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CONTENTS OF THIS NUMBER:

FOR THE CANADIAN ENGINEER.

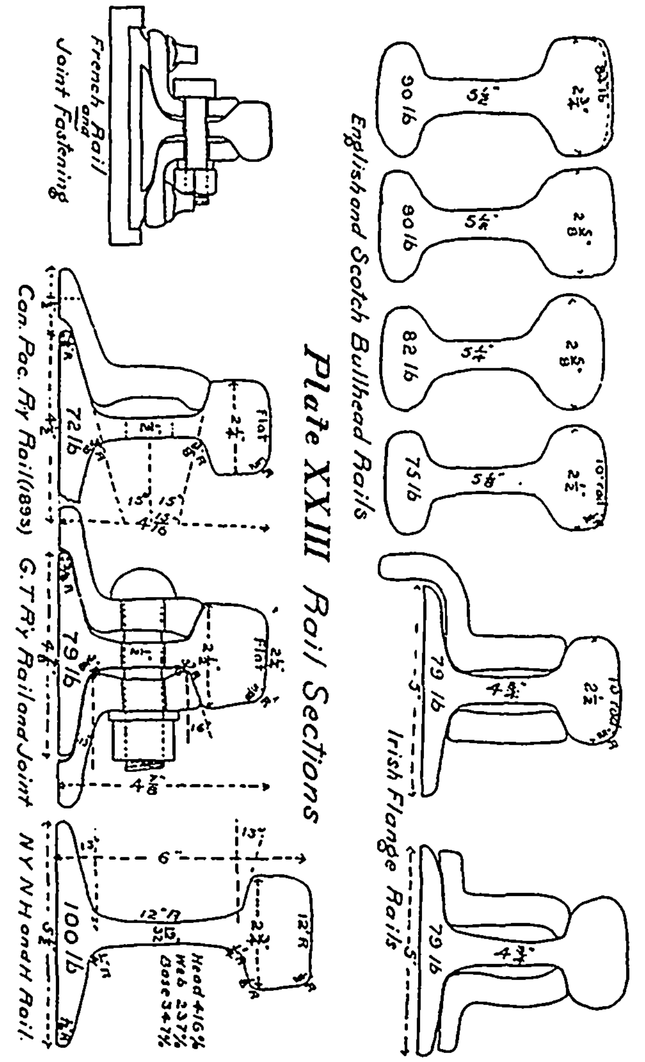
RAILWAY ENGINEERING.*

BY CECIL B. SMITH, MA. E., MEM. CAN. SOC. C.E., LATE ASSISTANT PROF. OF CIVIL ENGINEERING IN M'GILL UNIVERSITY.

ARTICLE 4.—RAILS.

The progressive history of rails from the first longitudinal wooden sleepers up to the present would be interesting but not in place here. We have arrived at two types, one used in England and Scotland, and in some British colonies and dependencies, etc., i.e, the bullhead or double-headed rail, resting in cast-iron chairs, the other used in the world generally, otherwise, (i.e)., the Viguoles or flanged rail, which is self-supporting.

(A) Plate XXIII. gives sections of bullhead rails, and on Plate XXV. is shown a cast-iron chair for fastening the rail to the ties, and which adds $1,500 to $2,000 per mile to the cost of the track. The original idea involved in the use of this section was to obtain a reversible rail which would double the wearing value if it could be turned over and used again after one head had worn down, but when it was found that the chairs damaged the rail so that they could not be reversed advantageously, this idea was abandoned, and the section now used has a much larger per cent. of metal in the head than in the base of the rail. The British railways use rather heavy rails considering the light rolling stock, but space their ties 2 feet 6 inches apart, centres, due to the superior supporting qualities of the cast-iron chairs; and, in general, the tracks are very solid and first class, the rails being held to the chair-seats by long tapering oak keys which are tightened



occasionally, while the chairs themselves are fastened to the ties with wood screws and bolts, and even those few British or Irish roads which use flanged rails use the same fastenings with tie plates, not trusting to spikes except at every other tie at the most. A special advantage in using rail chairs is that creosoted pine ties become available, and they are probably the most durable and economical tie in use, where it becomes possible to fasten the track securely to them.

(B) *Flanged Rails.*—The objections urged against flanged rails, that they cut into the ties, and that they cannot be held properly for heavy traffic with spikes, are overcome by adopting tie plates and screws or bolts for fastenings, and the idea that they are not rigid on curves is shown to be erroneous, as witness the very heavy engines of America running at high speed around much sharper curves than are used in England.

Plates XXIII. and XXIV. give sections of flanged rail of various designs and origins. In detail they will be found to vary widely, but with the exception of the New

*Now issued in book form.

York Central rail, which has a narrower base for use with tie plates or steel ties, the height is usually equal to the width of base. The first difference noticeable is the per cent. of metal in the head. Other things equal, the more metal in the head the more wear will be obtained, but rails with relatively heavy heads never cool equally,

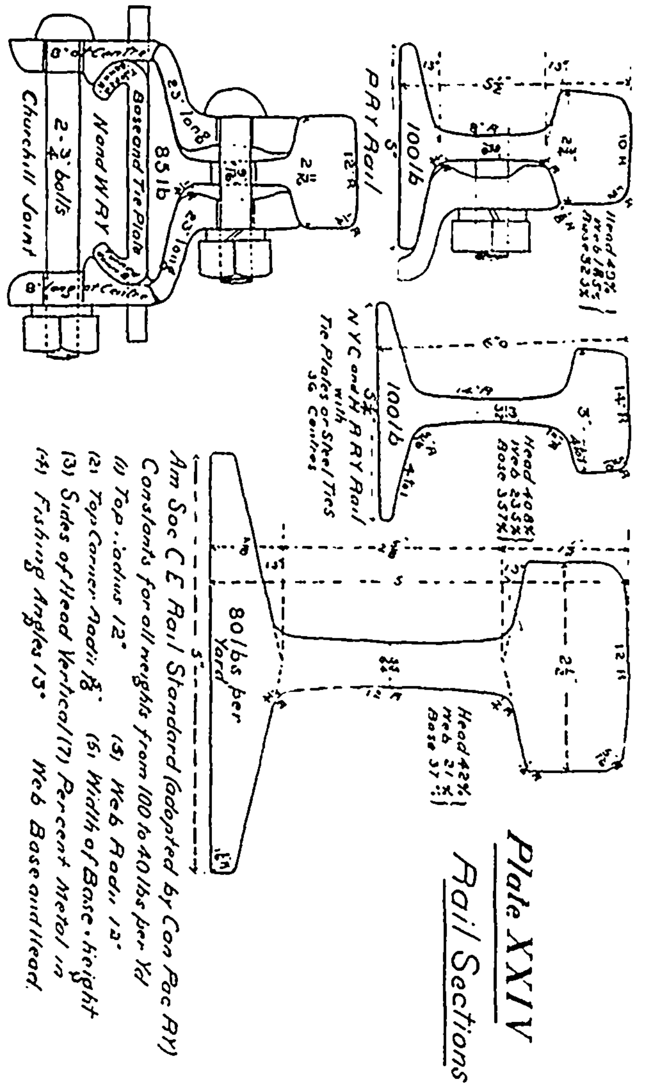


Plate XXIV Rail Sections

causing initial strains in the section, and a deep heavy head will not get well rolled, and being spongy will wear rapidly when the top layer is gone. The endeavor now is to get a rail as hard as possible, chemically, that will stand drop tests, with a wide, moderately deep head, but not so deep as to induce sponginess in the centre of the head. A wide head is necessary with modern heavy engines to prevent undue crushing of the top surface, due to heavy concentrated wheel loads, and this forces a small proportionate depth of head to keep the per cent. of metal in the rail head from being excessive.

Striking differences in rail design occur in the radius of the top of the head, the upper head corners, and in the side slopes of the head. The tendency in America is toward a flat top, sharp corners, and vertical sides, which is the reverse of English practice of round tops, easy corners and sloping sides, while fishing angles are getting flatter and tend to become standard at 13°.

Plate XXV. gives a standard U. S. wheel tread—rails after eleven years' wear on curves, and two drawings which contrast the fit of a wheel on a rail head of sharp corner radii with that on one of larger radii. It will be seen by the dotted lines that normal wear is upward and outward, thereby increasing the arc of contact between wheel and rail, thus also increasing the resistance and wear, so that the longer this can be deferred by starting with a sharp corner radius and vertical sides, the better, as the contact is then a rolling one only, and the wear and resistance small. Note that the radii of worn rail corners is still about $\frac{1}{4}$ inch, and investigation has shown that sharp radii of upper corners of rail heads do not cause sharp flanges on wheels, which has been the chief objection raised against them in the past.

Composition of Rails.—When steel began to replace iron as a material for rails it was found necessary to remove the notches in the flanges from the centre to the ends, and even omit them altogether to prevent breakage, the notches being put in the flanges of the angle bars instead, so as to prevent creeping of the track. Rails were made hard to stand wear. Then drop tests were introduced to detect brittleness, and soon forced soft rails to be used, but going to the other extreme the rail heads wore out very quickly, especially as the demand for cheapness produced insufficiently rolled rails. Now there is a gradual tendency to get as hard a rail, chemically, as will just stand the drop tests.

Specifications for Chemical Composition of Rails:

(1) Sandberg (Sweden)—Carbon, if alone, $\frac{5}{10}$ p.c., but only $\frac{3}{10}$ p.c. in presence of $\frac{1}{10}$ p.c. phosphorus; silicon, at least $\frac{1}{10}$ p.c. to give sound ingot and make rail wear.

(2) G. T. R. (Canada)—Carbon, $\frac{4}{10}$ to $\frac{5}{10}$ p.c., sulphur, $\frac{7}{100}$ p.c. or less, phosphorus, $\frac{7}{100}$ or less, silicon, $\frac{1}{10}$ p.c., manganese, $\frac{1}{10}$ p.c.

(3) New York Central Railway (Dudley)—60 to 70 lb. rail: Carbon, $\frac{45}{100}$ to $\frac{55}{100}$ p.c., manganese, $\frac{8}{10}$ to 1 p.c., silicon, $\frac{1}{10}$ to $\frac{15}{100}$ p.c., sulphur, $\frac{7}{100}$ p.c. or less, phosphorus $\frac{6}{100}$ p.c. or less; 70 to 80 lb. rail: Carbon, $\frac{5}{10}$ to $\frac{6}{10}$ p.c., manganese, $\frac{8}{10}$ to 1 p.c., silicon, $\frac{1}{10}$ to $\frac{15}{100}$ p.c., sulphur, $\frac{7}{100}$ p.c. or less, phosphorus, $\frac{8}{100}$ p.c. or less; 100 lb. rail: Carbon, $\frac{55}{100}$ to $\frac{75}{100}$ p.c., manganese, $\frac{8}{10}$ to 1 p.c., silicon, $\frac{1}{10}$ to $\frac{15}{100}$ p.c., sulphur, $\frac{7}{100}$ p.c. or less, phosphorus, $\frac{6}{100}$ p.c. or less.

Dudley, also regarding different constituents that affect the quality of rails, says: Manganese takes up the oxide of iron, and prevents red shortness, but over 1 p.c. makes rails not only hard but coarsely crystalline, with a tendency to brittleness, flowing easily under wear and oxidizing rapidly in tunnels. Silicon produces solid ingots, free from blow holes in columnar structure, with small compact crystallization. Sulphur causes red shortness and seamy heads; it also tends to check welding of blow holes and ingot pipes. Phosphorus increases the size of crystals and produces brittleness; it must therefore be very low in high carbon rails, which make prices higher, as most ores have phosphorus in them.

Physical Drop Tests for Rails:

(1) Intercolonial Railway of Canada—Supports 3 ft. 6 inches apart; a rail 12 ft. long is to stand one blow of 2,000 lbs. falling 18 ft., and three blows falling 6 feet for 67 lb. rail, with a deflection of 3 to $3\frac{1}{2}$ inches for first, and $2\frac{1}{4}$ to $3\frac{1}{4}$ inches for second case. (Drop tests for U. S. roads about the same.)

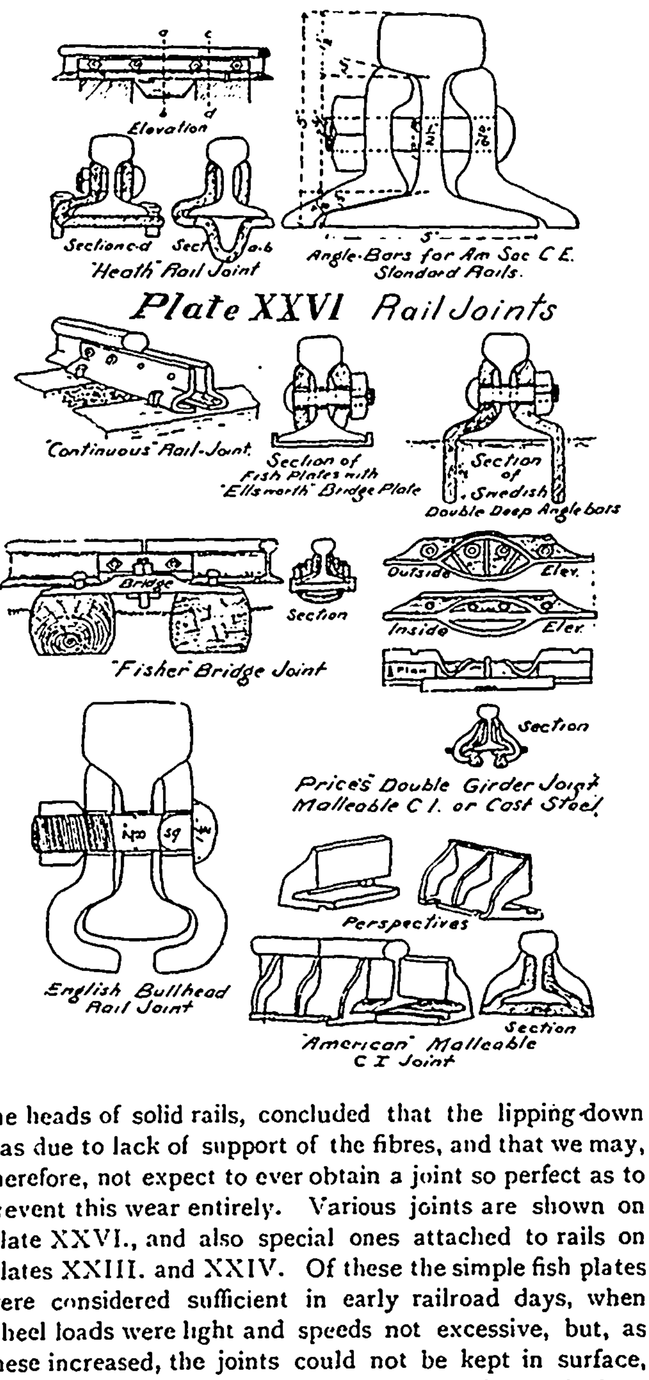
(2) Irish Flange Rails.—(a) Supports 3 ft. 6 inches apart, a rail not to deflect more than $\frac{3}{8}$ inch with permanent set not more than $\frac{1}{8}$ inch for 30,000 lbs. at centre for 30 minutes. (b) Same supports, rail to stand 2 blows without breaking, and not to deflect more than 1 inch for 2,000 lbs. falling 8 feet.

Under wear the top surface of a rail head gets more or less cold-rolled and brittle for about $\frac{1}{32}$ inch, which is the cause of heads breaking downwards (e.g.) a broken wheel may hammer and cause the brittle layer at top to crack, and the crack will continue on down until the rail breaks. High stiff rails with a broad head are more needed as the wheel loads on drivers get greater, so as to keep a decent track and prevent cold rolling. (Large drivers are not so hard as small ones on track.)

The endeavor is to get a high carbon rail and work it until it is tough and compact in texture in the head.

ARTICLE 5.—RAIL JOINTS.

While great progress has been made in the strength and rigidity of rail joints, they can hardly be considered yet equal to the criterion of simplicity, and of being as strong as the rail itself, and as stiff laterally. Sandberg, by watching the effect of trains on narrow notches cut in



the heads of solid rails, concluded that the lipping-down was due to lack of support of the fibres, and that we may, therefore, not expect to ever obtain a joint so perfect as to prevent this wear entirely. Various joints are shown on Plate XXVI., and also special ones attached to rails on Plates XXIII. and XXIV. Of these the simple fish plates were considered sufficient in early railroad days, when wheel loads were light and speeds not excessive, but, as these increased, the joints could not be kept in surface, and a lower flange was added, giving us the angle bar, which is the ordinary standard form to-day. It is simple, easily attached, etc., and may be used as a suspended joint on two ties with four bolts, or a longer one (44 inches), with 6 bolts, is often used, resting on three ties, and although more expensive, gives better results.

A comparison was made in Sweden between :

(1) Fish plates with Ellsworth base plate.

(2) Angle bars.

(3) Double deep angle bars with 2-inch extension downward between the ties.

The renewals for flattened ends in five years were (1) $6\frac{4}{10}$ p.c., (2) $14\frac{4}{10}$ p.c., (3) $17\frac{6}{10}$ p.c., but as for stiffness they were (1) $\frac{1}{3}$, (2) $\frac{2}{3}$, (3) 1. So that Nos. (2) and (3) were considered superior, particularly owing to their simplicity, but as No. 3 was easily heaved by frost and snow it was considered suitable for milder climates, and the choice rested on the angle bars.

The Fisher bridge joint has been tested quite extensively, and is found to be very stiff vertically, but weak laterally, and its various parts are rather expensive and more complicated than the angle bars. For these reasons it is not likely to find extensive favor. The Churchill joint of N. & W. R. R. is probably the most efficient joint yet designed as far as stiffness, etc., and is intended for use with 60 ft. rails. Otherwise it would be too expensive and complicated for ordinary use. The other joints shown appear to have good points, but are of less tried merit. (Also see *Engineering News*, page 178, Vol. I., 1891, for Paterson rail joint.)

We may expect, ultimately, to obtain a joint as strong as the rail itself, but how simple it can be made is for the future to show.

ARTICLE 6.—RAIL FIXTURES, ETC.

The weak spot of our track is its attachment to the ties by ordinary track spikes. Their heads are often cracked by excessive driving, re-spiking is frequent, and the ties get split and rotten much sooner than they would naturally, and while Greer, Goldie, curved, interlocking and other special spikes are improvements on the dog spike, yet the final solution would seem to be in some positive fastening such as wood screws or fang bolts, such as are used to hold rail chairs to the ties on British roads, and while tie plates and selected oak ties are keeping off the evil day, yet as speeds get higher and engines heavier, demanding a high stiff rail, this must be done by heavy traffic roads sooner or later, either with wooden ties and tie-plates, or with steel ties and bolts.

Tie plates (such as Goldie, Servis, Standard, Sandberg, etc.) will enable roads even with heavy traffic to use soft wood ties and a high stiff rail with narrow base (see N. Y. C. & H. R. R. R. section), and will prolong the life of ties. They are being adopted rapidly, some roads using them on curves only, others for the whole track. Wood screws for holding track are of steel, seven inches long, with thread for $4\frac{3}{4}$ inches, $\frac{3}{4}$ inch diameter, and have a pulling resistance of about six tons. Fang bolts are attached by boring holes through the ties, and screwing the bolts, which have heads on them suitable for holding down a rail, into a nut, with a fang on it. This fang grips into the wood on the under side of the tie, which prevents it turning or loosening.

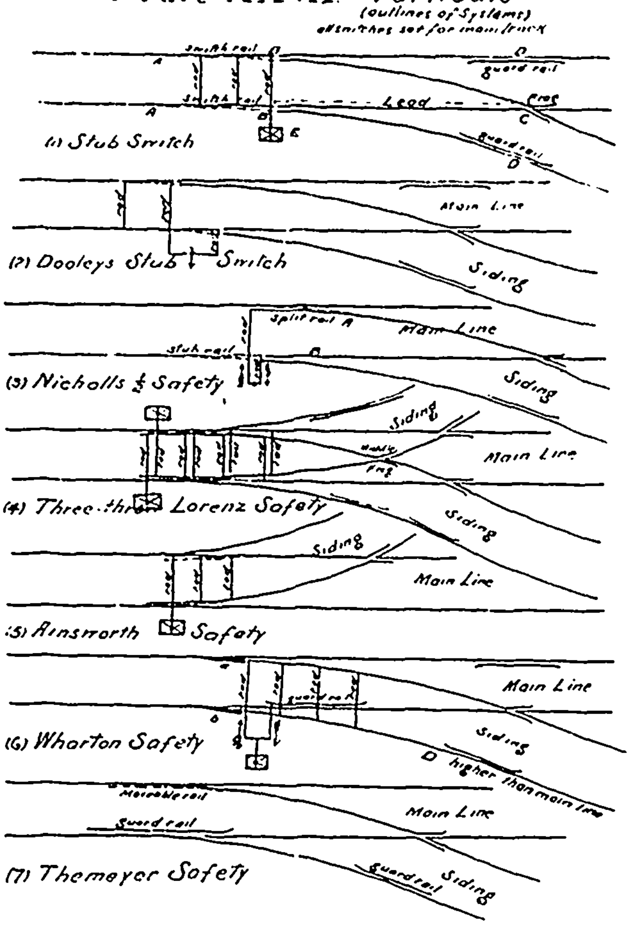
The vibration caused by passing trains would soon loosen the ordinary nut on the bolts which fasten the angle bar joint to the rails, and, in order to prevent this, many devices have been tried. The double nut is not effective. A gravity lock outside the ordinary nut in the form of an eccentric nut is much better, and Young's patent has been used quite extensively, but the spring nut lock, which consists of one turn or a little more, of a strong steel spiral, with two cutting lips taking hold of angle bar and nut as the nut is screwed on, on top of the nut-lock, is the kind generally used, and being simple, cheap and effective, is likely to remain the favorite kind in use.

ARTICLE 7.—SWITCHES AND FROGS.

Outlines of various designs for passing a train from one track to another are given on plate XXVII., but of course there are various forms of attachments differing in detail only.

