pressure of 1.6 atmospheres for a tide rise of 19 feet as in London. This way of computing pressure in atmospheres is in accordance with the custom adopted in steam gauges which also give an absolute pressure—that is, inclusive of atmospheric pressure. It is here computed in the same manner so as to enable an easy comparison with the usual pressure statements. With a rise of 50 feet the pressure would be 25 lbs., or $25 + 15 \div 15 = 2.7$ of atmospheres' absolute pressure. The intermediate tides give proportionate pressure. The cost of the buildings required would be very moderate as no skilled labor is required, and any cheap material found at the place of erection can be employed, the bell of the air holder only being required to be made of metal. Extensive employment of compressed air entirely depends upon the cost of its production. A calculation based upon ordinary prices gives the cost of 1,000 cubic feet of air at a little less than one halfpenny, taken at the place of compression. The erection of buildings A and B with their accessories would come to about $11,000. The chamber B would be 200 feet long, 20 feet broad and 15 feet high, with 60,000 cubic feet capacity. This gives 120,000 cubic feet daily of compressed air, which represents about 40 horsepower available every day within the year.

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A test at Hamilton recently revealed the fact that 3,000 gallons of water passes through an automatic closet left open for an hour, with a 1-in. service, and with a ½-in. service 643 gallons. The value of this per day, at the city's rate, is $7.20 and $6, respectively.

## CHICAGO PNEUMATIC TOOL CO.'S AFFAIRS.

Referring to the affairs of the Chicago Pneumatic Tool Company, President Duntley says: "The company has paid promptly all its interest and sinking fund charges on its bonded indebtedness. It has declared its dividends out of actual earnings, after writing off all expenses, fixed charges, and allowing liberally for depreciation of plants, etc. It has paid its dividends out of its own moneys. It does not owe a dollar of borrowed money. It has no floating indebtedness, except current monthly bills for material and supplies, which do not exceed $48,000, and these we are ready to pay promptly when due. The company has over $1,000,000 in quick assets over and above all current liabilities, including current bills, accrued interest, dividends, etc. Its net earnings for the past nine months are $513,224. Its present business, and the outlook for the future, is satisfactory in every way. Its European business is growing faster in proportion than the local business. The company is now selling its tools and machines in every civilized country in the world, and is no longer dependent on the American trade for its business. These are facts, and the company's record shows the payment of every obligation, no borrowed money, no current indebtedness, except its monthly bills, and a large surplus in quick assets. The regular annual statements will be published at the end of the year."

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## NEW CATALOGUES.

Copies of these may be had by writing any of the firms named, mentioning the Canadian Engineer.

The Link Belt Engineering Co., Nicetown, Philadelphia, catalogue describing shallow trough belt conveyors, coal and coke crushers, and link-belt disintegrators, for handling coal, coke, ore, clay, sand, grain, wool, etc.

The Jeffery Manufacturing Co., Columbus, Ohio, catalogue of power drills for rock and coal, electric mining locomotives, pumps, hoists, and other labor-saving appliances for mines, factories, contractors, etc.

The Westinghouse Electric Manufacturing Co., Pittsburg, Pa., a very interesting pamphlet entitled "Electricity in Mining," dealing with the successful application of electric power to hoisting, hauling, drilling, cutting, ventilating, pumping, and lighting.

The Chicago Pneumatic Tool Co., Chicago and New York, describing their "Little Giant" mechanical stoker.

The Brown & Sharpe Mfg. Co., Providence, R.I., "No. 13 Universal and Tool-Grinding Machine. How to use it. What it will do." An interesting description of the various uses to which this machine can be put. Also "The Gauge List," describing their standard gauges.

The Hess Machine Co., Philadelphia, Pa., "Milling Machines and Milling Cutters," descriptive of those machines.

The Colburn Machine Tool Co., Franklin, Pa., a bulletin describing their 34-inch vertical boring and turning mill.

The Grant-Hamilton Oil Co., Toronto, Montreal and Winnipeg, a bulletin describing Stafford's scale powder for steam boilers.

Davidson & Co., Limited, Belfast, Ireland, "Sirocco Centrifugal Fans," describing their advantages and applications for induced and forced draft on boilers, ventilation, air cooling and filtering, etc.

The Pratt & Whitney Co., Hartford, Conn.; a series of booklets; "Lathes," dealing with bench, 10-inch toolmakers, 13 and 14-inch engine lathes; "New Model Turret Lathes, 1½ by 18-inch, and 2 by 26-inch;" "New Model Turret Lathes, ⅝ by 4½-inch, and 1 by 10-inch;" "Hand Screw Machines;" "Propelling Machines;" all descriptive of these articles; also leaflets dealing with milling, centering, shaping and cutting-off machines.