(1) The Stub switch consists of two movable rails, A B, with the ends B supported, and free to slide on plates for a lateral distance of five inches, called "throw." These switch rails or points are from 10 to 25 feet long, depending on the frog distance, B C, and the angle of the frog C. The guard rails, D D, prevent derailment at the

Plate XXVII. Turnouts



throat of the frog. The stub switch works for a three-throw as easily as for a two-throw turnout, and can be made into a safety switch (see Cook Switch, Plate XXVII., and Dunn Switch, *Engineering News*, Vol. II., 1890, page 174), and is considered to be more durable and easily kept in working order with snow and ice than are the many forms of split rail switches.

(2) Dooley's stub switch is a modification which makes easier riding by having one point longer than the other, substituting two jolts for one severer one, but it is not as rigid as the ordinary stub switch.

(3) Nicoll half-safety switch is a compromise between the stub switch and a split or Lorenz switch. It is not at all a strong or secure switch, as the two rails are not opposite each other. Its advantages are not very obvious.

(4) Lorenz safety switch is the model of various split switches. Both rails are feathered down so as to fit close up against solid rails. One is a main line rail, the other for the siding, connected so as to act together. This switch is adapted to position where the traffic is considerable on the branch line, or turnout, and in climates not troubled with ice or snow, but the split rails or points wear out rapidly, and it is more complicated when applied to three-throw turnouts, necessitating two sets of switch rails, stands, etc., set one ahead of the other, in which case neither of the main line rails are solid. The Stewart switch (*Engineering News*, Vol. I., 1895, page 59) has a special feature in making the switch rails by bending over solid-headed rails, instead of planing them down to a point. It is claimed this will give durability and rigidity.

(5) Ainsworth safety switch is made by giving the solid siding rail a sharp bend or recess, and the corresponding switch rail is left square ended, thus providing a more solid track for the main line, and a more durable switch rail. This form is adapted to branch lines having little traffic.

(6) Wharton safety switch is used for heavy main line traffic. It gives a solid main track. The siding rails lead the wheels onto blocks (a.b.) higher than the main line rails, and fall down on to the main line, while in facing the switch the wheels are first lifted by the blocks (a.b.) and then carried over the main line rails by the wheel tread riding on the high rail D.

The Macpherson switch (Plate XXVIII.) is a modified Wharton coming into use on the Can. Pac. Ry. The main line is solid, and the train is thrown onto the siding by having the outside movable rail higher than the main line, and a movable guard rail which is also higher than the main line, but which is thrown into position only when the switch is set for the siding. This design also includes a special form of frog, which is a sliding plate brought into position by means of bell-crank levers and rods operated from the switch stand, when set for siding; when set for main line the plate is clear of the main line, leaving the main line solid at this point also. This design has been in use since 1892, and it has proven itself very satisfactory and durable.

(7) The Themeyer safety switch has one movable split rail, and a stationary split rail or half-frog and guard rail. The movable rail and guard rail guide the wheels onto the siding when set for it. It is successfully used on the B. & O. R. R.

The main object of safety switches is to make it safe for a train to trail through a switch from the siding, when it is set for the main line, or vice versa, and this is accomplished, with split switches, by using springs which allow the movable rails to be forced aside just enough to pass the wheel flanges through. The springs then force the switch points back to the position for which the stand and signal are set.

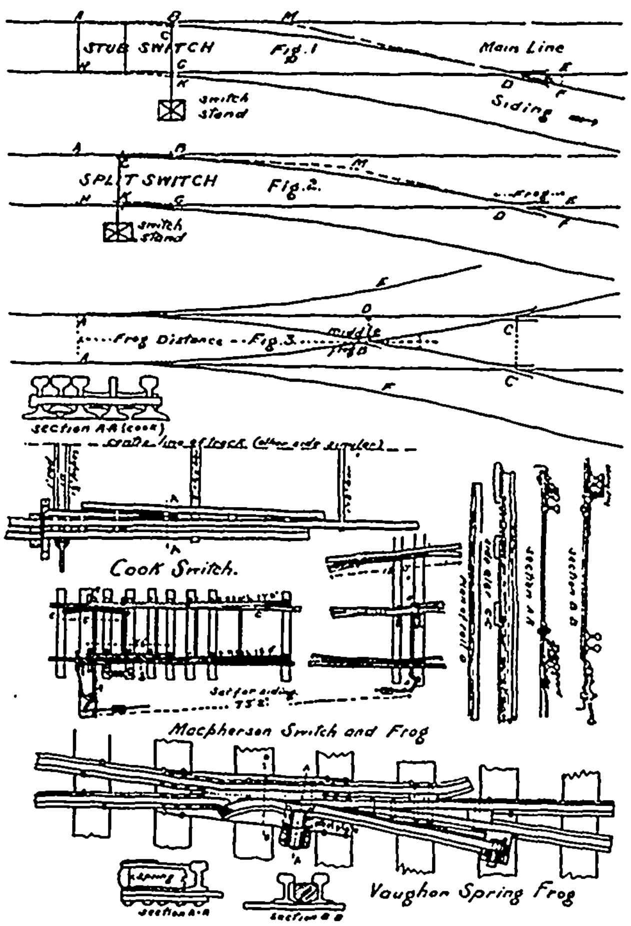
Other special switches of tried merit are the cam automatic, in which the split rails are fixed, and the solid ones move horizontally (see *Eng. News*, vol. I., 1890, page 489), and the Duggan switch, which has two knuckle-jointed vertical moving split rails. (See *Eng. News*, vol. I., 1893, page 390.)

Frogs.—Formerly cast steel solid frogs were common, but as they were more liable to crack, and when worn in one part were unfit for use, they were soon supplanted by frogs made up of pieces of steel rail fitted and bolted together onto a flat steel base plate—any worn part can be easily replaced. Such solid or stiff frogs are in most general use, but on main lines having heavy traffic, those turnouts with light traffic are now generally fitted with spring frogs (see Plate XXVIII.) in which either the "point" or the guard rail are movable, and the main line is normally a solid track. A train to or from the siding forces the frog open momentarily, and a spring brings it back again as soon as the train has passed, leaving the main line again solid. The defect in many of these spring frogs is the tendency to derail wheels with worn treads and flanges, by forcing open the spring frog when a train is on the main line. It is claimed that the Vaughan spring frog, used on the Penn. R. R., overcomes this difficulty by blocking up the tread. Other spring frogs of special features of merit are the Monarch, Ramapo and Pegram, described in the *Engineering News* since 1890.

Turnout Calculations.—The "lead" is the distance

'KD (Plate XXVIII.) from the switch stand to the frog point. The fixed end of switch rails is the "heel," and the movable one the "toe." The "throw" is the amount

Plate XXVIII.



which the switch stand rod moves the "toe" of the switch. It is 5 inches for stubs and 3 inches for split switches. To designate a frog angle $E\ D\ F$ the ratio $\frac{ED}{EF}$ is called the frog number (i.e.) if $\frac{ED}{EF} = 6$, then the frog is called a No. 6, the ordinary numbers in use are 8, 9, and 10 for main lines, and 5, 6 and 7 for crowded yards and sidings. The middle frog is a special one, derived from the others by calculation or from a large-scaled plan:

(1) To calculate the lead from the frog number we have (see Wicksteed, Trans. C. Soc. C. E.) $D\ M$ (Fig. 1.) $= \frac{\text{gauge}}{\sin \alpha}$ or approximately $A\ D = \frac{2 \times \text{gauge}}{\sin \alpha}$ but, for small angles $\frac{1}{\sin \alpha}$ = frog number = N and gauge = g = 4·75 ft., approximately, then frog distance $= 2.g.N = 9{\cdot}5\ N$ – – – –(A).

(2) *To find the length of the movable rails.*—Offsets to a circle from a tangent vary as the square of the distance from tangent point, and taking gauge as 57 inches and throw as 5 inches we have

$$\frac{\text{slide rails}}{\text{frog distance}} = \sqrt{\frac{5}{57}} = \frac{3}{10} \text{ approx. } (B)$$

also, for stub switch, lead $= \frac{7}{10}$ frog distance (C) which equations give all necessary data for a simple turnout for a stub switch. The frog for a very short distance is straight, and the slide rail is often practically straight, but by using a long rail and spiking the fixed portion, the movable part will bend to a curve.

If split switches are used Fig. 2 will apply, and the movable rail being, necessarily, straight, is from B to C only, is tangent to the circle at B, and is half as long as a stub switch movable rail, also in this case the switch stand is at a different place K. C. and we have

Switch rail $= \frac{1}{2} \times \frac{3}{10} = \frac{3}{20}$ frog distance (D).

Lead = frog distance $- A\ C = \frac{17}{20}$ frog distance (E).

EXAMPLES.

(a) Stub switch No. 8 frog—

Frog distance $= 8 \times 9{\cdot}5 = 76$ feet by (A).

Slide rail $= \frac{3}{10} \times 76 = 22\frac{8}{10}$ feet by (B).

Lead $= 76 - 22{\cdot}8 = 53\frac{2}{10}$ feet by (C).

(b) Split switch No. 9 frog—

Frog distance $= 9 \times 9{\cdot}5 = 85.5$ feet by (A).

Lead $= \frac{17}{20} \times 85.5 = 72.6$ feet by (E).

Slide rail $= \frac{3}{20} \times 85.5 = 12.9$ feet by (D).

NOTE.—These distances can be varied by a small percentage without affecting the running of the trains.

(3) Middle frog calculations, Fig. 3, Plate XXVIII. First let the two turnouts AE AF be of same degree of curve and start from same switch stand, then $\frac{AD}{AC} = \sqrt{\frac{1}{2}}$ or $A\ D = \frac{71}{100}\ A\ C$, which gives us the middle frog distance from the frog distance AC, which equation (A) determines.

Also for small angles the angle of the middle frog will be $2 \times \frac{71}{100}$ frog angle at $C = 1.42$ frog angle C, and the number of the frog will be $\frac{1}{1.42} \times$ frog number $C = {\cdot}703$ frog number C.

Second, let the turnouts be of different sharpness, and let one begin say 6 feet ahead of the other, let the right hand turnout start first and be a No. 8 frog, and the left hand one a No. 10 frog. Call the middle frog distance x.

The two turnout frog distances are

$8 \times 9{\cdot}5 = 76$ feet, and $6 + 10 \times 9{\cdot}5 = 101$ feet.

Offset from one tangent to $B = \left(\frac{x}{76}\right)^2 \times 4{\cdot}75$ ft.

" " other tangent to $B = \left(\frac{x-6}{95}\right)^2 \times 4{\cdot}75$ ft.

But both offsets added = gauge = 4.75 ft., therefore

$$\left\{\left(\frac{x}{76}\right)^2 + \left(\frac{x-6}{95}\right)^2\right\} 4{\cdot}75 = 4{\cdot}75$$

and solving this quadratic equation we get $x = 61{\cdot}6$ ft. Also we can determine its lateral position by substituting in either of the above equations this value of x, in this case these are 3.13 ft. and 1.62 ft. The angle of the middle frog, in this case, can be calculated thus:

$$\text{Middle frog angle} = \frac{61{\cdot}6}{76} \text{ angle of No. 8 frog} + \frac{55{\cdot}6}{95} \text{ angle of No. 10 frog.}$$

In crowded yards and with split switches these conditions prevail, and many much more intricate calculations are often needed when the turnouts are from curves, and cross other tracks which are also curving, but these can often be best obtained by carefully drawn plans to large scale.

MONTREAL'S TAXATION.

The ratepayers of Montreal find the present taxation of the city none too easy to be borne, and are constantly threatened with increases. The majority of the electors in the city do not feel a serious responsibility in the matter of the city's finances, being chiefly tenants or holders of small properties which bear a very low valuation. They do not therefore check the extravagance and recklessness of the city council, which are flagrant. The only recourse of the more economical portion of the people is to the Legislature at Quebec, many of whose members are not prepared to deal with questions of the magnitude which Montreal's money affairs assume. There has therefore existed hitherto a free expenditure of money, a large part of which never reached the objects for which it was voted, and a constantly growing civic debt for whose payment no means exist if the city is to be maintained in a habitable condition. The city council is constantly looking for fresh subjects for taxation because the limit of the borrowing power has been already reached on the present assessment. At the last session of the Quebec Legislature the city charter was revised and all machinery was expressly made taxable. This has raised a storm among the owners of plants in Montreal, meetings have been held and most vigorous protests made. Some of the leading manufacturers have spoken very plainly on the subject of their removal to more advantageous locations if the tax is imposed. Those who had the charter amendment in charge explain that the city has always had power to tax machinery under the head of "immovables," and the present clause was framed so as to make taxable the wires, rails, etc., of the electric companies which are at present exempt as not being attached to the property of the assessed.

While this explanation shows that the city council has no present intention of placing a tax on manufacturing plants, yet the existence of the clause is a constant menace to the manufacturers at present within the city limits, and a deterrent to others establishing themselves there. It will build up the small towns surrounding the city, and will be an incentive to those bonus-offering towns like Sherbrooke, Que., or Belleville, Ont., to grant inducements to secure the taxed industries. A manufacturer who is heavily taxed on his machinery to raise funds for street paving which is not put down (that is the method in Montreal) is apt to look longingly to towns where there are no taxes on machinery and a large cash bonus is available for buying new plant.

AN ALIEN ENGINEER.

St. Mary's, Ont., had been discussing waterworks systems for two years, but little progress had been made until early last month. Committees of the town council and board of trade had collected some information from other towns, and a public meeting had been held at which some of these had been read. A civil engineer from the United States who happened to be passing through (it is reported in the local papers) stopped off for a few hours, drove round the town with the chief officials and was instructed to prepare plans of a water supply system for the town. The engineer in question is of unquestioned ability, and has constructed some very large works in the United States with a great deal of success, but it would seem almost unfair to Canadians that an alien engineer should be employed upon the mere offer of his services without considering the claims of the many successful members of the profession who have done good work in Canada and depend upon Canadians for the substantial recognition of that work which will enable them to remain in Canada and follow their chosen profession.

INDEX.

The Index for Vol. 6, The Canadian Engineer, is now in course of preparation, and will be mailed to subscribers on application.

ENGINEERING WORKS UNDER GOVERNMENT INSPECTION.

There is a well-grounded prejudice in Canada in favor of the freedom of municipalities in the carrying on of local affairs. We have been accustomed to count our municipal freedom as one of the choicest growths of the freer air of the American continent, and to complain strongly against anything tending to strengthen the central Government at the expense of the outlying centres of authority. But in spite of preconceived notions we must admit that "they do some things better" in Great Britain. We require in Ontario a closer supervision by the Government of public works undertaken by the municipalities.

In Great Britain the Local Government Board has control of all public works such as water supply, sewage disposal works, etc. When a town decides to construct a work the plans are submitted to the Board and are passed upon by engineers whose standing in the profession makes their decisions irreproachable, both morally and scientifically. If the decision is favorable to the proposed work the town is authorized to borrow the necessary funds and carry on the work according to the plans submitted, and the inspectors of the Board see to it that the plans are not departed from nor any work not in accordance with the specifications as passed upon, put in. The consequence of this is that the British local public works are of unrivalled excellence, and the municipal indebtedness is low. In Ontario any clique of aldermen or town councillors who get together may decide upon a public work, talk the citizens into adopting it, hand over its execution to the individual whose arguments appeal most strongly to the aldermanic mind, and so add almost at will to the public debt. It is true that an issue of municipal bonds requires to be approved by the Local Legislature, but it is the issue of bonds that comes in for the criticism of the legislators, not the economical spending of the resulting moneys. Even if the plans were required to be passed by the Private Bills Committee there would be no improvement, for the legislators know very little more engineering than do the aldermen.

A supervisory board of civil and sanitary engineers of the highest standing is needed to act as a check, as does the Local Government Board in Great Britain. We would not then have unsatisfactory works constructed at absurd expense by municipalities unable to carry the resulting debt. This is true in too many cases in Ontario to-day.

SOME INCIDENTAL BENEFITS FROM THE GROWTH OF FORESTS.*

Mr. Chairman and Gentlemen—On considering the true meaning of the title of my subject it has occurred to me that what is the main and what the incidental benefits of forest growth to the community depends largely upon the point of view. The guardian of the public health would probably have no doubt that the principal use of forests was to purify the air by absorbing carbonic acid gas and exhaling oxygen and in regulating the temperature. The scientific agriculturist would be inclined to think that the chief function of a forest was to serve as a windbreak and shelter for farm crops, and assist the subterranean irrigation, while the old-fashioned farmer will be equally certain that the only use of trees is to furnish fuel and fencing, and they should only be grown so long as they are cheaper than substitutes, failing in this they should be cleared off to provide pasture or ploughed fields. The engineer will be inclined to regard trees growing in mass to be chiefly valuable as a regulator of stream flow

*From a paper read before the Association of Ontario Land Surveyors.

and a flood preventative, while the artist will look at them mainly from an æsthetic point of view, as making or marring the landscape, according to their presence or absence and thereby contributing to the sum total of human happiness.

Many land surveyors, I have no doubt, frequently have occasion to regard a forest as an unmitigated nuisance, especially when it is composed of Ilex verticillata, or black alder, and lies in the line of march. As an official of the Government, interested in maintaining the provincial revenues from sources remote from direct taxation, I have to admit that my own point of view is largely a utilitarian one, that regards the forest as a source of wealth to the province and to the people, but I fully recognize the importance of the other, and what I shall call the incidental benefits, benefits so great and so important to the general welfare of the community as to make it desirable that forestry should be an affair of the State rather than of individuals, with whom present financial necessities may cause a sacrifice of future profits and result the detriment of climatic conditions.

Before going into the matter of the incidental benefits of forest growth, allow me briefly to refer to what I consider the main question from the standpoint of provincial revenue, and the maintenance of the extensive industries dependent upon forest products. The provincial revenue received last year from woods and forests by way of ground rent and timber dues was over $981,000. This represents the production of a large amount of timber, and if we add to this the large quantity of firewood, railway ties, pulpwood and about 375,000,000 feet of timber cut yearly on lands not controlled by the Crown, it will be seen what a very important part in th industrial life of this province is played by our forests anc their products. The number of men employed in the woods, on the streams and in the saw-mills, apart altogether from those engaged in other industries dependent in part or wholly upon the forest, runs into the thousands, while the capital employed represents many millions.

It is not necessary for me to go into the many reasons why permanent forest industries must be dependent largely upon State control, that is I think pretty well understood by everybody now-a-days, but I desire to point out what the present forestry policy of the Government means to the future revenue, and the industrial life of the province. The Forest Reserves Act of 1897-8 proposes to set apart areas of non-agricultural lands to be withdrawn from settlement and kept permanently the property of the Crown for the purpose of growing successive crops of timber. If these areas had to be cultivated and planted to young trees, at an expense of about $15 an acre, the amount of money required would be very great, and if the amount thus expended, with interest, were added to the annual cost of care and protection of the young trees, it is doubtful if the resultant crop would show a very large profit on the transaction. True, the crop would be larger than in a forest grown under natural conditions, as was the one we are now harvesting, and a shorter time would be required to enable it to reach a state when it would be profitable to cut it. At the same time the initial expense and annual charges would be so great as to render the project of doubtful financial success on any large scale in this country, where only the more valuable products of the forest have a market value:

Fortunately for us, however, this is not necessary to provide future crops of trees and of the sorts experience has proved to be the most valuable. To do this will require the expenditure of very little money, but more time. I hesitate to make any remarks as to how we are fixed in the former commodity—it is more or less a political subject, on which doctors differ—but we are rich in the latter. How much money we can invest in reforesting without borrowing I will not attempt to say, but we have plenty of time. The nation never dies, or hardly ever, and we are a young nation, with millions of acres of land valuable for growing trees, of little value for any other purpose, so we can afford to wait to allow nature to restore the magnificent forest removed by axe and fire from these lands. And nature is already doing the work, not as evenly as we could wish, nor with a crop of pure white pine, our most valuable tree, but she is doing the work just the same. I had occasion this past summer to examine a tract of several thousand acres that had been lumbered over, and burned over several times. Over this tract I found a vigorous growth of poplar, birch, white pine, red pine, tamarack, cedar, maples and other trees. In some places there was very little pine, but over most of it there is a crop of pine numbering from 200 to 700 trees to the acre and growing very fast. Much of it is now 6 to 9 inches in diameter, and I estimate that in 50 years there will be a very heavy crop of pine ready to cut, not less than 50,000 feet B.M. to the acre. I do not mean that it would be wise to cut that much at that time, but it could be cut.

On much of the abandoned farm lands in New England 50,000 feet to the acre is now standing, and two years ago the Rathbun Co. cut 100,000 feet to the acre over quite a tract in Grinsthorpe. I mention this to show that my estimate is not excessive. The stumpage value of that pine 50 years from now will be worth not less than $4 per M, and is likely to be worth more. At this figure the pine timber on much of this land fifty years from now, if protected and cared for, will be worth $200 per acre, which represents a present cash value at 3 per cent. compound, of $45.62 an acre, and this land is generally considered of no value.

The main benefit to be expected from these reserves consists in the provincial revenue, and the maintenance of industries dependent on them, but in addition to this the incidental advantages from the presence of these masses of trees are of vast importance to the people of this country. Concerning these factors in forest value there is room for considerable diversity of opinion, and this diversity exists. It is claimed by some forestry advocates that forests materially affect the rainfall, while on the other hand, it is claimed that it is not so, but that the rainfall affects the forests. While there can be no doubt of rainfall affecting the forests, it is not equally certain that the presence of forests influences the amount of rainfall. It is a case of not proven, although to my mind the evidence mainly goes to show that if the total rainfall is not influenced by tree growth its distribution is. We know that trees take up immense quantities of water from the soil and transpire most of it through the leaves. The moisture thus transpired from a large hardwood forest is very large, though difficult to estimate accurately, as the amount varies with the thickness and number of the leaves, amount of water in the soil and other conditions. A conservative estimate is made by F. B. Hohnel, a German scientist, of a fifty or sixty-year old beech forest for the season of growth at 1,972,000 lbs. or 986 tons of water per acre. Some authorities make the amount much larger than this, but in any event there is sufficient to lead one to believe that the atmosphere immediately above a forest must be so charged with moisture as to hasten precipitation in clouds that may come in contact with it. That forests exercise a beneficial influence on the climate of the neighborhood there can be no doubt. The temperature of the air in the forest is cooler during the day and warmer during the night than in the open field. Consequently air currents are set in motion by this difference in temperature, cooler currents coming from the forest during the day in the lower strata and warmer air during the night from the upper strata, thus equalizing the temperature and increasing the humidity of the air. This is aside altogether from the mere windbreak action of the forest, which is of considerable importance.