The Niles-Bement-Pond Co., New York City, catalogue of lathes, planing, shaping, slotting, turning, and drilling machines; steam hammers, electric cranes, etc.

The John Dixon Crucible Co., Jersey City, N.J.,

"Graphite Suggestions," a pamphlet describing the many and varied uses of graphite, such as pencils, crucibles, facings, furnace linings, brazing, lubricating, belt-dressing, etc., also "Graphite Lubricants," descriptive of the same.

The Buffalo Forge Co., Buffalo and New York; "Mechanical Draft," describing induced and forced applications of mechanical draft, to street railway, electric light, and steamship plants and industrial works.

Marsh Bros. & Co., Sheffield, Eng., catalogue of "Roxo" twist drills.

The Packard Electric Co., St. Catharines, Ont.; a bulletin setting forth the advantages of "Packard" lamps.

The R. Woodman Manufacturing and Supply Co., Boston, Mass.; a catalogue of "Woodman's" patent railroad ticket punches, dating stamps, numbering machines, uniform badges, checks, buttons, etc.

The American Tool Works Co., Cincinnati, Ohio; a catalogue of "American" engine lathes, shapers, planes, drill presses, and turning mills.

The Canadian General Electric Co., Toronto, a catalogue of the Chicago Fuse Wire and Manufacturing Co.'s fuse wire and strip; telephone fuses, fuse links and blocks, etc.

The Diamond Saw and Stamping Works, Buffalo, N.Y., a catalogue of hack saw blades and frames.

Charles E. Moore & Co., San Francisco, and 1303 Havemeyer Building, New York, "Steam Power Plants of the Pacific Coast," a descriptive pamphlet of the many electric light, power, gas and other engineering plants installed by this firm on the Pacific Coast.

The Cleveland Crane and Car Co., Wickliffe, Ohio, bulletins "G," "H," and "J," descriptive of hand and electric jib, post and car; hand power travelling; and electric travelling cranes respectively.

The Nernst Lamp Co., Pittsburg, Pa., "The Nernst Lamp," setting forth its advantages for electric illumination.

The Buffalo Steam Pump Co., describing their "Underwriter Fire," and "Duplex Feed" pumps.

The Kennedy Vale Mfg. Co., New York, a catalogue descriptive of ammonia, angle, chain wheel, check, gas, grate, globe, indicator and other valves; hydrants, etc.

The Canadian General Electric Co., Toronto, "Possibilities of the Incandescent Lamp," a pamphlet embodying points of interest to station engineers and managers.

The Woodward Governor Company, Rockford, Ill.; "Woodward Water Wheel Governors," descriptive of the various makes of water wheels manufactured by this company.

The Smart-Turner Machine Co., Limited, Hamilton, Ont.; bulletin No. 3, describing the pumps made by this company.

John Birch & Co., Limited, London, England; a very comprehensive catalogue of 686 pages, of machinery, machine tools and engineering material. Among articles illustrated and described are: Direct coupled engines and generators, motors and dynamos; steam boilers, air pumps, surface condensers and circulating pumps; lathes of all types; drilling, planing, milling, boring, punching and shearing machines; plate-bending rolls; beam and angle iron bending and cutting machines; cold, hot, and electric sawing machines; nut forging machines; steam hammers; hydraulic pumps and presses; flour mill machinery; brick-making machines; disintegrators; pumps of all types; turbines and waterwheels; cranes of all types; winding and hauling engines; elevators; weighbridges; electric fans and blowers; forges; grease extractors and feed water filters; lifting jacks; fire engines; hopper barges and dredges; tip wagons; iron sheds; roller paint mills; storage batteries; electric lamps, wire and cables; steam pile drivers; artesian well boring apparatus; valves and injectors.

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The most powerful electric pump in America has just been started at the McTavish St. Pumping Station, Montreal. It is driven by power from Shawinigan Falls, Que.

## A NEW GOLD DREDGE.

A new style of gold dredge, says the Mining Review, is being built in Seattle by the Washington Iron Works and the Puget Sound Machinery Depot for the use of the Bachman Gold Dredging Co., of Pasadena, Cal., on streams in the Mount Baker District, State of Washington. It is claimed for the proposed dredger that its construction and operation is to be on lines entirely new in subaqueous gold mining. The following particulars may be of interest to those engaged in this branch of Canadian mining industry. The mechanism of this dredge is unique, a combination of the well-known chain bucket system and a powerful direct-action plunger pump. The pump is especially designed for pumping granular matter, and is the invention of James Bewsher, of Seattle. The chain buckets will be operated to bring the boulders and coarser gravel to the surface, where they are disposed of, while the fine sand, gravel and gold are all taken in through the suction pipes and delivered to the sluice boxes on board the dredge. It is claimed for this pump that it will lift and carry gold in any form in suspension as easily as it pumps fine sand, and that it will save all of the bed-rock gold, practically all of which is now lost under the old method of bucket dredging. The most interesting feature in this new departure in mechanics is the fact that the granular matter is passed through the chambers of the pump without injury to the plungers or other wearing parts. As a dredging pump for all purposes great efficiency is claimed for it over the centrifugal pattern now in general use.

## ANSWERS TO CORRESPONDENTS.

W. H. P.—Gold Rock, Ont.—Certificates of qualification for the work of a stationary engineer are granted in Ontario by the examining board of the Ontario Association of Stationary Engineers. Examination papers and other information can be obtained from Walter G. Blackgrove, Registrar, Ontario Association of Stationary Engineers, P.O. Box 531, Toronto.

J. E. B., Toronto.—A good ready made metal cement is made by the Smooth-On Mfg. Co., Jersey City, N.J. When properly mixed with water it "metalizes" and slightly expands during the process, giving very good results.

A correspondent at Regina asks us to define the technical meaning of the word "gumbo," as applied to a certain class of soil; the difference between gumbo and clay; and if it has any distinguishing features, or if it is a term applied to material which it is hard to excavate.

The word gumbo was, we believe, first applied to a kind of soup thickened with the mucilaginous pods of the okra, and used by the negroes of the Southern States. From that it came to be applied to the clay of the western prairies, which is described when wet as the stickiest mud on earth. Burnt gumbo is sometimes used for surfacing roads, and such a road is never muddy, that property being lost in the burning. It is said to make a smooth, hard and comparatively dustless highway on which no vegetation can grow.

E. M., Quebec.—Match machinery is usually not patented, but is got out by match manufacturing concerns, or invented especially for them, and kept secret as far as possible, so that you will not be likely to get much information outside of these firms, unless you strike an inventor who is getting up some new type of machine. We have given you privately the address of a man in Canada, and three firms in the States who make this class of machinery.

T. M., Johannesburg, Transvaal.—We are sending by letter the address of a Canadian company which we believe will be able to compete with the United States Steel Trust in the goods you require.

J. K. S.—A very good account of the progress of cement manufacturing in Canada, with information on the cement trade appeared in the report of the Bureau of Mines of Ontario for last year. Address Bureau of Mines, Parliament Buildings, Toronto.

S. W. B., Cornwall.—Steel rules on the metric system are made by the Brown & Sharpe Mfg. Co., Providence, R.I., and may be ordered through your local hardware dealer.

C. B., Quebec.—The yellow stains frequently seen on plastered ceilings and walls are due, we believe, to the action of the wet plaster in drawing the coloring matter out of the wood laths.

A correspondent wishes to know how to construct a battery for medical use. Get "How to Make a Medical Coil" by J. H. White, published at 10 cents, and to be had from the Toronto Electrical Works Co., 42 Adelaide St., west, Toronto. When you have made the coil connect it with a couple of dry batteries.

J. E. F., Niagara Falls.—The device described in November number for dealing with frost troubles in compressed air apparatus can be made as you suggest, with pipes, nipples and tees, or with pipes and headers.

X. Y. Z., Campbelltown, N.B.—Write to the Lunkenheimer Co., Cincinnati, O., for their card chart and pamphlet on the slide valve, sent free. If you want more information **write to Spon & Chamberlain, 12 Cortlandt St., New York,** for Tennant's Treatise on the Slide Valve.

W. G. T., and others, will be answered in next issue, and J. D. will find an answer to his question in the reply to W. H. P.