The aspect of forest growth most likely to appeal to the members of this association is its effect as a regulator of our water supplies, and a factor in flood prevention. Even here there seems to be a difference of opinion, and a Western States writer a short time ago claimed that the presence of forests in the mountains prevented the snow from drifting into immense banks and then gradually thawing all summer, keeping up a constant supply of water for the streams. Without disputing this statement—for it cannot possibly apply to our own province, which is not mountainous—I may state as an accepted fact that the main factor in our great wealth in water powers and navigable waters are the great forests. At the risk of repeating what you may already know better than I, I desire to point out some ways in which the forests serve to regulate the flow of streams and prevent alternate flood and drought. Speaking generally the steam flow can only reach a percentage of the rainfall in the catchment basin. If the water does not fall either as rain or snow there can be no streams; but granted a certain precipitation during the year it may be gradually given off to the streams, making them reasonably constant in volume, or it may run off quickly, causing a flood and subsequent drought. Our streams are fed in two ways, by underground springs, and by the run off from the surface of rain or melted snow. Springs occur generally where a layer of porous sand or gravel lies between an impenetrable subsoil and the surface soil. The rain water runs under this top soil through the sand or gravel, and as it cannot penetrate the subsoil it is forced out through an opening in the top soil and goes to add to the volume of the nearest stream. It will readily be seen that a larger quantity of water will reach the gravel layer if the surface is covered with forest than would be the case in the open field, as most of it would run off the surface after rain, in the latter case instead of soaking into the soil. Most of us have known of springs that have become dried up in the summer, that years ago before the woods had been removed were perennial.

In the same way the forest serves to regulate the water running from the surface into the streams. Concerning the extent of this action of the forest a great deal has been written pro and con, and volumes of figures have been compiled to show that the removal of the forest had little or nothing to do with stream flow. At the same time I think we are all pretty well convinced that Captain Eads, the famous engineer, was right when he remarked concerning the building of the jetties at the mouth of the Mississippi River, that he was working at the wrong end of the stream. The very nature of a forest floor covered with small twigs, leaves and sponge-like soil, indicate the mechanical action that dams the water and allows it to run off slowly. Branches die and fall to the ground. Trees do likewise and in falling across something would form dams and create small reservoirs of water against the time when it would be needed. The sorts of trees also form conductors that allow the water to penetrate the subsoil deeply, and add to the subterranean supply. Remove these forests and the rainfall rushes off to the streams, which are soon in flood and soon dry up. The snow exposed to the full force of the wind and sun follows the same course, and large sums are being spent all over the continent to prevent the disastrous floods that now cause so much damage and loss of life, but which were not known in the earlier days when this was really a "wooden country."

At Brantford, I believe, they are spending a large sum of money to prevent the annual flood of the Grand River doing so much damage. It is worth noting that the county of Brant has only about 7 per cent. of its total area classed as woodland, and of this much is not tree forest land, but is pastured and the soil beaten hard. Most of you know something of the vagaries of the river at Belleville, which nearly every spring causes anxiety as to the amount of damage it is likely to do in flood, and in summer is so dry as to cause the remark by a traveler who saw it last fall from a Grand Trunk car that "it looked like a first rate place to put a river in."

A concrete case of the effect of forest denudation on stream flow has been furnished by W. C. Caldwell, M.L.A. Mr. Caldwell is a lumberman and a mill owner, and as his business interests were affected, he made careful notes of the occurrence in his diary at the time. The watershed of the Clyde River was swept by successive fires in 1875-6-7, a large territory being affected. The water supply was gradually affected from 1880 to 1885. From 1885 to 1892 the flow of water was so reduced that in 1886-7-8 9 and 90 the mills on the Clyde were short of water in August and September, something unknown until that time. In the meantime the new crop of poplar, birch, etc., had reached quite a size, and in 1890 began to affect the water supply and restore the evenness of flow. Since 1893 there has been an abundant supply of water, and Mr. Caldwell has no doubt it is due to the effect of the new forest that has followed the fires. Failing this new forest a constant supply of water could only have been secured by a costly system of impounding reservoirs.

LITERARY NOTES.

The annual report of the Department of Mines, Nova Scotia, for the year ending Sept. 30th, 1898, contains 100 pages of facts and figures about the progress of mining in Canada's farthest East. Extracts from the report will be found on another page.

Canadian Hand-Book of Steam and Electricity is a volume of 150 pages in brown cloth, published by the C. H. Mortimer Co., Ltd., Toronto, contains a mass of valuable information, much of which is in tabular form and convenient for reference. A large portion of the work is of such an elementary character as to give it special value for beginners.

Accounts of the City of Charlottetown, P.E.I., and Annual Reports of the several departments of the City Government for the year ending the 31st Dec., 1898, embodies the report of the city engineer, Freeman C. Coffin, upon the system of sewage disposal for the city now being installed. We hope to refer to the special features of this system at a later date.

The Annual Report of the City Engineer of Hamilton, Ont., for 1898, contains among other interesting matter a large colored map, showing the proposed changes in the water distribution system. The expenditure on public works in the past year was $204,861.36. Full page illustrations are given of the new pumping station, the filtering basin, boiler room of the main pumping station, etc.

The Canadian Magazine for April contains an interesting chapter of Miss Wood's story "A Daughter of Witches" and a pleasant variety of short stories, together with the usual poetry. Judge Ermatinger continues his historical sketch of the Michilimackinac. It is unfortunate that this number, however, retains the dime magazine standard by publishing a variety of uninteresting pictures of more or less uninteresting theatrical persons.

The special Easter number of the Ironmonger issued March 25th, 1899, is one of the most successful special numbers that trade journalism has produced. The lithographed cover is a pleasing introduction to the three hundred and eighty pages of illustrated advertisements and general reading.

The Universal Electrical Directory (J. A. Berley's) for 1899, which is the eighteenth year of publication, contains in its 1,250 pages an amazing mass of most useful information. The index alone, to the classified trades, occupies four pages, which is a criterion of the thoroughness with which the ground is covered. It is difficult to think of an electrical trade question which cannot be answered by the aid of this well-named Universal Electrical Directory.

We have received A. S. Lovendal's Dictionnaire Technique Francais-Anglais des Outils et Ustensiles Employés dans les Metiers manuels, La Petite Industrie, La Ménage, etc. This is a most valuable dictionary for anyone who has to do in any way with the arts or trades among our French-speaking fellow citizens. The lists are most complete and are so arranged as to be most conveniently referred to, as not only are the different tools and apparatus listed alphabetically, but also each art or trade has grouped under it, as a heading, all the tools, etc., which naturally fall there.

The series of papers by Cecil B. Smith, Ma. E., which appeared in THE CANADIAN ENGINEER during the past two years have now been issued in book form under the title "Railway Engineering." There are many standard works written upon various phases of railroad construction, the merits of which are universally recognized, such as "Wellington's Theory of Location" and "Foster's Wooden Trestle Bridges," but Mr. Smith's work is the only general discussion of the entire subject that has recently been published and the work is therefore very welcome, especially to those who may wish to acquire a general knowledge of the subject before commencing a special study of any one of its details. The title "Railway Construction" would perhaps be more appropriate than that of "Railway Engineering" as the book does not deal with the important branches of track maintenance and operation. Mr. Smith's long and honorable professional career amply qualifies him to write as an authority upon his chosen theme, for he has been prominent in the locating and constructing staff of the Northern Pacific Junction, Niagara Central, Charleston, Cincinnati and Chicago, Roanoke and Southern, Baltimore and Ohio, and Canadian Pacific Railways, and had ample opportunity during his connection with McGill University to thoroughly study the theory and literature of railroading. His work therefore presents to the reader a concise and thorough description of the engineering side of railroad construction, and in detail is as follows. Chapter I. is devoted to railroad statistics, dealing more especially with those of Canada, and commenting particularly upon the maxims of railroading and the considerations technical, political and local which must be taken into account when studying any proposed line. In Chapter II. train resistances and their effect upon the cost of transportation are discussed, the methods introduced by A. M. Wellington in his "Theory of Location" being closely followed. This chapter is perhaps the most valuable in the book, for to-day no locating engineer can be considered as properly qualified who is not fully aware of the financial effects of grades and curvature. Chapter III. contains a brief reference to the use of circular curves and a clear exposition of vertical and transition curves. These latter may still be classified as recently introduced, for their use is by no means general to-day and the realization of their importance dates only from the first scientific study of the theory of location. The simple methods of calculation that are recommended nullify the objections on the ground of intricacy that are so often urged against them. In Chapter IV. the reader gets the benefit of Mr. Smith's wide experience in reconnaissance and field work, and the many practical hints given are of great value. Chapter V. is devoted to construction and treats of those structures that are usually under the superintendence of the resident engineer. It is plentifully illustrated with cuts of the standard plans of the various railroads with which the author has been connected and concludes with some very pertinent advice upon classification and estimation. Chapter VI. is a most unusual and interesting addition and contains a careful resumé of those clauses of the Railway Act that are of special importance to engineers. A brief second part upon track material concludes the work, but the collection of diagrams for the rough estimation of timber and masonry quantities from the profile are worthy of especial mention from their particular usefulness in the comparative study of locations. While the book as a whole is very welcome, dealing as it does with the entire field of the construction engineer, the chapters upon train resistances and railway law deserve the most especial commendation, because many of our engineers have simply grown into their profession and are ignorant of the great forces, natural and political, that control our common carriers. It is only to be regretted that Mr. Smith has not seen fit to discuss his interesting subject at greater length, for there is room at present for a successor to the once standard work of G. L. Vose, but as it is, it is to be heartily recommended to all who desire a clear introduction to the art of railroad building. Railway Engineering, Cecil B. Smith, Ma. E. Cloth, 200 pages, profusely illustrated. Biggar, Samuel & Co., Publishers. $1.50.

METAL IMPORTS FROM GREAT BRITAIN.

The following are the sterling values of the imports into Canada from Great Britain of interest to the metal trades for the month of February and the two months to February, 1898 and 1899:—

	Month of February,		Two Months to February,	
	1898.	1899.	1898.	1899.
Hardware	£1,629	£1,116	£3,333	£2,654
Cutlery	3,283	3,055	6,612	7,820
Pig iron	1,348	401	1,852	762
Bar, etc.	1,212	801	1,412	1,246
Railroad	6,872	..	6,922	..
Hoops, sheets, etc.	1,939	1,618	2,753	1,743
Galvanized sheets	542	332	2,518	820
Tin plates....................	6 586	5,862	18,515	11,547
Cast, wrought, etc., iron	1,998	1,443	3,571	2,440
Old (for re-manufacture)	80	..	80	..
Steel	6,106	1,919	10,627	5,689
Lead	594	133	1,518	1,022
Tin, unwrought	619	118	1,920	2,633
Alkali	1,383	853	2,884	2,396
Cement	1,389	35	1,874	248

SUMMARY OF THE MINERAL PRODUCTION OF CANADA I 1898.

The following figures have been submitted by the Geological Survey of Canada to the Government, and are subject to revision:

Product.	Quantity. (*a*)	Value. (*a*)
Metallic—		
Copper (fine, in ore, etc.) (*b*) lbs....	17,951,421	$ 2,159,556
Gold, Yukon district*	....	$10,000,000
Gold, all other	....	3,700,000
Iron ore, tons	58,161	152,510
Lead (fine, in ore, etc.) (*c*) lbs......	31,915,319	1,206,399
Nickel (fine, in ore, etc.) (*d*) lbs......	5,517,690	1,820,838
Silver, (fine, in ore, etc.) (*e*) ounces..	4,434,085	2,583,298
Total metallic..................	....	$21,622,601
Non-Metallic—		
Asbestus and asbestic, tons	23 785	486,227
Chromite, tons	2,021	24,252
Coal, tons	4,172,655	8,227,958
*Coke (*f*) tons.................. ...	72,444	219,200
Felspar, tons	2,500	6,250
*Fire clay, tons	2,170	5,000
Graphite, tons	....	11,998
Grindstones, tons	....	39,465
Gypsum, tons	219,256	230,440
Limestone for flux, tons............	33,913	31,153
Manganese ore, tons	50	1,600
Mica, ...	....	117,598
Mineral pigments—		
Baryta, tons	1,070	5,258
Ochres, tons	2,341	18,600
*Mineral water	....	155,000
Moulding sand, tons	10,572	21,038
*Natural gas (*g*)	....	320,000
Petroleum (*h*) bbls..................	700,790	981,106
Phosphate (apatite), tons	733	3,665
Pyrites, tons	32,218	128,872
Salt, tons	57,142	248,639
Structural materials and clay products—		
Cement, natural rock, bbls..........	87,125	73,412
Cement, Portland, bbls..............	163,084	324,168
Flagstones	....	4,250
Granite	....	73,573
*Pottery	....	135,000

Sewer pipe	....	166,421
Slate	....	40,791
Terra cotta	....	167,902
Tripolite, tons	1,017	16,660
Building material, including bricks, building stone, lime, sands and gravels and tiles (estimated as for previous year)	....	3,600,000
Total structural materials and clay products	....	4,002,177
All other non-metallic	......	11,282,419
Total non-metallic	....	15,884,596
Total metallic	......	21,622,602
Estimated value of mineral products not returned	....	250,000
1898 total	.....	37,757,107
1897 total	....	28,661,430
1896 total	....	22,584,513
1895 total	....	20,758,450
1894 total	....	19,933,857
1893 total	....	20,035,082
1892 total	....	16,628,417
1891 total	....	18,976,616
1890 total	....	16,763,353
1889 total	....	14,013,913
1888 total	....	12,518,894
1887 total	....	11,321,331
1886 total	....	10,221,255

*Partly estimated.

(*a*) Quantity or value of product marketed. The ton used is that of 2,000 lbs.

(*b* Copper contents of ore, matte, etc., at 12.03 cents per lb.

(*c*) Lead contents of ores, etc., at 3.78 cents per lb.

(*d*) Nickel contents of ore, matte, etc., at 33 cents per lb.

(*e*) Silver contents of ore at 58.26 cents per oz.

(*f*) Oven coke, all the production of Nova Scotia and British Columbia.

(*g*) Gross return from sale of gas.

(*h*) Calculated from inspection returns at 100 gals. crude to 42 refined oil, and computed at $1.40 per bbl. of 35 imp. gals. The barrel of refined oil is assumed to contain 42 imp. gals.

In studying the figures given in the above general table, many interesting and gratifying features will be noticed. In the grand total an increase is shown of over $9,000,000 or nearly 32 per cent. as compared with 1897. This is a still larger proportional increase than that of 1897 over 1896 which amounted to nearly 27 per cent. Compared with 1886, the first year for which statistics were issued, we find an increase in the value of mineral products in thirteen years of nearly 270 per cent. When it is remembered that during the same period the increase in the population has been only about 14 per cent., it will be evident that the proportional importance of the mining industry to the country is very much greater than it was at the beginning of the period dealt with. Thus the per capita value of the mineral production of the country has increased from about $2.20 to $7.20. Whilst these large increases of late years have of course been partly due to the discovery and working of the rich gold-placers of the Yukon, other important mineral industries have also contributed to them, and there is every reason to expect a continued rapid growth in many of them for some years to come, especially as the province of British Columbia continues to develop. The following table shows the principal changes in the production and values for the year 1898 as compared with the revised figures for 1897:

Product.	—Quantity— Increase. Per cent.	Decrease. Per cent.	—Value— Increase. Per cent.	Decrease. Per cent.
Metallic—				
Copper	34.96	.....	43.81	.....
Gold	.....	.....	127.31	.....
Iron ore	14.70	.....	17.05	.....
Lead	.....	18.20	.....	13.63
Nickel	38.02	.....	30.14	.....
Silver	.....	20.23	.....	22.27
Non-Metallic—				
Asbestus and asbestic	.....	21.87	9.17	.....
Coal	10.21	.....	12.66	.....
Gypsum	.....	8.52	.....	5.76
Natural gas	.....	.....	.....	1.80
Petroleum	.....	1.28	.....	3.00
Cement	21.93	.....	44.43	.....

It will be observed that most of the large increase in the total is to be credited to the metals, gold, copper, nickel, the non-metallic materials, coal, asbestus and cement also contributing. Beginning with the most important, the increases in these products were as follows, viz.: Gold, about $7,673,000; coal, over $924,000; copper, nearly $658,000; nickel, nearly $422,000; asbestus, iron ore and cement aggregating about $185,000. Of the gold output the main feature was the very large increase in that of the Yukon. This accounts for $7,500,000 of the enlargement, which is three times as great an estimated output as that for last year. With the exception of the gold washings of the Saskatchewan River in the Northwest Territories, there were also increases in all the other districts of the Dominion. There were increased outputs of coal in all the different districts. In copper the largest increase was in Ontario, which amounted to over 50 per cent. of the previous year's output. British Columbia showed also a considerable enlargement, whilst in Quebec a small falling off was apparent. A rise in the price of the metal makes the proportional increase in value greater than that for quantity. In nickel, the increase in the quantity is greater than that in the value, owing to a fall in the average price of the metal for the year.

The falling away in the production of both lead and silver is, in the former case, partly offset by the rise in the average price, whilst in the latter case a lower price for the year has aggravated the proportional decrease in the value as compared with the quantity. Whilst there was a decrease in the actual quantity of the product of the asbestus mines of Quebec, the value shows a large percentage increase, which is explained by the lesser proportion of asbestic and low grade fiber in the output. The proportional contributions of the chief products to the grand total of value are set forth in the following table both for 1897 and 1898:

PRODUCT AND PER CENT. OF TOTAL PRODUCTION

1897.		1898.	
Coal	26.87	Gold	36.28
Gold	21.02	Coal	21.79
Building material	12.56	Building material	9.53
Silver	11.59	Silver	6.84
Copper	5.24	Copper	5.72
Nickel	4.88	Nickel	4.82
Lead	4.87	Lead	3.19
Petroleum	3.53	Petroleum	2.60
Asbestus	1.55	Asbestus	1.29
Natural gas	1.14	Cement	1.05
Cement	96	Natural gas	85
Gypsum	85	Salt	66
Salt	79	Gypsum	61
Coke	62	Coke	58

With the exception of the transposition of the positions of gold and coal, of natural gas and cement, and of gypsum and salt, the items stand in the same order as before. The feature mainly noticeable is of course the assumption of the first place by gold, and its large predominance over the rest. To this is largely due the fact that the metallic minerals as a class contributed in 1898 over 57 per cent. of the whole, as compared with about 48 per cent. last year. The structural materials amounted to about 12 per cent., and the other non-metallic minerals to about 30 per cent.

BOSTON SEWAGE OUTFALL.

BY CHARLES E. TROUT.

For THE CANADIAN ENGINEER.

More than one-half the sewage of Boston and vicinity is discharged into tide water at Moon Island, about six miles from the main water front of the city. To reach this point the sewage flows by gravity to a pumping station on the harbor front near Moon Island, where it is raised about thirty-five feet and forced through a tunnel under an arm of the harbor to the outfall works. These consist of a storage reservoir, together with the necessary gate houses and machinery for filling and discharging. The function of the reservoir is to store the sewage while the tide is flowing in and discharge it after the tide has turned, when the strong current carries it out to sea. The reservoir is composed of four distinct basins, so arranged that one may be kept empty for any purpose, as cleaning or repairs, while the others are in use. The four basins are of nearly equal capacity and the division walls between the basins are of rubble on concrete foundation. Where the foundation rests on gravel or other pervious material a line of tongued and grooved sheet piling is driven into the clay underlying such material. As a further precaution against water passing under the division walls and the bursting of the reservoir floor by springs, a line of drain pipe, with open joints, is laid on either side of each division wall, and beneath the floor of the basin. These drains discharge outside the reservoir. Thus, water accumulating beneath the floor finds free access to the drains, and is carried safely outside the reservoir. A safety valve, opening into the reservoir is provided on each drain to relieve an excess of pressure below the floor in event of a drain being choked. The floor of the reservoir is of concrete nine inches thick, and is shaped in alternate gutters and ridges, the width centre to centre of ridges being twenty feet. Set in the ridges at intervals of thirty feet are blocks of granite, three feet square and eighteen inches deep, to be used as pier stones in case it should ever be necessary to roof the reservoir.

The arrangements by means of which the reservoir is filled and emptied could best be illustrated from a figure. Across the lower end of the reservoir runs the outfall sewer, which brings the sewage from the city to the works. Immediately below it are the discharge sewers, which carry the sewage from the reservoir out to sea. These are all of brick and backed with rubble masonry. Between the sewers and the reservoir is what is known as the six foot gallery which serves as a foundation for the gate house above, and as a protection for the gates from frost. It is divided by the division walls of the reservoir and four partition walls, one opposite the centre of each basin, into eight compartments. In both the outfall and discharge sewers, on the side next the reservoirs, are twenty gate openings, each three by four feet. Only half of these, eight in the outfall and twelve in the discharge sewers, are at present in use. The rest are bricked up until the increased amount of sewage renders them necessary. The gates with their frames are of cast iron, with bearing surfaces of composition. Both gates and frames are single castings, which are grooved to receive the strips of composition for valve faces and gate rests. The grooves are worked out by machine tools and the strips are riveted in place with composition rivets. The gates are pressed tight by adjustable gibs, bearing on inclined planes, cast on the frames. The gates are raised by lifting rods and screws, connected with suitable gearing above the floor of the gate house. The clutches for each gate are thrown in by a hand lever, and may be thrown out by hand or by the gate itself on reaching either end of its course. The gearing is driven by a main line of shafting, running the full length of the gate-house—575 feet—and varying in diameter from three and one-half to two and one-half inches. The power to operate the gates and for other purposes is furnished by a turbine wheel installed at the lower end of the outfall sewer, and driven by the sewage. The wheel pit drains into the discharge sewers. Ample power is furnished by the turbine for operating the gates, pumping and running other machinery about the works, at no expense for maintenance, and with no attention beyond opening and closing the gates leading to the wheel pit.

The reservoir has a capacity of about 25,000,000 gallons. Under ordinary conditions it will fill in about ten hours. In time of storm, however, the reservoir is not large enough to store the extraordinary quantities of sewage received, and it is frequently necessary to begin discharging before the turn of the tide. The frequency of this early discharge is constantly increasing with increasing population and water consumption, and might in time give cause for complaint to property owners on the water front of the city. The builders of the present reservoir foresaw the necessity of increasing its capacity in the future, and they so located and carried on the work that such an extension could be easily carried out by increasing the length of the basins. Such works are now in progress. The length and capacity of the basins will be doubled.

The method of discharging, flushing and filling the reservoir is as follows: An hour or so after high water, the water in the harbor being then about the height of the bottom of the reservoir, the gate leading to the wheel pit is opened and water is admitted to turbine. The shafting in the gate house starts and it is possible to raise or lower any gate by throwing its operating machinery into gear. First, the gates leading from the outfall sewer are closed, then those leading to the discharge sewers are opened. Under ordinary conditions the reservoir is empty in less than an hour. A deposit of slime remains in the bottom of the reservoir, generally quite thin, but in considerable quantities after a storm. To remove this the reservoir is flushed by the sewage stored in the outfall sewer. The openings from the reservoir to the six-foot gallery, excepting those next the side and division walls, are provided with gates hinged at the top and swinging into the six-foot gallery. Thus, while the basins discharge at all the openings they fill only from the two extreme openings. As soon as a basin is empty the lower gates at one side are closed and the upper gate on the same side opened wide. The sewage rushes in, filling one compartment of the six-foot gallery, and rushing into the basin by the one opening not provided with a gate, it flows up the gutter opposite that opening, and at the same time it spreads out over the ridges washing the slime into the gutters. As soon as enough sewage has entered, the upper gate is closed and the lower ones opened. The flush is drawn into the discharge sewers, where it is held till the next discharge, in order that, being the foulest of the discharge it may have an early start and be carried well out to sea. The flushing is done alternately from opposite sides of the basin. This method works well excepting that it will not clean the back corners of the basins of heavy materials, and a deposit of gravel, sand and sludge collects there which has to be occasionally shovelled out. Once a month or so the reservoir walls are washed by a fire stream furnished by a power pump driven by the turbine. Salt water from the harbor is used in this washing.

As it is not expected that the present method of flushing will be effective when the basins are doubled in length, a method has been devised by means of which the flushing will be done from the upper end. A large sewer will be built from the outfall around the upper end of the reservoir. On this sewer will be four gate houses, one opposite the centre of each basin, through which sewage can be admitted in sufficient quantities to thoroughly flush the basin. A system of stop planks will be provided to distribute the sewage over the width of the basin. The gates in these gate houses will be operated by compressed air pistons with valves operated by electricity. The compresser and perhaps a dynamo as well, will be operated by the turbine.

In winter scarcely any odor is noticed from the basins, but in hot weather an offensive smell arises at times. However, as no one lives nearer than the main land, a mile away, this is not a serious matter. Generally the tidal currents carry the sewage away from all inhabited places, but occasional complaints are heard from summer resorts along the coast. These are neither very earnestly made nor very seriously taken, and are probably due to a readiness to attribute the consequences of local carelessness to a distant cause. At the worst, however, the works quite fulfil their object in minimizing the nuisance caused by the sewage of the district they serve.

METALLURGICAL MACHINERY.*

BY A. C. M'CALLUM, M.E., PETERBORO, ONT.

In the matter of the design of metallurgical machinery it must be admitted, with reference to rolls, crushers, stamps and other machines employed in the reduction of ores, one is almost led to believe that they are not susceptible of as exact an analysis as a bridge for example. In the following remarks it is purported to deal with the most familiar machines employed by mining engineers, such for instance as crushers, rolls, stamps and feeders. To deal with them from the designer's point is my purpose.

Considering in the first place crushers, the introductory remarks anent them are applicable to most all of the other machines mentioned. It will readily be admitted that many de-

*From a paper read before the Canadian Mining Institute.

signs of crushers show by the distribution of the material within them, that the designer neglected to take advantage of a method of analysis commonly employed by designers of bridges and other large structures, a system of analyzing quite applicable to mining machinery, namely by that of graphics. The construction of a graphic diagram of stresses within any machine under design is most essential, as upon it the designer elaborates his working drawing. The benefits to be derived from such a process of designing cannot be overestimated, it impresses upon the designer an intimate and exact knowledge of the acting forces and their distribution throughout the parts of the machine in the process of design; there may be many problems which are extremely complex and frequently unsolvable; it is necessary however, to possess definite knowledge of the resistance of the materials employed in the construction of the machine to those complex forces.

It has been sometimes remarked that skill and good workmanship are not essential features in the make-up of mining machinery, but the idea is false, more plants built for the purpose of ore reduction have been failures, due in large measure to the fact that the enterprise was handicapped by machinery ill adapted for the purpose. It is to be much regretted that many engineers in the purchase of mining machinery estimate the superiority of the machines to be purchased by the dead weight, regardless of how the material is utilized and distributed. Discussion will not alone settle the question finally in all cases without elaborate and unprejudiced experimental work. Most careful investigation is necessary in many instances to discriminate between real improvement and the impractical. The sine qua non of good machine design, from a structural point of view, is the presence of sufficient material of the proper kind, in the right place. There are many types of crushers upon the market, and there is no doubt that the majority of them were originally intended for breaking road ballast. The demand within recent years for crushing machinery in mining regions is primarily the cause of their being advanced to the front as crushing and pulverizing machines. There is no doubt that the "Blake" type of crusher stands pre-eminently for service and has been generally adjudged the most efficient and economical in use; perhaps the reasons most readily advanced for such, lies in the fact that for a given capacity the first cost is less, the cost for repairs is also less, and they are idle for repairs much less of the time. The "Blake" type of crusher has developed few changes from the original design. The first type of "Blake" crushers had the crushing jaw pivoted at the bottom, as at present in general use the jaw is pivoted at the upper end. It is a matter of choice, to do a given amount of work by either of the types of machine; one with the working jaw pivoted above, the other below. For the jaw pivoted at the bottom, the plea is used that a more uniform product is obtained, and that finer crushing, when that is desirable, can be secured. The concurrence of preference however if gauged by use, is in favor of the modern "Blake" design with overhung jaws, when that type of crusher is chosen.

A general summary of crushers upon the market if analyzed would reveal the important fact of a want of harmony amongst the various types of similar dimensions. The dimensions of the openings are not called in question, but like pieces within different makes of crusher. So far as the openings of the jaws are concerned, those dimensions are not by any means arbitrary, but have been fixed by experience. Quartz generally breaking in sizes which can be suitably crushed by ore breakers of such standard dimensions as 10x7 in., 15x9 in., 20x10 in. Mining engineers in charge of plants are well acquainted with the many faults developed in crushers under their care, broken frames, pitmans, jaws and other parts are known. What then are requirements of a good crusher?

In order that the crusher shall run easily, cool, and prove serviceable, it is requisite that all of the journals be in correct alignment one with the other. Rigidity, strength and sufficient weight must be found in the frame, so that the vibrations created while crushing may become absorbed. This must be advanced as the reason for the failure of the many types of steel plate frames, they easily yield to the strains within the machine, thus causing the working parts to become out of proper relation one with the other, and resulting in heating, and running hard. According to the nature of the product to be crushed, we must have a certain direction of stroke, length of stroke, and relative angle in the position of jaws, and to procure those conditions various means are employed, which methods are well known to mining men. But it has appeared to the writer that simplicity of construction may be secured by abolishing from the type of crusher under consideration, the wedge block so common, and employing other means of adjustment, for instance by means of the toggles. Change of toggles can be effected as readily as by means of the adjustable wedge. The movement required can then be made by rearrangement of the toggles. The machine being provided with a set of toggles giving the requisite maximum and minimum openings. It is necessary that the shaft supporting the jaw should be securely fastened to the jaw, not by means of set screws, a preferable method of fastening is that of the gib and key. The jaw shaft is then required to move in the bearings of the machine. This overcomes the pounding and jumping due to lost motion, which readily develops when the jaw moves upon the shaft. The caps of the bearings can then be tightened whenever wear renders it necessary. Within the pitman much trouble is often created, perhaps no other feature within the make-up of the pitman creates more trouble than the adjustable devices provided to take up wear, when the eccentric shaft has worn out of round, due to the strain upon it being constantly in one direction.

Fly-wheels as commonly fastened to crushers are at fault By employing them as a means to prevent serious injury to the working parts of the machine, owing to sledge hammer heads falling into the jaws, or other causes, we may so fasten the fly-wheel upon the shaft that in case of accident the belt may slip and the crusher stop while the fly-wheels exhaust their motion. We may use taper keys.

The reduction of granulation of coarse particles of ore by means of rolls, has been given much consideration during the past few years. The variety of crushing rolls are many and various in type and construction. Machines for this class of work have been largely involved by American engineers, and proof of their superiority is to be found in the fact of their having gained admission to almost every large metallurgical work throughout the world. Notwithstanding the many changes that have been made during past years in all the various designs known to us, no special one has met with general approval. The most potent change has been in the adoption of steel as the material for use in the construction of the shells. The construction of the frame in one piece, having sufficient weight and strength to absorb the vibrations set up within the machine, and closer study has been given to the matter of the strains with the structure. Marked improvement over the older forms of crushing rolls has been made in the design of journal bearings, methods of lubrication, and the facilities for dismantling the machine if required. Considerable ingenuity has been displayed to obtain complete and satisfactory methods for keeping the lateral adjustment of the rolls correct. The adoption of springs for that of levers and dead weights within the machine to give crushing power to the rolls is an important improvement, affording as it does, a much more uniform product. The adoption of some form of housing obviates the wasteful and disagreeable nuisance of dust usually found around rolls employed in dry crushing, and length of life to the machine is ensured. The most marked change within recent years has been along the line of increased peripheral speed, by the employment of rolls of larger diameters, and narrower faces. The results being decrease of journal friction, increase of crushing surface, and reduction of spring pressures. Those changes are undoubtedly the direction in which modern practice is tending. Peripheral speeds of 600 to 1,000 feet per minute are now found to be practicable, but this change in speed has also brought about many of the improvements already mentioned. The aggregate spring pressure is now greater, ranging from 2 to 3 tons per inch width of face of roll shells. Change has also been made from gears to belts, proving a much more preferable method of driving. In the earlier form of rolls, the spring pressure was carried along the main tension bolts, making it a matter of considerable labor to adjust the rolls. The method now in use consists of enclosing the whole nest of springs between two washers, and constructing them so that each nest forms a complete washer of an inelastic nature, until such time when the maximum pressure is reached, further compression taking place, relief is afforded to the rolls by the deflection of the springs. Chilled iron shells in all probability will be displaced by steel shells. In the design of rolls presented all the above mentioned improvements have been embodied, simplicity of construction, fewness of parts, and interchangeability is to be found. The hopper underneath the rolls is constructed in such a manner that no pockets are permitted, all four sides declining towards the bottom at an angle of 45 degrees, thus affording cleanliness at all times within the machine. The matter of sliding versus swing bearings for the removable roll, was decided in favor of swinging roll bearings. The wearing surfaces become reduced by means of their adoption. Any wear about the bearing surfaces of sliding roll bearings is an evil which may result in damage to the frame of the machine; it is easier to maintain the alignment of the swinging bearing in the sliding type of bearing. In design for rolls, a feature worthy of consideration is that of the disposition of the bolts employed for the purpose of bolting the machine together, it is a desirable feature to have as few as possible, and so arranged that should they by any means become loose, they may not fall within the machine. The use of common nuts is not desirable, and recourse must be made to lock nuts or elastic nuts; this provision prevents the bolts becoming loose, and may help to preserve the machine from injury.

The construction of mortars will always prove interesting to mining men. The sectional mortar contains a feature new to the writer. It is usual in the construction of sectional mortars to make the ends in two pieces. In this particular mortar, to overcome making the ends in the above way, they were carefully designed (not to exceed 350 lbs. in weight) and in making the ends of cast steel the joint usually found was eliminated, and considerable strength has been thus added. The drawing shows the construction clearly. This type of mortar was designed for the Ben d'Or Mine, Bridge River, B C. In the 3-stamp double discharge mortar, the lower guides of the battery are to be found in the upper part of the mortar, water supply is carried to and around to each of the heads. The pulp from back screen running through a channel cored in base of mortar and joining to that of the channel from front screen is then carried by a pipe and distributed over the amalgam table. This type of mortar was designed for the Oro Fino Mill of Fairview district, B. C. Amongst designers of mining machinery the ore feeder has been taken in hand, and it doubtless has been observed in recent designs presented for public favor that of the suspended type shows many marks of improvement in design, utility and simplicity of construction. The marked changes in this feeder are to be seen in the abolition of the adjustable mechanism to the feed lever, the lever adjustment being made by means of a collar on the stamp stem, or by the bumping rod. Gears are not employed at all, thus resulting in quiet running. One could, perhaps, make extended remarks with regard to other machines in process of design and manufacture. I feel I have not done justice to the subject, it is much too wide for a single paper. Papers on metallurgical machines to be of real benefit to the Institute should be divided into sections, treating of the design and dynamics of each machine in separate papers. Should it be the pleasure of the Institute I would willingly contribute my small quota. Publication of data thus collected may not be considered of much moment by the busy outer world, but it clarifies the writer's ideas, and brings into compact form and small bulk, a large amount of knowledge otherwise unattainable. This information adds much to the making of the routine work of the profession more productive and pleasurable.

THE NOVA SCOTIA COAL TRADE.

The following returns of Nova Scotia coal sold during the year 1898, shown in the report of the Department of Mines, Nova Scotia, in comparison with those of 1897, are as follows:

	1897.	1898.
Nova Scotia	641,308	667,252
New Brunswick	242,043	266,789
P. E. Island	62,032	93,241
Newfoundland	75,990	62,051
Quebec	875,874	944,160
West Indies	9,356	......
United States	106,279	98,027
Other countries	......	3,877

The production was 2,281,454 tons compared with 2,320,916 tons in the year 1897. There is an increase in the sales in Nova Scotia, New Brunswick, Prince Edward Island and Quebec, the sales to the last named point coming close to the million mark. There has been a decrease in the Newfoundland and United States sales. It is confidently expected that in a few weeks shipments of gas coal to Boston from Cape Breton collieries will be commenced on a basis of at least 700,000 tons per annum. If this be carried out and no unforeseen obstacle intervenes, the total sales of next year should be in the vicinity of 3,000,000 tons. The total sales for the year were 2,135,397 tons, compared with 2,013,421 tons in 1897.

THE PRACTICAL MAN.

The Friction of Metal on Metal, without Lubrication—
May be taken at 1-6 of the weight up to 40 lbs. per sq. inch.
May be taken at 1-5 of the weight up to 100 lbs. per sq. inch
Brass on cast iron ¼ of the weight up to 800 lbs. per sq. inch.
W'r't on cast iron 1-3 of the weight up to 500 lbs. per sq. inch.
Well oiled with tallow at 1-10 of the weight.
Well oiled with olive oil at 1-3 of the weight; 800 lbs. per inch forces out the oil; friction of journals under ordinary circumstances 1-30 of weight; friction of journals well oiled sometimes only 1-60 of weight.

Rules for Calculating Speed.—The diameter of driven given to find its number of revolutions: Multiply the diameter of the driver by its number of revolutions and divide the product by the diameter of the driven. The quotient will be the number of revolutions of the driven.

The diameter and revolutions of the driver being given to find the diameter of the driven, that shall make any number of revolutions: Multiply the diameter of the driver by its number of revolutions and divide the product by the number of required revolutions of the driven. The quotient will be its diameter.

To ascertain the size of pulleys for given speeds: Multiply all the diameters of the drivers together and all the diameters of driven together; divide the drivers by the driven. Multiply the answer by the known revolutions of main shaft.

To Drill or Turn Aluminum.—Use kerosene oil (coal oil) for drilling or turning aluminum.

To Drill Hard Steel —Use turpentine instead of oil, when drilling hard steel, saw plate, etc. It will drill readily when you could not touch it with oil.

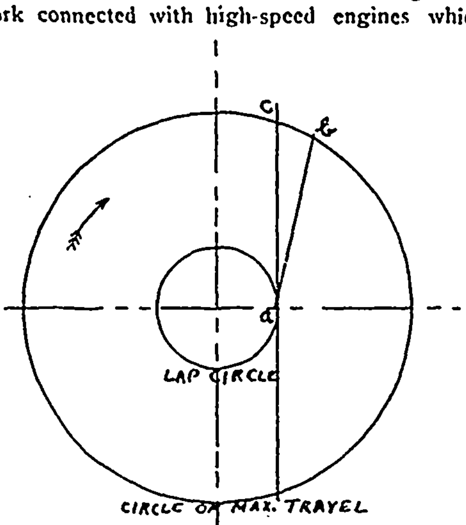
To Prevent Rust on Tools.—Use vaseline, to which a small amount of powdered gum camphor has been added, heat together over a slow fire.

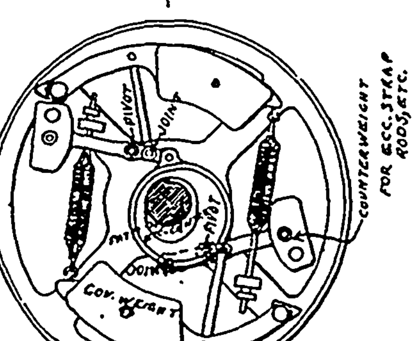
Alloys.	Tin.	Copper.	Zinc.	Antimony.	Lead.	Bismuth.
Brass, engine bearing	13	112	¼	..	..	..
Tough brass, engine work	15	100	15	..	..	..
Tough, for heavy bearings	25	160	5	..	..	..
Yellow brass, for turning	..	2	1	..	..	..
Flanges to stand brazing	..	32	1	..	1	.
Bell metal	5	16	..	..	..	..
Babbitt's metal	10	1	..	1	..	..
Brass, locomotive bearings	7	64	1	..	..	..
Brass for straps and glands	16	130	1	.	..	..
Muntz's sheathing	..	6	4	..	..	..
Metal to expand in cooling	..	..	..	2	9	1
Pewter	100	..	..	17	..	..
Spelter	..	1	1	..	..	..
Statuary bronze	2	90	5	..	2	..
Type metal, from	..	..	..	1	3	..
Type metal, to	..	..	..	1	7	..
Solders.						
For lead	1	..	..	..	1½	..
For tin	1	..	..	..	2	..
For pewter	2	..	..	..	1	..
For brazing (hardest)	..	3	1	..	..	..
For brazing (hard)	..	1	1	..	..	..
For brazing (soft)	1	4	3	..	..	..
For brazing (soft), or	2	..	..	1	..	..

NOTES ON SHAFT GOVERNORS.*

BY W. B. M'LEAN.

The following paper does not propose to discuss the many difficult mathematical and other problems involved in a treatment of the theory of shaft governors. It will only deal with some practical points in the design of these appliances which have come to the notice of the writer during a summer spent at work connected with high-speed engines which were thus

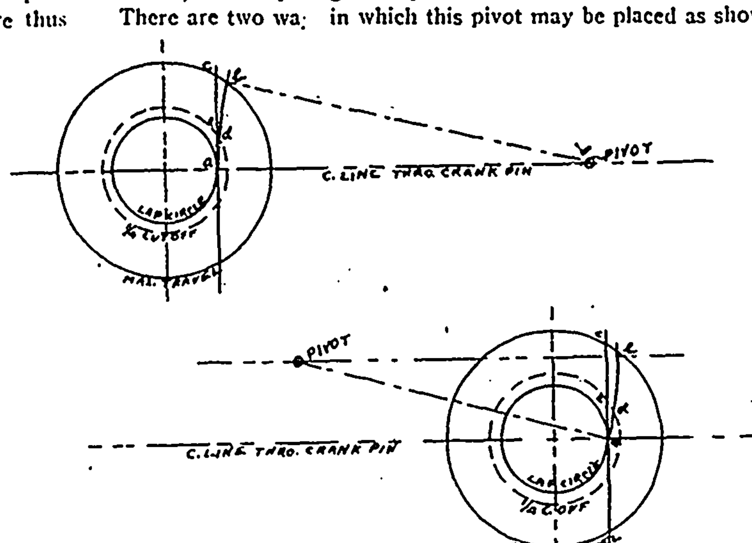




FIGS. 1 AND 2.—AUTOMATIC GOVERNOR. FITCHBURG CO. STEAM ENGINE.

governed. The shaft governor is the means now almost universally employed for regulating the speed of the modern (American) high-speed engine. In most American engines it acts by changing the point of cut-off of the valve, and thus varying the volume of steam admitted to the cylinder at each stroke to suit the varying loads. This of course changes the ratio of expansion; but between the ordinary limits of cut-off, under working conditions, the variations of this ratio do not greatly affect the economy, and the regulation is much quicker than with the old type of throttling governor.

In the older forms of shaft governor the cut-off was changed by having an eccentric of the ordinary type placed loose upon the shaft, which was turned around by the governor so that the angle of advance varied, about from 0° to 90° under the full movement of the governor. (Fig. 9.) In more modern forms, however, the object is to have the eccentric centre describe a path, relatively to the shaft, such as that shown in Fig. 1. Here the large circle has a radius representing, on some scale, the half-travel of the valve or the throw of the eccentric, at the point of greatest cut-off, and the small circle has a radius representing, on the same scale, the outside lap; *b* is the position of the eccentric centre which gives the proper lead when the valve has its greatest travel. The path which the eccentric centre is required to describe under the action of the governor is from *b* to *a* where *a* is a point either at or slightly inside of the intersection of the lap circle with the centre line through the centre of crank pin and centre of shaft. At the minimum travel of the valve there will then be no admission of steam at all to the cylinder and the lead will diminish from *bc* to *o*, or to a small negative lead at *a*, as the eccentric is moved in by the governor. The form taken by the line *ba* is a matter on which designers differ. In the governor shown in Fig. 2 it is made very approximately a straight line by an application of Watt's parallel motion. The form usually adopted, however, is that of a circular arc, the eccentric plate being pivoted directly on the supporting governor frame or wheel. By this arrangement a greatly increased rigidity is obtained to resist the pull necessary for moving the valves; which pull generally comes at a considerable off-set. There are two ways in which this pivot may be placed as shown



FIGS. 3 AND 4.

in Figs. 3 and 4. To compass the two the circle is drawn which represents the path of the eccentric centre at ¼ cut-off. The lead at ¼ cut-off is in each case *de*; and it will be seen that the arrangement of Fig. 4 gives much more lead and also a greater maximum port opening at the early cut-offs than does that of Fig. 3.