## ELECTRICITY ON THE FARM.

The "Electrical Engineer," of London, England, gives the following interesting particulars regarding electricity as an aid to agriculture: "It may not be generally known that three German companies—the Union, the Schuckert, and the Helios—own model farms on which most of the work is done by electricity. It is used both for lighting and power. The Helios Company's farm, Quednan, covers some 450 acres near Konisberg, and is in charge of Professor Backhaus. There is a power-house equipped with a 50-h.p. engine driving a four-pole dynamo and yielding a current of 90 amperes at a pressure of 500 volts. For lighting purposes a small two-pole dynamo has been installed, giving current at 30 amperes and 220 volts, or at 18 amperes and a pressure of 320 volts when used for charging a Pollak storage battery of 130 volts. Incidentally, electricity is also employed for cooking and heating purposes at the farmhouse. The agricultural machinery is driven by three electric motors, one of 1½-h.p. being used for cutting vegetables. The other two are portable, and do odd work, such as driving mills and threshing machines, crushing flax seed, pumping water, turning a circular saw, and so on. A feature of the agricultural implements is an electrically-driven plough. The same company own the Simmern farm, where in the power-house the Helios dynamos are driven by turbines of the Beché type. The experiments which are being tried in this case are aimed at dispensing with manual labor as much as possible, and two small portable motors are employed. One of 10-h.p. does the heavier work of the farm, and one of ¾-h.p. drives either a centrifugal cream separator or else a winnower in the wheat bin. In other ways on the other farms electricity is taken full advantage of, and its application is being tried to a number of farm implements which have hitherto been worked by hand.

## ELECTRIC SMELTING FURNACE.

The Electrical World and Engineer gives the following description of a new electric furnace invented by Prof. William S. Franklin, of Lehigh University: "A masonry structure contains a pear-shaped chamber communicating at its upper end with a short cylindrical passage, which opens into a flaring mouth. The lower portion of the hearth of the furnace is covered with a layer of carbon, which is connected by means of a metallic rod passing through the masonry structure with one pole of the source of current. A rod of carbon or metal which forms the other electrode is suspended into the top of the furnace. It is provided with downwardly-inclined teeth. The material to be acted upon is fed into the furnace by the reciprocation of the carbon rod. As the latter descends, the horizontal lower surfaces of the teeth engage the material and carry it downward. When the carbon rises both the action of gravity and the inclined upper surface of the teeth facilitate the passage of the teeth upward through the material without raising the latter, so that on the next downward stretch a fresh quantity of material is fed.

The first application of this furnace, described by the inventor, is to the reduction of iron ore. For this purpose the hearth of the furnace is first filled to a certain height with slag and the current is started. If the carbon rod dips into the slag the heat developed is altogether Joulean heat. If the carbon rod is raised above the slag, there is added to this the heat of the electric arc formed between the lower end of the rod and the slag. If then the iron ore is fed into the furnace through the mouth, it is reduced during its descent by the heat of the molten slag and the arc. When the ore reaches the intensely hot slag, it melts and filters through the slag to the bottom of the receptacle, where it collects. The iron is drawn off through a tap hole in the bottom of the furnace, while the slag is kept at the proper level through a tap hole at a higher level.

Another application of the furnace is for the manufacture of glass. In this case the inventor uses glass itself for the first filling of the hearth, instead of the slag in the former example. The raw materials from which the glass is to be formed are fed through the mouth. They become heated as they descend until when they reach the surface of the intensely hot molten glass they are fused and form glass. Only one tap hole is here, of course, required.

## SURFACING ROADS.

In surfacing a road, the work should be well organized. The number of shovellers should be proportioned to the number of teams engaged, and the number of teams regulated by the distance of the haul, so that there may be little or no delay to teams or men by waiting. Beginning the work at the end of the section of road to be surfaced nearest to the source of the gravel, in this way each loaded team passes over the gravel already applied, and returning empty, does the same. This helps to build the road, especially if there is no road roller for this purpose. A man of skill should have charge of spreading the material, and the loads should be spread as they are dumped. In this way the material is evenly distributed. Other means are sometimes employed for spreading the gravel by the use of a harrow or road machine, after the material is all applied; but no amount of harrowing the surface with any tool will secure as good results as hand-spreading as each load is dumped. This gives not only even thickness, but an even compactness that cannot be secured by dumping loads one after another and simply leveling the surface. We should know that we are building an artificial floor, which, when finished, should have an even surface, hard and smooth, without depressions where water may stand and materially damage the road. The material should not be spread over too great surface and should be well rounded up in the middle. The greatest general fault with our roads is they do not shed water. A road when finished, and at all times, should have sufficient grade from centre to side drains to readily carry off all surface water. We should bear in mind that surfacing a road with broken stone, gravel or other road material, is but one step in the process of road building. The best of material, however well applied, does not build a road.—Municipal World.

—Dr. Karl Gruhn, of Dresden, has adopted a form of the telautograph in which, instead of using a stylus at the receiving end, he employs a moving beam of light, which writes the message transmitted on a strip of sensitized photographic paper. After being acted on, the moving strip passes through a developing bath and a pair of drying rollers, and emerges as a photograph of the writing despatched.