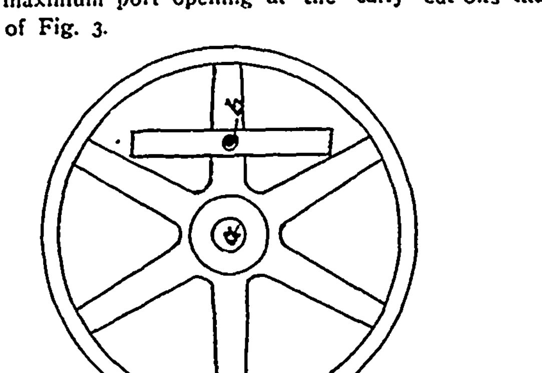


FIG. 5.

The desired movement of the eccentric plate is ordinarily obtained by connecting it to weights, pivoted in the governor frame so as to be movable in the plane of rotation, the movement of the weights being controlled by springs. When the rate of rotation of the shaft changes new forces act on the weights which produce the desired movement. The most im-

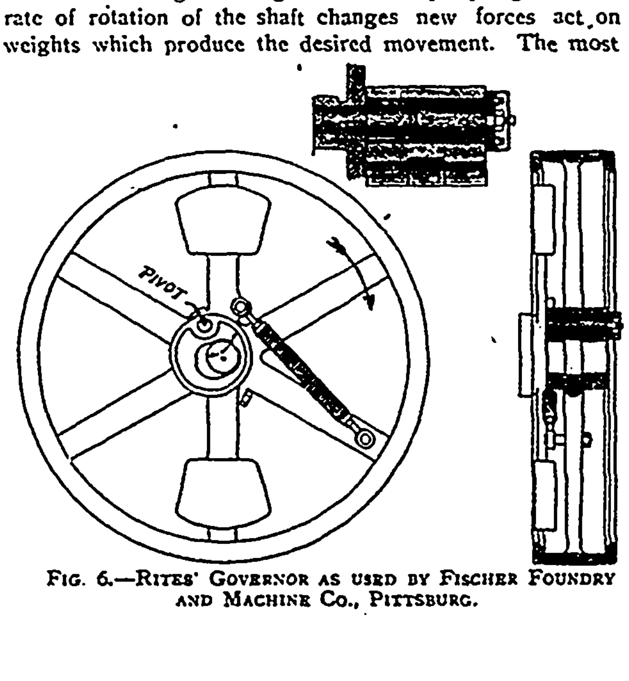


FIG. 6.—RITES' GOVERNOR AS USED BY FISCHER FOUNDRY AND MACHINE CO., PITTSBURG.

*A paper read before the Applied Science Graduates' Society of McGill and published exclusively in the Canadian Engineer.

portant of these is the change of the centrifugal force. This is, however, by no means the only force made use of. Forces due to the inertia of the masses themselves are now largely used. Suppose we have a weight, as shown in Fig. 5, in the form of a long bar pivoted at *b* to a frame rotating about *a*. Then in addition to its rotation as a whole about *a*, the weight will have a rotation at the same rate about *b*. If the rate of rotation about *a* change, that about *b* will still tend to remain the same, and the weight will consequently turn on the pivot *b*. The couple producing this movement depends for its magnitude upon the moment of inertia of the weight about the axis through *b*. This couple may be called angular accelerating couple. The Rites' governor, which has been recently brought out and is now used by a large number of prominent American

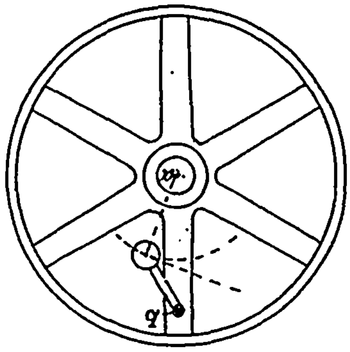


FIG. 7.

engine builders, depends for its action principally upon this force. As seen in Fig. 6 the weight arm and eccentric plate are made in one piece, thus necessitating the arrangement of the pivot shown in Fig. 3. This governor gives very quick regulation, but from the very nature of its action a light fly-wheel must always be used with it. Its action depends not on the total change of rotation but on the rate of change or angular acceleration.

Let a weight in the form of a ball at the end of a lever arm be placed in some such position as that shown in Fig. 7. so that the tangent to its path at the centre of gravity falls some distance to one side of the pivot. Then, if the rotation about *a* be accelerated, it is evident that on account of its in-

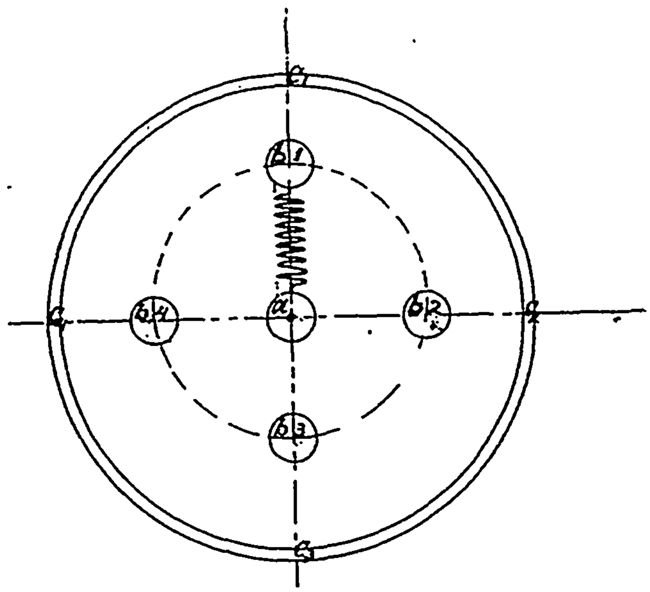


FIG. 8.

ertia the weight would resist the change of linear velocity due to a change of angular velocity (and of radius of rotation if a movement about *b* did occur), and a force would be produced tending to cause motion of the weight about *b*. But this is not the only force developed in this case, and Prof. J. G. Klein has demonstrated to the satisfaction of leading engineers, who have discussed this subject (see Trans. Am. Soc. M.E., 1897, discussion on paper by F. H. Ball, p. 311), that in such a case the resultant of all the forces developed always passes through the pivot. The force mentioned will therefore not be available for governing. The two prominent forces made use of in shaft governing will then be centrifugal force and angular accelerating couple, and it is in the combination or opposition of these that the action of different governors varies.

In the case of weights rotating about a horizontal axis as is the case in shaft governors the effect of gravity must be taken into account. To show what this would be in the case of a single unbalanced weight take the following case: Suppose a wheel (Fig. 8), moving at a constant rate of rotation to

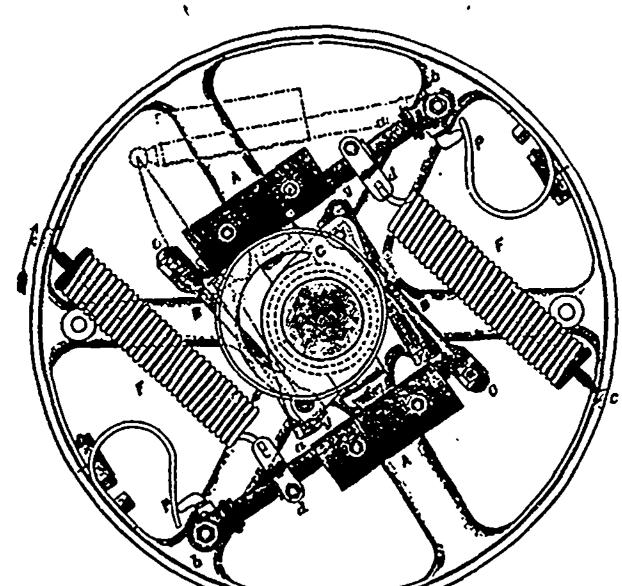


FIG. 9.—THE BUCKEYE ENGINE CO.'S ISOCHRONAL GOVERNOR.

have a weight placed in it so as to be movable, without friction, only along the radius *ac*, of which ac_1, ac_2, etc., are successive positions as the wheel makes a revolution. Also suppose that a spring is attached to it and to the wheel which balances the centrifugal force in all positions, that is makes it isochronous. Then the only force which we need consider will be that of gravity. Starting from the position *b*, the weight will be pulled towards *a* until it reaches b_2. At b_2 it will cease to be pulled towards *a*, but will then have a certain velocity inwards. From b_2 to b_3 this velocity will be destroyed by the retarding force of gravity pulling it away from *a* again. At b_3 it will have reached its nearest position to the centre *a*, and will start mov-

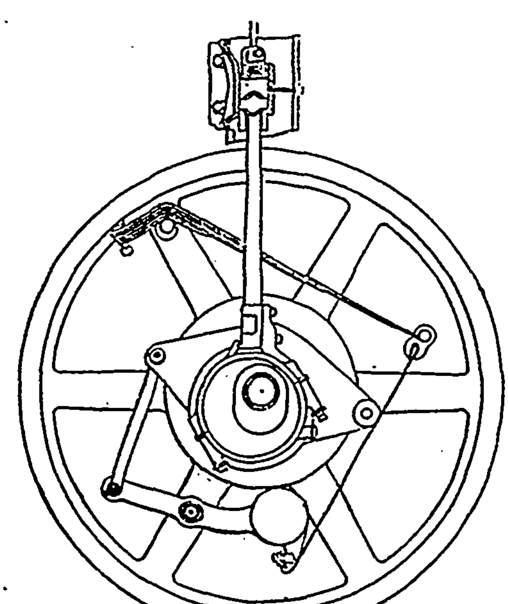


FIG. 10.—GOVERNOR AND VALVE MOTION. STRAIGHT-LINE ENGINE CO.

ing out again. At b_4 it will have its greatest velocity outwards, which from b_4 to b_1 will be destroyed again by gravity until it reaches its extreme outward position at b_1. By experiment and mathematical demonstration Prof. S. P. Robinson has shown (Trans. Am. Soc. M.E., 1890, pp. 1055-64, discussion on paper by J. E. Sweet), that the path of the weight under these circumstances is very nearly a circle, whose centre is vertically above the centre of rotation by a distance $\frac{g}{w^2}$ where g= acceleration due to gravity and w = angular velocity in radius It will be seen from the above that if a governor weight be unbalanced, one effect of gravity will be to make it move more or less on its pivot at every revolution, and thus move the whole governor. The argument for balancing is that this makes the pins wear out and necessitates increased lubrication Two methods of balancing may be noticed The first is that of

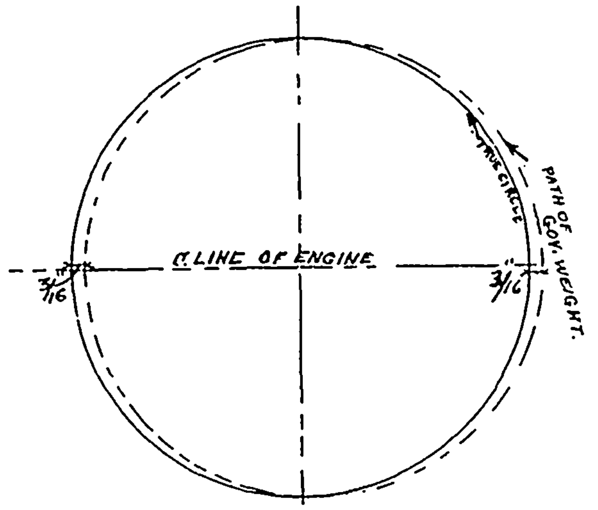
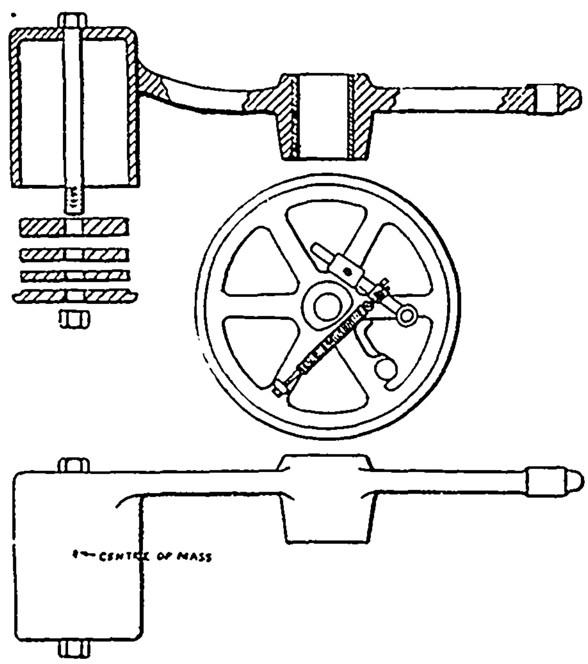


FIG 11.

duplicating the weights and connecting them to opposite sides of the eccentric plate pivot as in the governor shown in Fig. 9. The second, shown in Fig. 10, is to make the weight of the eccentric plate and connections balance that of the weight. The governor shown in Fig. 2 presents a peculiarity in balancing in the counterweights *o o*, which are put in to balance the weight of the eccentric plate and strap, and in vertical engines of the valve and rods also, and thus relieve the governor of these disturbing influences.



FIGS. 12, 13, AND 14.

The resistance of the valve is another element of disturbance in the shaft governor. It is principally due to three causes, friction, inertia, and unbalanced steam pressure. The friction in the best practice is reduced to a minimum by the use of balanced valves, and by accurate scraping processes, thorough lubrication, etc. The inertia is reduced by making the valve and connections as light as possible. The unbalanced steam pressure is not generally accounted for as it is not generally recognized as a disturbing force. It is due to the unbalanced area of the valve rod which enters one side of the steam chest and does not usually pierce the other. Thus the pressure on the one side of the valve will not be perfectly balanced by that on the other, and there will be a constant force tending to push the valve towards the shaft, which will be equal to the area of the valve rod steam pressure per square inch. In conjunction with the others mentioned this force may cause considerable trouble in a governor, as may be illustrated from the case of a 12-inch tandem compound engine, which was found to have too light a governor. A pencil was attached to the governor weight and a board was held up against it while the engine was running, and thus the actual path of the weight was traced on the board. The true circle concentric with the

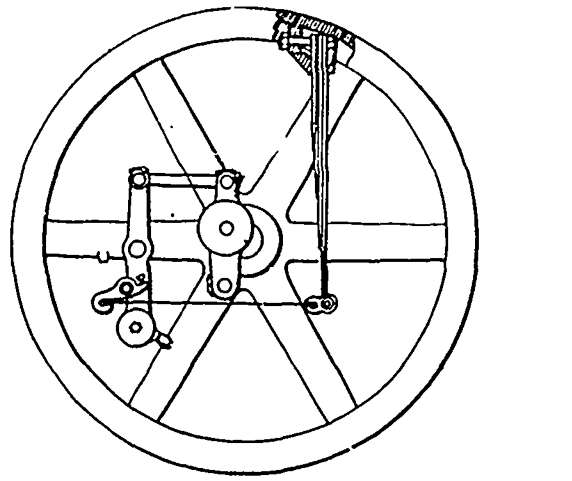


FIG. 16.—ROBB-ARMSTRONG GOVERNOR.

shaft, which the pencil would describe if the weight had been fixed in the wheel, was also described on the same diagram. It was thus found that the path of the governor weight was, as shown in Fig. 11, sensibly a circle whose centre was displaced horizontally from the centre of the shaft by about 3-16 of an inch. This of course disturbed the adjustment of the valves, both of which were attached to the governor in this case, and made it necessary to put on a much larger and more powerful governor. Some makers point out the influence of the valves as rather an advantage, and seemingly for the same reason that the somewhat similar effect of gravity is claimed by others to be a disadvantage. It is argued that the alternate push and pull due to the inertia and friction of the valve gear tends to, and doubtless does produce a small movement of the governor and that this overcomes the friction of rest at the joints four times in each revolution, thus making the governor more sensitive and free to act. Governor weights, especially when in the form of

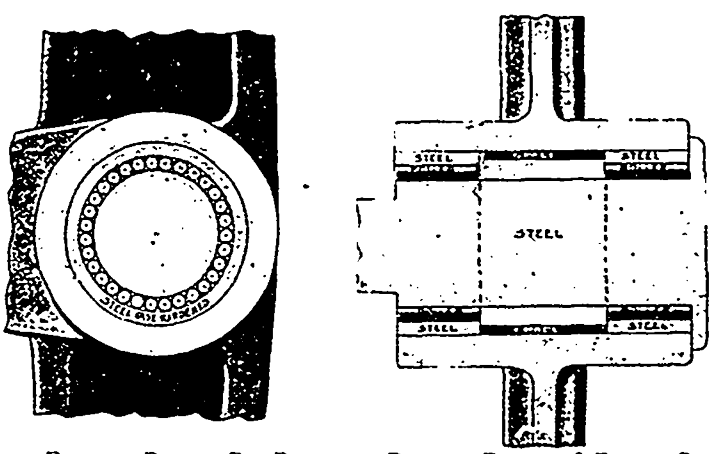


FIG. 17.—ROLLER PIN BEARING. RIDGWAY DYNAMO & ENGINE CO.

a ball and lever, are often made adjustable both as to mass and leverage. An adjustment for mass is shown in Fig. 12, where the governor ball is cast hollow, of malleable iron and weights of varying thickness put in until proper working is secured. Adjustments for leverage are made by making the weight so that it can be moved along the lever arm and clamped in any desired position as shown in Fig. 13. A consideration of some importance which is often lost sight of in designing governor weights is to so distribute the mass of the weight as to avoid as much as possible twisting couples on the weight pivot at right angles to plane of rotation, as these cause rapid and uneven wear. To illustrate what is meant Fig. 14 shows a possible distribution of the mass of the weight shown in Fig. 12, which would cause it to have the bending or twisting couple about its pivot, referred to.

The springs used to control the movement of the weights are of two kinds, coil springs and flat-leaved springs. Coil springs are almost always used in tension. In using them stresses are developed due to the centrifugal force of their own mass, which at high speeds become of some importance and cause the spring to assume a slightly curved form. Means must be provided for adjusting their tension. Examples of these may be noticed in Figs. 6 and 13. The ends of these springs are generally fastened with simple pins as shown in Fig. 6, but sometimes have knife-edge bearings to do away with friction. There are two ways in which flat-leaved springs may be used, either to push the weights in as shown in Fig. 15, the weight being on the same side of the centre as the spring, or to pull it in by a connecting strap, the weight and spring being on opposite sides of the centre as shown in Figs. 10 and 16. In the arrangement of Fig. 15 the centrifugal force due to the mass of the spring itself will oppose its action, and if the spring be made stronger to resist this opposing force its mass must be increased, and thus the opposing force will also increase and

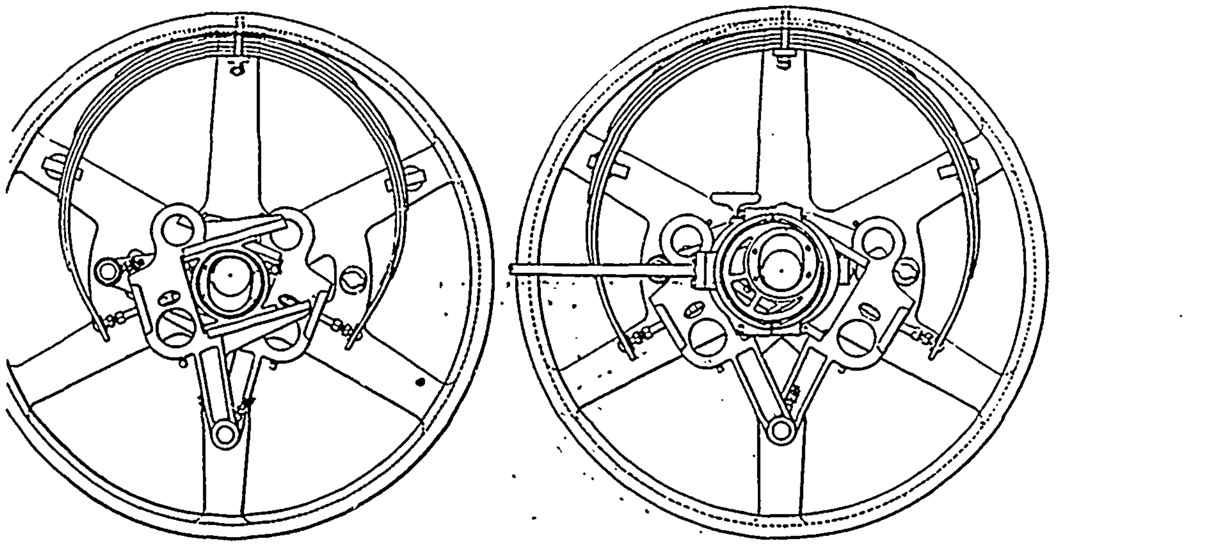


FIG. 15.—GOVERNOR FOR SINGLE VALVE. McINTOSH, SEYMOUR & CO.

hence a much stronger spring is necessary with this arrangement than with that of Figs. 10 and 16, where the centrifugal force of the spring itself assists its action. Arrangements for adjusting the tension of flat-leaved springs are applied, either at the fixed end of the spring, as shown in Figs. 10 and 16, or at the moving end, as shown in Fig. 15. When the spring is connected to the weight by a metal strap an important and useful adjustment of the spring's action may be made by the use of a quadrant, as shown in Fig. 16. As the weight goes out the leverage of the spring in acting on the weight may be made to vary in any desirable way by adjusting the quadrant to different angles about its pivot, and by making the face in profile of different curves. The curve usually adopted, however, is that of the arc of a circle.

The joints and pivots are among the most important items to be considered in the construction of a governor. If there be too much friction the governor is apt to stick at first when the load changes, and then to move suddenly and too far, thus causing racing of the engine. The ordinary construction is to bore out the bearing, say ⅜-inch larger than the pin, and to press or clamp in a bush, which can be replaced when it wears out. These bushes are usually of hard babbitt metal or some similar alloy, or of brass, but graphite is often used. A more expensive construction, which is coming into favor, is that of a roller pin bearing, as shown in Fig. 17. Governors have been designed with the weights pivoted on knife-edges, but the idea does not appear to have been prosecuted with much success, although knife-edges are used on the springs by some makers as has been mentioned. The shaft governor has now been brought to such perfection that the variation of speed with the best types between no load and full load or between maximum and minimum boiler pressure, is a small fraction of 1 per cent. of the average speed. They are so simple in their action that they require almost no attention, and with proper design and workmanship are as durable as any part of the engine.

THE ELECTRIC POWER AND LIGHTING PLANT OF THE SOULANGES CANAL.

The Canadian General Electric Co. is supplying the electric power and lighting plant for the Soulanges Canal upon specifications of which the following is an outline:

GENERATORS.—There will be two generators of multi-phase type of 110 amperes at 2,400 volts, (264 k.w.) when operated at a speed of 225 r.p.m., frequency 60 p.p.s. Each generator to be direct connected, and when the generators have been operated at the above capacity for twelve consecutive hours, the temperature of the hottest part of the machine shall not be more than 45 C. above that of the surrounding atmosphere. The machines are to be so constructed that the insulation between the armature winding and frame of the machines and also between phases, will withstand a break-down test of 6,500 volts for five consecutive minutes, such test being made with a transformer of not less than 4,000 watts capacity. The insulation between field winding and frame of machines shall withstand a break-down test for five consecutive minutes of an alternating voltage equal to five times the voltage to be used in exciting the generators. The armature and field winding insulation to be capable of withstanding the break-down tests specified, immediately after generators shall have been operated at the load runs above stipulated. The generators will have an inherent regulation of at least ten per cent. The generators are not to have so-called "compounding devices." Regulating appliances must be provided so that the E.M.F. of each or any phase may be varied ten per cent entirely independently and separately from each other. When the generators are operated under full load they shall have a commercial efficiency of at least ninety-two per cent.; when operated at half load, of eighty-nine per cent., and at quarter load of eighty-four per cent.

EXCITERS.—There are to be two exciters of modern design, with self-oiling bearings, and to be provided with a belt-tightening device. The armature to be of the iron-clad type, and the armature coils "machine wound." The capacity of the exciter to be such that it will deliver continually, without undue sparking, exciting current to an extent equal to two times that required by one generator when it is operating at its maximum load. The temperature of any part of either exciter, after working for twelve hours at about stated output capacity, shall not exceed 45° C. above the surrounding air.

SWITCHBOARD APPLIANCES.—The switchboard appliances will be mounted on marble slabs, supported on an oak or iron frame, and consist of the following instruments: 2 voltmeters, 2 main switches or set of switches, 2 voltmeter transformers, 2 exciter switches, 2 voltmeter switches, so arranged that the voltage can be determined of each phase, 1 ampere meter for each phase of each generator, 2 generator rheostats, 2 exciter rheostats, 2 motor circuit switches and ampere meters, 2 arc light circuit switches and ampere meters, 1 static ground detector, 1 switch for ground detector, so that connections can also be made to each phase, also the necessary bus bars, pilot lamps, etc. There shall also be supplied the necessary lightning arresters for the protection of the switchboard and generating apparatus from lighting discharges from the outside line; each lightning arrester to be equally efficient as any at present made.

All wiring in connecting the generator and exciter to switchboard and to line to be done with rubber-covered wire and according to the rules and regulations of the Canadian Fire Underwriters' Association.

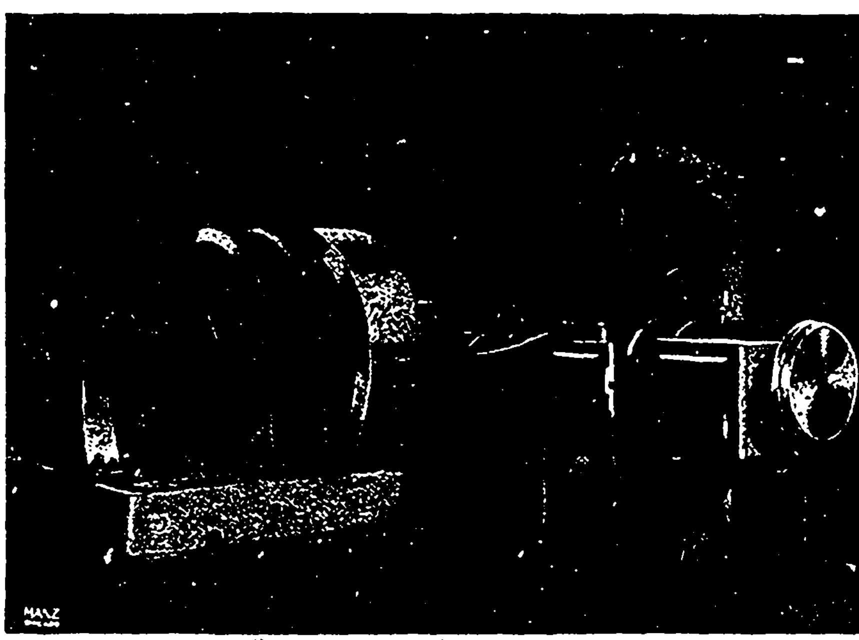
MOTORS.—The following motors to be furnished, erected and installed in motor housings, to be furnished by the contractor at each one of the five locks: Lock No. 1, at the lower entrance to the canal; lock No. 2, at about 1,900 feet from the lower entrance of the canal lock; No. 3, at about ¾ of a mile from the lower entrance of the canal; lock No. 4, at about 3 miles from the lower entrance of the canal; lock No. 5, at the upper entrance of the canal or about 14 miles from the lower entrance of the canal; guard gates at about 3½ miles from the lower entrance of canal. Twenty (20) 1 h.p. motors, one to be connected to each of the four sluice gates at each lock, each motor to be provided with the necessary mechanism, reducing gears, etc., to operate the shafts of the sluice gates; twenty-two (22) 7 h.p. motors, one to be connected to each of the gates at each lock, each motor to be provided with the necessary mechanism, reducing gears, etc., to drive the pinions operating gate bars; each of the above motors to be also supplied with the necessary releasing or brake arrangement, so that in opening or closing the gates, the power may be released automatically so as to prevent any undue strain on the machinery in connection with the gates. Seven (7) 2 h.p. motors, each to be placed and connected with suitable mechanism ready for the operation of each of the seven bridges, situated along the canal; each motor to be provided with its necessary switch, starting box, etc. One (1) 15 h.p. motor, complete, with the necessary starting box, switch sliding bars, etc., to be installed at a workshop to be erected near the lower end of the canal. At each of the five locks and at the guard gates there shall be installed in a building to be provided therefor, a switchboard to which will be provided the necessary switches and instruments for effectually and completely handling and controlling the operation of all the motors required at each lock. Where it becomes necessary for wires to cross the canal, such wires shall be lead covered, and shall be placed on the bed of canal or locks at places to be determined by the Government engineer, and shall be placed in such a manner that they cannot receive any injury

TRANSFORMERS.—The following transformers are to be supplied and erected, as follows 5 transformers, each suitable for four 1 h p and four 7 h p induction motors, one to be installed at each lock; 2 transformers suitable for two 7 h.p. induction motors, to be installed at guard gates, 7 transformers, each suitable for one 2 h p. induction motor, one to be installed at each bridge; 1 transformer, suitable for one 15 h.p. induction motor, and to be installed at the workshop at the lower end of the canal Each transformer will withstand a break down test of 6,000 volts of alternating current, for five consecutive minutes, between the primary and secondary coils, between primary and iron, and between secondary and iron. No part of the transformers are to have a rise in temperature when in use at full load during twelve hours consecutively, of more than 45 C above the surrounding air.

ARC LAMPS.—There shall be 194 alternating current, 60 cycle, 12 hour open arc lamps. Each arc lamp will be of nominal 2,000 c.p., and consume not more than 500 watts per lamp. There will also be 320 incandescent lamps of 16 c.p. each.

CANADIAN ENGINES IN SPAIN.

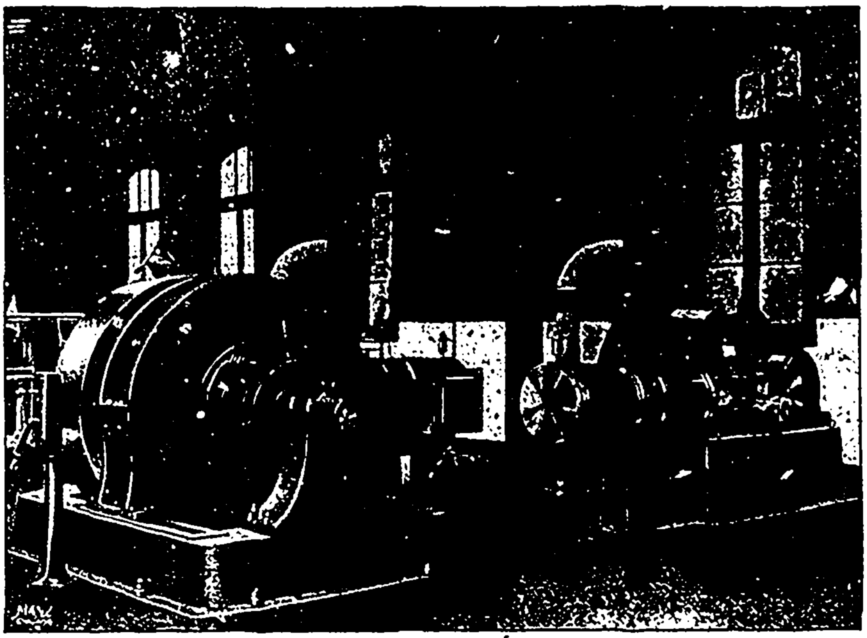
In October, 1897, contracts were given for the equipment of electric tramways in Barcelona and Madrid, the two most important cities in Spain. The work was completed a few months ago and the lines are now in successful operation. Barcelona with a population of about 600,000 is the largest city in Spain, and is an important seaport and manufacturing centre. It is an ideal city in many respects but particularly from the standpoint of the owners of the electric railway, as it is well patronized on account of the climate being too warm for walking. Madrid is the capital of Spain, and is nearly as large as Barcelona. It is situated inland, and has many parks, broad streets and fine buildings. In the character of its population it resembles a western American city, as not more than 40 per cent. of its residents are natives. Although these systems are owned by British capital and built by British contractors, much of the apparatus was purchased on this side of the Atlantic. The main engines were manufactured in the United States, and three smaller engines were supplied by the Robb Engineering Co., Amherst, N.S. These engines, as shown in the accompanying illustrations, are tandem compound, of the side crank type with dynamos direct connected. They were put in principally for lighting the extensive car sheds and driving the machinery in the workshops connected with the tramway systems, but are also used for running part of the cars late at night or early in the morning when the main engines are shut down. The high pressure cylinder of these engines is 10 inches in diameter, low pressure 16 inches in diameter, stroke 15 inches, and they are rated at 115 h.p. each. Both valves are controlled by the automatic governor in such a way as to divide the work equally between the two cylinders. The crank shaft, connecting rod and crank pin are of hammered open-hearth steel. The high pressure cylinder is placed next the frame, the low pressure in the rear so that the cylinder heads and pistons can be removed without disturbing the cylinders. The throttle consists of a flat valve rotated through one-half revolution by a lever, and as the valve and seat are protected from the steam whether open or shut they can neither wear nor rust. The main bearings have a ring oiling device, the oil being continuously conveyed from a cavity beneath the bearing to the top of the shaft by metal rings which



ROBB-ARMSTRONG ENGINE AT MADRID.

dip in the oil. All bearings are large and the parts of the engines few and simple, and as strong as possible, making them well adapted to any service where continuous running and variable or severe work is required.

It is highly creditable to the Robb Engineering Co. that its engines were selected as part of these installations, which are said to be the most important undertakings of the kind completed in any part of the world during the year 1898. The products of this firm have been favorably known throughout Canada for a number of years, and we have no doubt the foreign shipments, which have been quite numerous during the past year, will give as great satisfaction and lead to a large increase of business.



Robb-Armstrong Engines at Barcelona.

MINING METHODS.

Editor Canadian Engineer :

Would you kindly give me some information through your valued monthly in regard to placer mining, panning, sluicing, etc. J. H.

North Bay, Ont.

[Placer mining is only practicable where free gold is deposited in beds of sand and gravel. The sand underlying the gravel of streams is the most likely place, and the gold will be found—owing to its great weight—where eddies or bends in the stream check the speed of the current, thus allowing the gold to settle. The most simple way of extracting gold from the sand is by panning. A shovel full of sand is placed in the pan, which is a steel dish, shaped very much like a frying pan, about 15 inches wide and 3 inches deep, with sloping sides. The loose, light mud is then washed out with water, and the large pebbles removed by hand. The sand is then subjected to washing, which is done by giving the pan a circular motion, and adding water at the same time: in this way all the light sand is washed over the edge, leaving behind a heavy residue, mostly black iron ore, and the gold. If the gold is in fairly large nuggets it can be extracted by further panning, as it is so much heavier than the black sand, but if it is in a fine state it will have to be treated with mercury, this is done by mixing the sand thoroughly with mercury, and squeezing in a buckskin bag, thus freeing the mercury from the alloy. The gold can then be extracted from the alloy by heat. Skill in panning can only be obtained by considerable practice. In the case of a large deposit of auriferous gravel the best way to treat it—if circumstances allow—is by hydraulicing, this is done by playing a stream of water, under considerable head, upon the gravel deposit, which will be carried by the water through a number of sluices, which are large, frame troughs lying on the ground and paved with wooden blocks or riffles, which are fit to catch the gold and amalgam. The sluices are slanted according to the nature of the gravel worked and the supply of water, and are made long enough so that a test of the balings being taken, no gold will be found. The supply of water must be sufficient to cover the largest boulder met with, and is supposed to carry away 1-5 its own weight in gravel. Mercury is added several times daily at the sluice head. The stream of water, sometimes under a head of 400 feet, is directed by a nozzle (monitor) of from 5 to 9 inches in diameter. When it is time for a "clean up" the water is turned off, all the loose gravel picked out and the gold and amalgam carefully collected. Under favorable circumstances gravel running as low as 2 to 3 cents per cubic yard can be treated with profit by this method. The gold rocker is such a crude home-made affair that it is difficult to get cuts of it, but it may be found in some text-books on gold mining, for instance in "Gold (Metallurgy of)" by T. H. Rose. Roughly, it is a wooden box, 3 feet long by 1½ feet wide, one side being knocked out, and resting on two rockers, one of which is lower than the other, thus giving the floor a slant from back to front. About two feet above the floor is a removable riddle box, 3 feet long by 9 inches wide, with ½ inch mesh screen; below the riddle and forming an angle of about 30 deg. with it, and slanting toward the back of the rocker, is stretched a piece of blanket or canvas apron, the length of the rocker and about 10 inches wide. The gravel is placed in the middle box with water, which washes it through into the apron; here the fine gold is caught, and the dirt passes out from back to front over the bottom where the heavy sand and coarse gold is caught by two or three riffles nailed across the bottom. Mercury is sometimes added. The object of the rocking motion is to prevent the sand from packing behind the riffles. The capacity of a rocker of this description—two men washing—is from 3 to 5 cubic yards per day: the amount of water used is 3 or 4 parts to 1 of gravel.—Ed. Can. Eng.]

DAM BUILDING.

Editor Canadian Engineer :

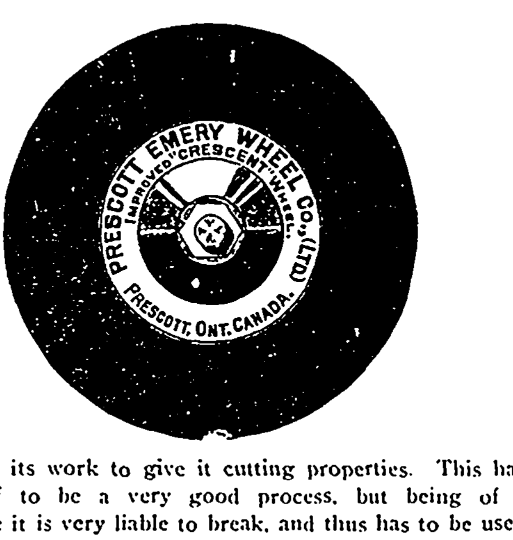
Your January number contains an article upon dam construction by Chas. Baillairge, which opens up discussion upon a subject which is of great importance at a time like the present, when so much capital is being invested in the development of water power plants in all parts of the country. Mr. Baillairge, quite rightly, in my opinion, advocates the use of concrete for such works. In approaching the question of ratio of thickness to depth of water, however, it will be necessary to take into account some other factors in the problem which Mr. Baillairge has not embraced in his statement of the matter. The length of the structure should be considered as well as the depth of the water. About 1 10 of the length will figure out a good proportion for dams of moderate length, provided this is not less than .5 of the depth of water. This width being increased by footing courses so as to give a total width of effective base to resist overturning equal to .8 of the depth of water. The proportion of .5 however, should be maintained to the top of the dam, and the dam should not be tapered off at the top as is the customary practice By building the dam of a uniform thickness, the structure is much better equipped for resisting the action of moving loads, and it is my belief that engineers will fail in the search for a satisfactory formula for the strength or proportioning of dams, until they recognize the presence of moving loads upon such structures. It has long been known that the stresses caused by the moving loads were the most destructive in the cases of bridges and buildings, and it will have to come to the same point in regard to dams. The arched design spoken of by Mr. Baillairge is of doubtful advantage. If it is properly equipped at the abutment ends for receiving thrust, it may possibly contrive to act as an arch, but if the same amount of material were put into a straight dam, and the transverse section so designed as to enable the structure to resist moving loads, it would be a much better dam than the more slender extended structure in the form of an arch would ever be.

Yours truly,
JNO. S. FIELDING.

3606 Boquet St., Pittsburg, Pa., Mar. 14th, 1899.

A STUDY OF EMERY WHEELS.

Emery wheels that were thirty years ago practically unknown and forty years ago not manufactured, are to-day an article understood by everyone who knows the uses of a grindstone. Emery is a mineral; the best quality, and that which is used almost exclusively being found in Turkey. The Canadian trade is supplied by United States and English mills which crush and grade it, at the same time clearing it of impurities. The manufacturing of wheels is done by a variety of processes, many of which are adapted only for special varieties of grinding. The wheel that is most called for and which must be of good quality to prove a labor-saving and durable article is a general purpose wheel. What we mean by a general purpose wheel is one for coarse work, such as castings, steel, and all kinds of metal. The two varieties of wheels which have heretofore principally been used for this purpose are what is known as the "Vitrified" and "Silicate." The "Vitrified" wheel is taken from the same process as a brick-maker would make brick, with various alterations to make it much harder and hold the



emery up to its work to give it cutting properties. This has proved itself to be a very good process, but being of a glassy nature it is very liable to break, and thus has to be used with caution. The high speed at which it has to run to prove a good cutting wheel also proves a detriment to its use. The "Silicate" may be said to be the first and last, being in use for a great number of years it is yet more used as a general purpose wheel than that of any other process. The chief ingredient in the bond of this wheel is silicate of soda, sometimes known as "liquid glass," commonly called silicate. This can be used with safety, as a defective wheel can easily be detected, it is claimed, by tapping it gently with a hammer, if cracked or defective in any way it will give a dull sound, whereas a good wheel will ring sharp and clear.

Some two years ago a combination of the "Vitrified" and "Silicate" wheel was attempted by the Prescott Emery Wheel Co., limited, and they have now on the market a wheel known as the "semi-vitrified" wheel, which contains the good qualities of the two already referred to, together with its own advantages. It is said to be waterproof, can be used wet or dry, the bond being of such a nature that it has cutting qualities as well as the emery contained therein. It is perfectly safe, as it can be tested, which, it is claimed, cannot be said of the "Vitrified" wheel, and has advantages over the "Silicate" wheel inasmuch as the bond therein contains no cutting qualities which clog the faces of the particles of emery, causing it to glaze and burn the work instead of cutting it. The semi-vitrified always has a cutting surface, which cuts very fast and cool. The manufacturers claim that this process is rapidly taking the place of the other two processes mentioned, as the results wherever they are used show forth.

To procure the greatest amount of work from an emery wheel and ensure safety in running, only the best grinders should be used. The arbor should be of sufficient proportion to easily carry the wheel adjusted on it. The following table will give an idea of the correct size of arbor: Wheels 6 in. in diameter and less, ½ in. arbor, 7 to 10 in. inclusive, ¾ to 1 in.; 12 to 14 in., 1¼ in.; 16 to 18 in., 1½ in.; 20 to 24 in., 1¾ to 2 in. In mounting a wheel, it should slip on the arbor easily, never force it on the arbor. Keep boxes of machine tight, so as arbor will not jump. Keep rests close up to wheel. The collars should be one-third the size of the wheel, and made slightly concave to touch the wheel only at their circumference; washers of paper or some other pliable nature should be used between the wheel and collar. All our wheels are supplied with circular labels which serve to protect the wheel in this capacity. The cutting surface of the wheel, to give good satisfaction, should be kept true. This can be done with a dresser or diamond tool. All emery wheels should be run at a surface speed of 5,500 feet per minute. By running at speed marked on the label of every wheel, this can be attained. Running faster than this speed will cause it to glaze, burn the work and a certain risk is involved. By running too slow, it wears the wheel unnecessarily and does no more work. The Aikenhead Hardware Co., Toronto, carry a full line of wheels of the Prescott Emery Wheel Co.'s manufacture.

TABLE OF EMERY WHEEL SPEEDS.

Diam. Wheel.	Rev. per Min. for Surface Speed of 4,000 ft.	Rev. per Min. for Surface Speed of 5,000 ft.	Rev. per Min. for Surface Speed of 6,000 ft.
1 in.	15,279	19,099	22,918
2 in.	7,639	9,549	11,450
3 in.	5,093	6,366	7,639
4 in.	3,820	4,775	5,730
5 in.	3,056	3,820	4,584
6 in.	2,546	3,183	3,820
7 in.	2,183	2,728	3,274
8 in.	1,910	2,387	2,865
10 in.	1,528	1,910	2,292
12 in.	1,273	1,592	1,910
14 in.	1,091	1,364	1,637
16 in.	955	1,194	1,432
18 in.	849	1,061	1,273
20 in.	764	955	1,146
22 in.	694	868	1,042
24 in.	637	796	955
30 in.	509	637	764
36 in.	424	531	637

OUR FRIENDS SAY SO.

[Copy].

Depot Harbor, February 3rd, 1899.

Biggar, Samuel & Co., Fraser Building, Montreal, Que.

Dear Sirs.—Enclosed find $1, my subscription to Canadian Engineer for the year 1899. I like your paper, it contains a lot of information which is valuable to know and I would miss it if it were stopped. Wishing you a greater amount of success this year than ever before, I remain, yours truly,

D. S. LOUGH.

P S —Please address my paper to 354 Elgin street, Ottawa, Ont.

D. S. L.

[Copy].

The Riordan Paper Mills, Ltd.

Merritton, February 4th, 1899.

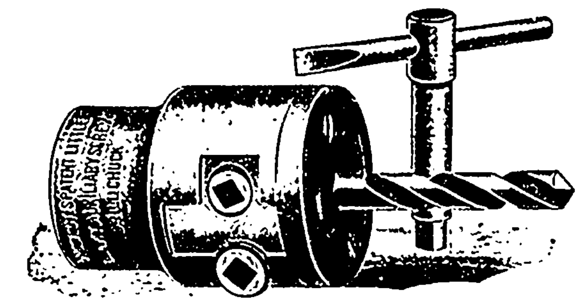
Biggar, Samuel & Co., Fraser Building, Montreal, Que.

Dear Sirs.—I take pleasure in remitting you by P.O. order my subscription for The Canadian Engineer for the ensuing year to December, 1899. I consider this dollar better spent than most. Your paper surpasses any trade papers I have seen, in value of contents and its attractive style. I am glad it is "Canadian." Yours sincerely,

CHAS. C. RIORDON, JR.

LITTLE GIANT AUXILIARY SCREW DRILL CHUCK.

In addition to the popular Little Giant Improved, Little Giant Double Grip, and Oneida Drill Chucks, and Lathe Chucks of all kinds, the Westcott Chuck Co. is now furnishing the Little Giant Auxiliary Screw Drill Chuck, as shown in illustration. In drill chucks with side screws it is claimed that the inner or gripping part of jaws has a tendency to crowd away from the right and left hand screw, and the outer end of



jaws has a tendency to draw toward the right and left hand screw. The auxiliary screw (in this new Little Giant Auxiliary Screw *Drill Chuck) entirely overcomes said tendencies. After* closing jaws on drill in the usual manner (by turning right and left hand screw), then tighten the auxiliary screw. This will greatly increase the gripping power of chuck. The effect of the auxiliary screw is similar to that of a bolt, as it virtually bolts the two jaws together. The ½-inch, ¾-inch and 1-inch sizes are made of pattern shown in the figures. The hole in the hub is made to fit the Morse taper, but can be bored out

and threaded to suit the customer's templet at small cost. These chucks are also made with straight bodies, which are especially adapted for Hollow Spindle Lathes, for holding rods, round or square, which are to be turned or cut off. When a chuck is wanted for holding square work it should be so stated in order. The Aikenhead Hardware Co., Adelaide street, Toronto, reports a steady and increasing demand for the Westcott chucks.

NEW CATALOGUES.

The following catalogues have been received and are filed in our office, where they may be consulted at any time:

The Unbreakable Pulley and Mill Gearing Co., Ltd., West Gorton, Manchester.—A Treatise on the Economical Transmission of Power. Eighth edition. Cloth covers, 160 pages.

Darling Bros., Reliance Works, Montreal, Que.—Illustrated catalogue of Darling Bros., Reliance engineers, machinists and manufacturers of special and patented machinery. Boards, 100 pages.

Prescott Emery Wheel Co., Ltd., Prescott, Ont.—Catalogue and Price List No. 16.—Paper, 40 pages, illustrated. Attention is called to some new features, as the "Semi-Vitrified," which is more open in texture than the other wheels, and which has an abrasive bond.

Gas and Gasoline Marine Engines and Launches.—The John Gillies Estate Co., Carleton Place, Ont.

The Gartshore-Thompson Pipe and Foundry Co., Ltd., Hamilton, Ont.—Catalogue of cast-iron pipe (3 inches to 60 inches in diameter), for water, gas, culverts and sewers; also special castings, hydrants, valves, etc.

The Michigan College of Mines, Houghton, Mich., U.S.A. —The catalogue of the Michigan College of Mines, with statements concerning the institution and its courses of instruction for 1898-1900.

The Lehigh University, South Bethlehem, Pa., U.S.A.—The Register of Lehigh University, South Bethlehem, Pa., U.S.A.

The Massachusetts Institute of Technology, Boston. Annual Catalogue, 1898-1899; paper, 350 pages.

The Fairbanks Co., Montreal.—Illustrated Supply Catalogue; cloth, 250 pages; profusely illustrated, showing a full line of the varied mill supplies carried by this well-known company.

ROLLING OR RAMMING IN ROAD BUILDING.

Editor CANADIAN ENGINEER:

Sir,—There is one thing as to which the profession is entirely in the dark, and where information is capable of being afforded by such an institution as McGill University, under Professor Bovey's able direction, and supplied as the institution is, avowedly, with all the necessary and the best and most suitable machinery for the purpose. I allude to comparative statistics of ramming and rolling for purposes of street paving. What amount of pressure is equivalent to a blow from a hammer or pounder of a given weight, lifted by the operator to and descending from a certain height. In a word what weight of a road roller exerted on a given surface is equivalent to ramming the same in an efficient manner. Maybe an inkling of it might be obtained by estimating the force of impact used in driving a nail into a piece of soft or ordinary wood, and the pressure in pounds to be exerted to drive another nail in the same time to the same depth.

This question of ramming vs. rolling a road-bed or of rolling vs. ramming is most pertinent; and though of extreme intricacy, considering the rather indefinite breadth and area of the strip of surface on which the roller bears; still I am confident Mr. Bovey can make something of it and give us at least, and as soon as possible, to begin with, in view of the approaching season for paving, some approximate mode of being satisfied, which I am prone to believe that almost no imaginable weight of road rollers (10 tons, 20 tons or more) can be nearly as effective as ramming.

Another question to which I would invite your attention is a statement of the depth to which an impacting of the surface, or a rolling of it, will reach, in an effective manner. Of course, we know that in trench filling, the ramming amounts to nothing if left to be performed only when the trench is filled, and the filling should be rammed, in successive layers of six to eight inches it is supposed, and this is the practice followed out in embanking for reservoir dams; but still it is guess work more or less, and has not been calculated and reduced to a science as it should be, if possible. In trench filling, here in Quebec, by our gas company, when it excavates for any purpose, a man goes and comes along the bottom of the trench as it is being filled in from above, and in such a way as, by allowing say one rammer to half a dozen fillers, to ram almost every successive shovelful of filling as it goes down. This, of course, is the right thing to do, or should be, but could hardly be expected, over extended areas.

A heavy (steam) road roller is most deceptive. It inspires the general public with full confidence in its efficiency; but we are not, in such matters, to be guided by mere sentiment. Very little is known of the comparative effect of rolling and ramming. I have just now before me paving specifications, best or most recent editions of them all, from Washington, New York, Boston, Baltimore, Philadelphia and Chicago, and they are all at one in specifying "ramming or rolling with a 5 to 10 ton roller," as if the one were equivalent to the other. Now on the contrary, I do not know that even a 50-ton roller, which it would be impractical to use, would be an equivalent. I am far from stating this; having no data to go by, but suppose a rammer be 6-inches square, or of an area of 36 inches, and suppose a roller is 5 feet long or broad, and 5 feet in diameter and weighs 10 tons, then will there be but one ton weight or pressure on every 6 inches lineal of the length or breadth of roller. Suppose, now that the effective breadth of the strip of surface pressed on by the roller be 6 inches, and it hardly could be less, on an already rolled surface, or after a first or second rolling without a versed line of sinkage into the surface to an extent to widen the cord of section of area sunk into by the roller. I say that in such a case, only one-tenth of weight of roller would come upon this surface or area of 6-in. by 6-in. or 36 square inches, and a comparison is now to be instituted, in how far this weight of one ton on one-quarter of a square foot is equivalent to a blow or succession of blows of a rammer of given weight falling from it or brought down like a hammer with a man's muscular effort in addition to the effect of its own or unaided weight or impact.

C. BAILLAIRGE,
Consulting Engineer.

Quebec, March 23rd, 1899.

HARRIS VS. THE TORONTO ELECTRIC LIGHT CO.

The verdict against the defendant in Harris vs. the Toronto Electric Light Co. marks the first step in a legal fight which will be watched with absorbing interest by everyone interested in electricity, either as producer or consumer. The number of double services such as is alleged to have caused the fire is very great, and all producers of electric current will feel most insecure until the finding of the Court in this case has been reversed as no doubt it will be when heard before a Court which will go fully into the technical points involved. The plaintiff's witnesses swore that they saw the wires fire the building. Such a result would only be produced by a short circuit of course. The defendants showed that the fire alarm sent in by telephone by Dr. A. A. Macdonald, who saw the fire in the interior of the building, was given at 2.35, and the short circuit was recorded at the defendant's works as occurring at 2.48. The verdict was for $10,000 damages.

The whole of the evidence in this interesting case will be reviewed in a later issue.

ONTARIO RAILWAY GRANTS.

The following bonuses have been granted by the Ontario Government:

To the Ontario, Hudson Bay & Western Railway, between Missinabie Station on the Canadian Pacific Railway and tidewater on the mouth of Moose River on James Bay, a distance not exceeding two hundred and forty miles, a cash subsidy of $2,000 a mile—$480,000.

To the James Bay Railway, from a point at or near Sudbury to a point at or near Lake Abittibi, a distance not exceeding one hundred and seventy-five miles, a cash subsidy of $2,000 a mile—$350,000.

To the Haliburton, Whitney & Mattawa Railway, between Haliburton and Whitney, a distance not exceeding thirty miles, a cash subsidy of $3,000 a mile—$90,000.

To the Ontario & Rainy River Railway, from its junction with the Port Arthur, Duluth & Western Railway to Fort Frances, a distance not exceeding two hundred and five miles, a cash subsidy of $1,000 a mile, and from Fort Frances to the mouth of Rainy River, a distance not exceeding seventy-five miles, a cash subsidy of $4,000 a mile—$505,000.

To the Central Ontario Railway from Ormsby or Coe Hill to a point at or near Bancroft, a distance not exceeding twenty-one miles, a cash subsidy of $3,000 a mile—$63,000.

To the Central Counties Railway from Glen Robertson to Vankleek Hill, a distance not exceeding fourteen miles, a cash subsidy of $2,000 a mile—$28,000.

To the Ontario, Belmont & Northern Railway, from the northern terminus thereof in the direction of the townships of Belmont and Lake, a distance not exceeding seven miles, at the rate of $3,200 a mile—$22,400.

Resolved, That there shall be set apart for the use of the Sault Ste. Marie & Hudson Bay Railway and the James Bay Railway out of the lands of the Crown through which they may pass, 5,000 acres to the mile of each of the said railways for the portions above mentioned, such areas to be selected in blocks of 5,000 acres on each side of the line alternately by taking the necessary number of lots as the townships are surveyed or outlined, or by taking the proportionate grant for each ten miles of railway (or 50,000 acres) in blocks on alternate sides of the line, such blocks to have a frontage on the line of ten miles each, or in such other way as may be agreed upon by the said company and the Lieutenant-Governor-in-Council.

THE BICYCLE INDUSTRY.

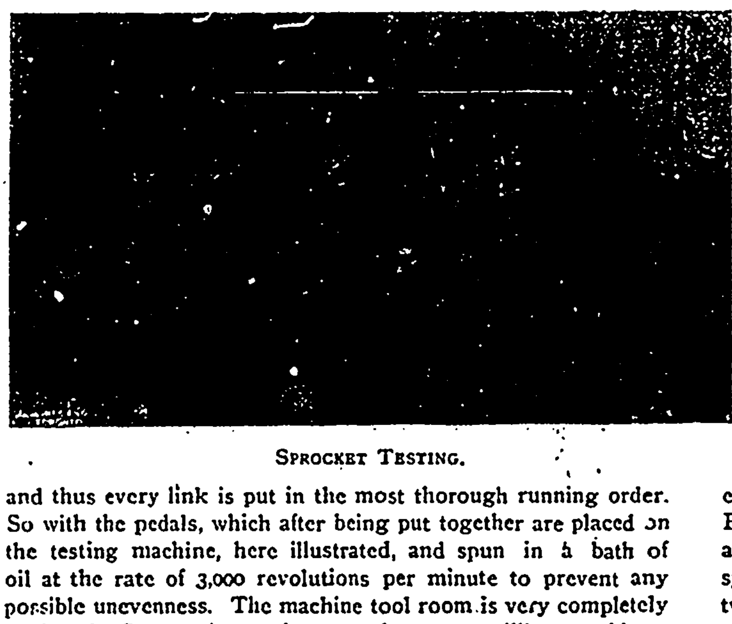
During the last five years Canada has come to the front in a remarkable way in the bicycle industry. Last year this journal gave several instances of large shipments of Canadian-made bicycles to foreign countries and the British colonies, as well as to Great Britain itself. That Canadian manufacturers are doing their best to maintain their position in this branch of trade was made evident to a representative of The Canadian Engineer, who in company with a number of other journalists paid a visit the other day to the bicycle factory of H. A. Lozier & Co., Toronto Junction, makers of the Cleveland wheel. The extensions built to these works during the past year have enabled this company to double its output—which is now from 150 to 200 wheels per day. The various departments have an aggregate floor space of 137,000 square feet, and with the exception of the wood rims and rubber goods all parts of the Cleveland wheel are made in the firm's own works. In addition to its own steam plant the company has its own electric lighting plant, and its own gas plant, supplying fuel oil and gas for various departments. There are two oil tanks with a capacity of 5,000 gallons each. The works have their own water supply also, there being a roof tank of 10,000 gallons capacity, and an underground tank of 100,000 gallons capacity. The brazing of the bicycle frames is carried out chiefly by the "dip" process, ensuring uniform and rapid work. For removing the borax and encrustations the sand blast is used instead of the "pickle," commonly applied after brazing. The sand blast has the advantage not only of rapidly and completely cleaning the brazed parts, but the fine frosting which it gives to the entire frame enables the rust proof coating and subsequent enameling coats to adhere with greater tenacity. A view of the sand blast room is here given. It contains five sand tanks, to each of which is attached a pipe ending in a funnel which discharges the sand in a thin stream on the principle of a sand hour-glass. An air compressor supplies the air blast to each operator through a flexible tube which ends in a nozzle, manipulated by the operator as the nozzle of a fire hose would be The operator's eyes are protected from the rebounding particles of sand by a canvas screen in which a pane of glass

SAND BLASTING DEPARTMENT.

is fitted to enable him to see his work. Armholes are cut in the canvas so that he can hold the frame with one hand, and direct the stream of sand by means of the hose in the other hand. The blast of air is brought in under a pressure of 15 lbs., this being sufficient to drive the fine grains of hard sand with such force as to impart a fine frosting on the smooth tubing almost instantly. This is a hard silicious sand, imported from St. Louis, the Missouri sand being the best yet discovered for the purpose. Previous to being enameled the frames are primed with a special rust-proof composition. The enameling room has four double "dips," each tank holding 120 gallons of

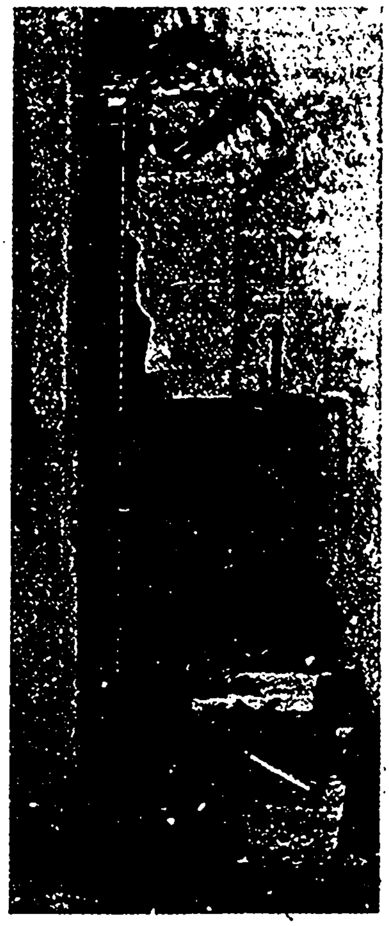
Drop Forging Department.

the enamel, and there are 10 furnaces, heated by fuel oil to a temperature of about 340 degrees for the baking of the enamel, which is put on in four coats. The blue dipping room for putting on the blue dip, which is the distinguishing feature of the Cleveland spokes, has a capacity for dipping spokes in lots of 5,000 at a time. A great amount of special machinery is used for the rapid production of the various parts of wheels, such as the pedals, cranks, hubs, chains, gear wheels, etc., and each part as it is completed is tested by automatic machinery, except the pedal cranks, which are tested by hand. For instance, a chain when finished is put into a device (shown in the engraving), by which it is subjected to a strain of 1,000 lbs. by means of a weight. Having been thus tested for strength the chain is put on a pair of sprocket wheels revolving at such a rate as would be equal to a run of 200 miles in a few minutes.



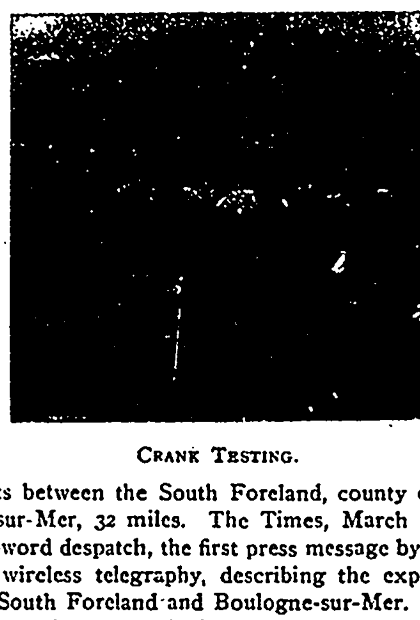
Sprocket Testing.

and thus every link is put in the most thorough running order. So with the pedals, which after being put together are placed on the testing machine, here illustrated, and spun in a bath of oil at the rate of 3,000 revolutions per minute to prevent any possible unevenness. The machine tool room is very completely equipped. It contains a planer, 5 shapers, 2 milling machines, 15 lathes, 1 speed lathe, 50 vises, 1 die sinker, 1 universal grinder, 1 cutter grinder, 6 drill presses and many other machines; while the milling, drilling and punch press room contain 24 plain and universal machines, 15 drill presses, 10 punch presses and other special machines. The lathe department contains 21 screw machines, 10 lathes, 3 grinders and other machines. The air compressor used is from the well-known works of the Canadian Rand Drill Co., Sherbrooke. The company employs at Toronto Junction 350 to 500 hands, but the hands in the United States and Canadian works aggregate over 2,000, with a total production of 500 wheels per day. The works are under the able management of E. R. Thomas.



Chain Testing Machine.

Signor Cuigliemo Marconi, the inventor, who recently, after long delay, obtained permission from the French Government to establish a station on the French coast for the purpose of experimenting with wireless telegraphy between England and France, announces that he has conducted successful



Crank Testing.

experiments between the South Foreland, county of Kent, and Boulogne-sur-Mer, 32 miles. The Times, March 29th, printed a hundred-word despatch, the first press message by the Marconi system of wireless telegraphy, describing the experiments between the South Foreland and Boulogne-sur-Mer. The experiments were carried out in the Morse code, and were read as distinctly as if wires were used.

Industrial Notes.

Toronto is advertising for tenders for a gas plant for Toronto Island.

The Niagara Falls Planing Mill Co., Ltd.; capital, $3,500, has been incorporated.

The town of Windsor, N.S., has voted $2,000 for a site for a public building; $5,000 for the building and $5,000 for a steam fire engine.

The Dodge Mnfg. Co., Ltd., Toronto, is working a large staff of employees full time, turning out pulleys and rope drives, etc.

Vancouver, B.C., has ordered a No. 5 Champion rock crusher with elevator and screen from the Good Roads Machinery Co., Hamilton, Ont.

Shurley & Dietrich, Galt, Ont., have, it is said, decided to move their iron bedstead factory, now at St. Catharines, to Galt shortly. A new building will be erected.

The R. Simpson Co., Ltd., department store, Toronto, has bought the corner of Richmond and Yonge streets, and will build a large extension to the store at once.

Listowel, Ont., is organizing a co-operative pork packing establishment, whose proposed capital is $37,500, and also a furniture factory to be heavily bonused by the town.

Tenders are called for the construction of a system of waterworks for the village of Hintonburgh, Ont., as will be seen by reference to the advertisement in another column.

The Middleton, N.S., Outlook reports that the people of Berwick, N.S., are considering the advisability of starting a cannery in connection with the creamery already established there.

The McClosky Wire Fence Co., Ltd., Windsor, Ont., has been incorporated with a capital of $40,000. The provisional directors are: W. McClosky, J. R. Dixon, J. A. Auld, S. A. King, M.D., and J. Kay.

J. O. C. Mignault, C.E., has entered an action claiming $5,000 damages from the corporation of Roberval, Que., on account of a protest served upon him in connection with certain work which he did for the municipality.

W. H. Comstock, J. McL. Gill, G. I. Mallory, E. W. Meca, O. K. Fraser, Brockville, Ont., and J. Cumming, Lyn, Ont., have been incorporated as the Brockville Peat and Power Company, Ltd.; chief place of business, Brockville, Ont.; capital, $99,000.

H. P. Dwight, W. D. Matthews, R. Jaffray, E. B. Osler, G. A. Cox, Fred. Nicholls and J. K. Kerr, Toronto, are the directors of the Motor Carriage Co., of Ontario, Ltd., which has been organized to make, and sell, and let for hire motor carriages and other vehicles; chief place of business, Toronto; capital, $250,000.

The Montreal Pipe Foundry Company, together with C. A. Meissner, have leased the works of the old Londonderry Iron Company, situated in Colchester county, N.S. The new company will, like the old, manufacture cast-iron water pipe and other cast iron fittings. Mr. Meissner was the general manager of the old concern.

The B. Greening Wire Co., Hamilton, Ont., has just closed a contract for the erection of a new wire cleaning house, which will enable it to greatly increase the output of the wire drawing mill. During the building of this addition there will be added thirty feet to the smoke-stack, it being the intention to increase the power by the addition of 100 h.p., either electric or steam, as may be decided.

The reports of the British Fire Prevention Committee continue to be of great interest. No. 14, just received, contains the statement of a test made by the committee upon a floor built by the Expanded Metal Co., Ltd., London. In this test a room lined with expanded metal lathing and floored with concrete laid upon expanded metal, withstood a temperature of 2,000 deg. for an hour, and only showed slight cracking when water was thrown from a hose at 20 lbs. pressure for three minutes.

E. H. Bronson, F. P. Bronson, W. G. Bronson, Levi Crannell, Ottawa; T. L. Willson, Woodstock, Ont.; J. Sutherland, M.P., Woodstock, and J. J. Gormully, Ottawa, are applying for incorporation as the Ottawa Carbide Company, Ltd., to manufacture calcium carbide at Ottawa, with a capital of $200,000. It is said that the large sawmill premises of Bronson & Weston with its valuable water power will be used for the purposes of the company.

R. M. Thompson, New York; J. J. Thompson, Bayonne, N.J.; J. R. Wilson, Montreal; C. C. Colby, Stanstead, Que., and R. G. Leckie, Esq., Truro, N.S., are applying for a Dominion charter as the Canada Mining and Metallurgical Company, Ltd., to carry on exploring for mining, smelting, treating, manufacturing, extracting, reducing and selling gold, silver, copper, lead, iron, tin and other ores, metals and mineral substances. Chief place of business, Montreal; capital, $5,000,000.

The Fairbanks Co. has placed a large stock of its scales with Miller, Morse & Co., of Winnipeg, who will handle Fairbanks' standard scales, gasolene engines, and some of the other specialties of the Fairbanks Co. for Manitoba and the Northwest Territories. They will constantly carry in stock a full assortment of goods most commonly called for, and all enquiries for these products for this territory should be sent to them. The Fairbanks Co. is extending its business rapidly and while covering new territory accounts for some of the increase, the satisfaction experienced by former clients is a much greater source of the firm's development.

The Dominion Iron & Steel Company has been granted by the Nova Scotia Legislature a partial exemption from payment of royalty on coal used in the operations of the company, which has just been incorporated with a capital of $20,000,000. H. M. Whitney, Boston, who is head of the new company, as well as the Dominion Coal Company, asked for entire exemption from payment of the provincial royalty for a period of five years on the coal used by the Iron & Steel Company, and the Government granted half the exemption for eight years. The Dominion Coal Company pays a royalty of twelve and a half cents a ton. The Dominion Iron & Steel Company will use enormous quantities of coal.

Electric Flashes.

A. and G. Cornell are establishing an electric light plant at Stanbridge East, Que.

Quyon, Que., is to have electric light and a large grain elevator in the near future.

The Richelieu & Ontario Navigation Co. is placing a lighting plant in its hotel at Tadousac.

The Welland-Vale Co., St. Catharines, has recently installed a lighting plant in its bicycle factory.

The electors of Winnipeg will vote this month on a by-law providing for a municipal electric light plant.

The Canadian General Electric Co., Ltd., is installing an 800 light alternating dynamo for Jas. Knox, of Stayner, Ont.

The Montreal Novelty Co. has placed an order with the Canadian General Electric Co. for a 6 k.w. Edison generator.

The Radial Railway repair shops at Hamilton Beach were destroyed by fire, March 13th; damages, $4,500; fully insured.

The University of New Brunswick has purchased an experimental electric plant from the Canadian General Electric Co., Ltd.

Jos. Knot, Stayner, Ont., proposes to develop power on the Nottawasaga river for lighting and industrial purposes generally.

A project is on foot to build an electric railroad between Trenton and Westville, Pictou county, via New Glasgow and Stellarton.

The people of Cornwall Ont., are making strong representations to the Government to secure an effective head of water for power development in the improvements being made in the Farran's Point canal.

The award in the Brantford, Ont., Electric Co. and Robson Bros. arbitration has been handed down and gives Robson Bros. $4,195.

The Penman Mnfg. Co., of Paris, Ont., is adding an 8½ k.w. generator of the Canadian General Electric Co.'s make to their present plant.

Cunliffe & Ablett, Vancouver, B.C., have bought from the Canadian General Electric Co., Ltd., two 50 h.p. three-phase induction motors.

The Hull and Aylmer, Que., Electric Railway Company has decided to equip its cars with new gearing so that they will run at forty miles an hour.

The Guelph Street Railway Co. has placed an order with the Canadian General Electric Co., Ltd., for a multipolar railway generator of 110 k.w. capacity.

The Montreal Street Railway Co. has placed an order with the Canadian General Electric Co., Ltd., for ten more two motor G.E. 1,000 motor equipments.

The street railway line is to be extended to English Bay beach, the Vancouver city council having granted the necessary franchises renewable every five years.

The Department of Railways and Canals has placed an order with the Canadian General Electric Co., Ltd., for additional plant to be used on the canal at Sault Ste. Marie, Ont.

The Kootenay Standard Publishing Company, Rossland, B.C., is placing in its printing house one of the Royal Electric Company's "S.K.C." induction motors to operate the printing presses.

F. H. Daigneault, M.D., J. E. Mareile, L. S. Plamondon, E. St. Amour and E. Tetreault, Acton, Que., have been incorporated as the Acton Hydraulic Power Co., with a capital of $15,000; headquarters at Acton.

The Kentville, N.S., Electric Light and Power Co. is installing, as an increase to the present plant, two multipolar generators of 45 k.w. each, which will be supplied by the Canadian General Electric Co., Ltd.

The Lindsay Light, Heat & Power Co. has placed an order with the Canadian General Electric Co., Ltd., for one multipolar generator of 25 k.w. capacity, which is intended as an addition to the present power plant.

It is stated that the various electric companies doing business in Montreal in lighting, power distribution and passenger transportation, will be amalgamated with a probable capital of ten or fifteen million dollars.

The Richelieu & Ontario Navigation Company are installing complete lighting outfits on two of its boats, consisting of Canadian General Electric Company's multipolar generators of 30 k.w. capacity directly connected to high speed engines.

The Canadian Brotherhood of Electrical Workers elected the following officers for the year at a recent meeting in Toronto: President, T. Eaton; vice-president, S. P. Kent; recording secretary, J. C. Long; financial secretary, F. Marson; treasurer, F. Hawkey.

W. A. Johnson, J. W. Thompson, J. N. Smith, G. E. Scholey, Eric Thompson, C. J. Holman and A. B. Lee, Toronto, have been incorporated as the United Electric Co., Ltd., to carry on the business of the W. A. Johnson Electric Co., and the Toronto Electric Motor Co., Ltd.

A. S. Bowen, Kemptville, Ont., has purchased the lighting plant recently operated by Mr. Collins of that town, and is installing a standard 1,000 light alternator of the Canadian General Electric Co.'s make, together with a complete new transformer and arc lighting system.

The T. Eaton Co., Ltd., Toronto, has given the Canadian General Electric Co., Ltd., a contract to supply another 130 k.w. 110 volt direct connected generator, as an addition to its already extensive plant. This company will now have probably the largest and most modern isolated plant in Canada.

The Montreal Cotton Co., Valleyfield, Que., is constantly increasing its large electric transmission plant, of which the three-phase induction motor is found so satisfactory for cotton mill operation. There have recently been ordered from the Canadian General Electric Co., Ltd., three motors of 75, 50 and 10 h.p., respectively.

Local capitalists propose to subscribe the funds for the talked of Guelph-Hespeler electric railway.

An electric light plant has been added to the Standard Chemical Co.'s equipment, Deseronto, Ont.

The proposed Galt, Preston and Hespeler Railway would enter Galt via Doon and Blair and connect with the C.P.R.

The Montreal Cotton Co., of Valleyfield, Que., has ordered another 100 h.p. induction motor from the Canadian General Electric Co.

The Dominion Coal Co. proposes doing away with the horses used in the mine for hauling purposes, and will use electricity entirely.

The London Electric Light Company, Ltd., has secured an amendment to its charter increasing its total capital stock from $250,000 to $500,000.

The Canadian General Electric Co. has received an order from Stunden & Perrine, of Rossland, B.C., for a standard induction three-phase motor.

The Montreal Island Belt Line Co. is applying for increased powers in building branch lines, and to buy the Chateauguay and Northern Railway Co.

Jno. Forman, Montreal, has sold his property, 565 acres, at Shawinigan Falls, to the Shawinigan Water & Power Co., and the development will now proceed.

The Brantford Street Railway Co., Brantford, Ont., is installing six Canadian General Electric "800" railway motors, purchased from the Canadian General Electric Co.

The Canadian Pacific Railway Co. has placed an order with the Canadian General Electric Co. for one 75 k.w. three-phase synchronous motor for the Trail smelter, Trail, B.C.

The Winnipeg Electric Street Railway Co. has placed an order with the Canadian General Electric Co. for two additional Canadian General Electric "1,000" 2-motor equipments.

The National Electric Co., 1586½ Notre Dame street, Montreal, is the style of a new firm commencing business as electrical contractors, and making a specialty of installation for electric lighting.

The linemen of the construction department of the Hamilton Electric Light and Power Company recently struck for an increase from $8.50 to $10.50 per week for experienced hands. The demands of the men were granted.

A verdict for $4,000 damages was given against the Toronto Railway Co. recently for damages sustained by a Mrs. Darling, who fell and broke her leg, owing to the street car beginning to move while she was getting off.

The Canadian General Electric Co. is supplying the Hospital St. Jean de Dieu of Longue Point, Que., with a motor equipment of the standard Canadian General Electric 1,200 motors, including controllers, rheostats, etc.

The Electrical Maintenance and Construction Co. of Toronto, Ltd., has been formed by P. H. Patriarche, P. D. Ball, H. L. Dunn, W. M. Boultbee and others, of Toronto; capital, $20,000; chief place of business, Toronto.

The Dominion Oilcloth Co., of Montreal, has placed an order with the Royal Electric Co. for the complete equipment of its factory with "S.K.C." motors. The different units as required throughout the building in the different departments, aggregate over 150 h.p.

Hamilton, Ont., is understood to be the home of a large electrical combine similar to that alleged to exist in Montreal. The plan includes all the electrical plants in Hamilton, light, power and trolley, and is said to have designs on the Cataract Power Co., and the electric lines at Niagara Falls.

The Esquimalt & Nanaimo Railway Co., which is opening up its coal mines at Oyster Harbor, B.C., has decided to operate the entire mining and hauling apparatus by electricity, and for this purpose has placed their order for two direct connected units of 150 h.p. each, with Ideal engines, and two 40 h.p. mining locomotives with switchboards, and all the necessary supplies for the complete installation, with the Royal Electric Co. of Montreal. This is the second order that the Royal Electric Co. has received for mining locomotives and apparatus on Vancouver Island.

Joliette, Que., is extending its arc system, and has placed an order with the Royal Electric Company for a 50-light 2,000 c.p. T.H. Royal arc machine, with a full equipment of lamps. This is an addition to a recent purchase of an 120 k.w. "S.K.C." generator with transformer, etc., which was put in operation recently.

The Consumers' Cordage Co., of Montreal, is fitting out its factories with electric power and has placed its order with the Royal Electric Co. for two 50 h.p. "S.K.C." synchronous motors. The current for these motors is to be furnished by the Chambly Mufg Co. as soon as it has their current in the city, which is expected about the first of May.

The Montreal Street Railway Company is building a hundred new open cars for its summer service. One improvement is a safety board of wooden sheeting on the side of the car nearest the other tracks, instead of the wire screen, as formerly; the cotton cover intended to keep out rain is replaced by waterproof blinds, which fit tightly into frames.

A company to be known as the Nova Scotia Electric Light Co. is being organized to furnish electric light, heat and power to all points in the valley from Windsor to Annapolis, with branches to Canning, Kingsport, Granville Ferry and other outlying centres. The source of power will be the Gaspereau river, where there will be an effective head of water of 375 feet with a minimum flow of 8,000 cubic feet. F. B. Wade, Q.C., and C. E. Foss, are the organizers of the company.

The bill respecting the Hamilton, Chedoke and Ancaster Street Railway Company was passed by the Railway Committee of the Ontario Legislature with one amendment, which provides that the road may be run by electricity or compressed air but not by steam. The capital stock is raised from $100,000 to $300,000, and the line will in future be known as the Hamilton, Ancaster and Brantford Railway. An agreement may be made with the Brantford Street Railway for the use of its tracks.

The Riordon Paper Mills Co., Hawksbury, Ont., is lighting its plant throughout by electricity. An order has been placed with the Royal Electric Company, Montreal, for a 25 k.w. "S.K.C." two-phase generator, wound to deliver 110 volts. There will be 200 incandescent lamps installed from this throughout the mills, as well as ten alternating enclosed arc lamps. This is the fifth large mill or factory which has within the past year installed alternating current apparatus of the "S.K.C." two-phase type.

John Ross Robertson, of The Telegram, in laying out his new buildings at the corner of Bay and Melinda streets, Toronto, is arranging for a most complete electrical installation. All the printing machinery, shafting, hoists and elevators are to be operated by electricity as well as the lighting of the building throughout. The Goldie, McCulloch Co., of Galt, Ont., are furnishing the steam engines and boilers; the Sprague Electric Co. are furnishing the hoists and elevators, and the Canadian General Electric Co. is supplying the generators and slow speed motors for lighting and power. A more detailed account of this ideal installation will be given in a later issue.

The regular annual convention of the Maritime Electrical Association will be held in Halifax, April 18th. The convention headquarters will be at the New Victoria Hotel, and the meetings will be held in the assembly room. The programme will be as follows: 9.30 a.m., meeting of the Executive Committee; morning session, 10 a.m., president's address, report of secretary-treasurer, report of committees, election of officers, general business. Afternoon session, 2 p.m., papers will be read by members on Iron Armoured Conduit Wiring, Fire Alarm Systems, Steam Engineering, Telephone Work and Electric Meters. Questions which have been suggested by the members will also be discussed. In the evening a reception, consisting of banquet and smoking concert, will be tendered by the Halifax members of the association. The president, F. A. Bowman, states that no effort is being spared to make this convention a success from every point of view; and all members attending will not only receive some very practical information from the papers to be read and the discussions which will follow, but will also find the occasion a most enjoyable one socially.

At the annual meeting of the Canadian General Electric Company all the old directors who are eligible were re-elected. The following comprise the board for the present year: W. R. Brock, president; H. P. Dwight, first vice-president; Frederic Nicholls, second vice-president and managing director; Hon. Geo. A. Cox, W. D. Matthews, Robert Jaffray, E. B. Osler, J. K. Kerr, S. D. Greene, E. W. Rice, jun., and H. Parsons.

The Folger-Hammond Mines Co. has given a contract to the Canadian General Electric Co., Ltd., which covers the installation of a complete transmission plant to operate their stamp mills and compressors from a water fall some three miles distant from the line. The generating plant will consist of a three phase generator of 150 k.w. capacity, operating at 2,000 volts. For operating the machinery there will be supplied one 100 h.p. three-phase induction motor and one 20 [illegible]

F. Richardson, assistant electrician of the C.P.R., accompanied by M. Grimes, Ottawa, and a staff of assistants, left early last month for the Pacific coast under instructions from the Minister of Public Works, to construct a telegraph line from Skaguay to Dawson. The estimated cost of the line for the distance of 600 miles between the two points named is $150,000. It is expected that the line will be in operation by the 15th of November. Whether the sea link will subsequently be connected by a cable between Vancouver and Skaguay, or whether the Government line from Quesnelle, in the Cariboo country, will be extended northward to connect with the Skaguay-Dawson line, has not been made known.

The specifications on which the Central Construction Company was awarded the contract for the power plant at Orillia, Ont., provide for a solid masonry dam laid in cement. There are two steel flumes, with an opening in the dam for a third. The power house, which is to be fire-proof, will be 62x36. The company also undertakes to cut down all trees along the route, to furnish two motors for the present plant, one for the pumps and one for lighting plant. The Westinghouse Company is supplying the electrical machinery; the Stillwell-Bierce and Smith-Vaille Company the wheels. The Central Construction Company gives a bond of $12,000 from the National Security Company, good for sixteen months (which will carry the town over the freshets of the spring of 1900), that the dam, etc., is of sufficient strength, and one of $5,000 for four years.

Judge McDougall, in a judgment delivered March 27th, upheld the conviction of the Toronto Railway Company for a breach of the city by-law which provides that every railway operating within the limits of the city shall, during the months of January, February, March, November and December, provide each car with a proper and sufficient vestibule to protect the motorman and others in charge of the car. His Honor held that the meaning and interpretation of the by-law is plain, and the conviction should be affirmed, and the appeal dismissed with costs. He found that the evidence showed that the conductor and motorman were in charge of the car within the ordinary meaning of the expression. His Honor added: "As to the argument that the rear-end vestibule would interfere with the proper working of the car, it should be addressed to the city council." His Honor also found that the objection raised as to the alleged application of the Dominion Railway Act, owing to the fact that the Street Railway Company's tracks crossed the tracks of the G.T.R. and C.P.R., was not sustained.

Personal

William Clare has been appointed to the charge of the East End sewage disposal works, Hamilton, Ont.

Horace Mabee, a graduate of the Kingston School of Mines, has been appointed chemist of the Deseronto Iron Co.

Samuel Hall, one of the oldest employees of the G.T.R., Belleville, died last month. He was 25 years an engineer, and for twenty years had charge of the pump house in Belleville.

Thos. Potter, in charge of the electric lighting plant, Walkerton, Ont., received a shock at 1,000 volts last month, and was severely injured though not killed. He was sitting reading a newspaper, and leaned back in his chair till his head came in contact with a wire.

Geo. A. Calvert, who represents the Fairbanks Co., Montreal, Fairbanks' standard scales, asbestos disc valves, etc., called upon us recently while in Toronto.

C. J. Peppin, night watchman in the Parliament Buildings, Toronto, has been appointed engineer at the Deaf and Dumb Institute, Belleville, Ont. The position carries with it a salary of $600 and house rent free.

Near Millwood station on the Manitoba and Northwestern railway the engineer, W. Hill, and the fireman, P. Donlon, were instantly killed, March 6th, by the explosion of the locomotive boiler, while working up a steep grade

Joseph Chartier, thirty years of age, a wire drawer in the Dominion Wire Works, Lachine, Que., while at work became entangled in a mass of wire, which drew him into a cutting machine, with the result that his left foot was almost completely severed.

The death took place in St. Thomas recently of William Chambers, ex-locomotive foreman of the Grand Trunk shops. Mr. Chambers was born in England in 1828, and on coming to Canada entered the employ of the G.T.R. in 1854, and only left its employ in 1888.

Joseph R. Roy, C.E., resident engineer-in-chief for the Dominion Government in British Columbia, who has been for some weeks in Montreal recuperating from a severe illness, has gone in charge of a party sent by the Dominion Government to Dawson City, in the Yukon, to make some surveys and carry out needed public works.

The scaffold erected inside of a large sawdust burner for the purpose of repairs at the mills of W. C. Edwards & Company, Rockland, Ont., gave way just as the men were entering at 1 o'clock, March 20th, and coming down upon the five who entered, killed four of them. The dead are: Louis Rochon. Henry Dalrymple, Eugene Deschamp, Archie Stewart. Xavier Frappier was four hours under the debris and was finally got out seriously hurt.

At a meeting of the Can. Assoc. Sta'ry Engineers, Montreal No. 1, held shortly after the death of Capt. Jas Wright, an honorary member of the association, many expressions of regret were made by the members at the loss of an earnest and faithful friend. A motion of condolence and sympathy was unanimously passed, and the meeting adjourned immediately out of respect to his memory. Capt. Wright was one of the oldest and most reliable mechanical engineers in the country, was for many years superintending engineer of the dredging plant of the Montreal Harbor Commissioners.

It is announced that the Joule scholarship for physical research has been awarded by the council of the Royal Society, London, to Howard T. Barnes, M.Sc., demonstrator in the Physics department, McGill University, Montreal, and whose training has been received at McGill. The annual value of the scholarship is a hundred pounds, and it is generally awarded for two years. Mr. Barnes will continue the researches into the specific heat of water on which he has been for some time engaged.

The death took place recently at Albany, N.Y., of Arthur S. C. Wurtele, C.E. The deceased, who was 69 years of age, was the second son of the late Jonathan Wurtele, seigneur of River David, and was born at Quebec. He studied civil engineering with Walter Shanly, C.E., and afterwards received an appointment as one of the resident engineers of the New York Central Railway. He was next appointed deputy state engineer of the State of New York. He retired a few years ago, having gained an excellent and widespread reputation as an engineer.

F. H. Badger, only son of Mr. Badger, Montreal, city electrician, died a short time ago at his father's residence, Montreal. Deceased, who was 36 years of age, was an expert electrician and for many years in the service of the Royal Electric Company, having charge of the outside work and installing the company's present wire system. Some four years ago he went to Quebec to take charge of the Montmorency and Quebec Electric Light system. On the amalgamation of that system with the Quebec Street Railway Company, last year, he went to New York, where he has since been engaged. He was offered his choice of two good positions, one in Washington, D.C., the other in St. Paul, Minn. Before deciding which to accept he determined to visit both places. After doing so he decided to accept the post in Washington, but was suddenly taken ill. When he was at Washington the weather was mild, and he wore light clothing. When he reached St. Paul the thermometer stood at 45 below zero, and he caught a severe cold, which had developed into pneumonia by the time he reached Montreal; and resulted, as stated, in his death.

F. G. Beckett, Hamilton, Ont., died very suddenly at Inglewood, N.J., last month. Grip was the cause of death. Deceased went to Inglewood in January to visit a married daughter. He was about 70 years of age, and was well known in Hamilton for almost half a century. Many years ago he had an engine works where the cotton factory now is and did a big business during the oil fever. He manufactured engines and boilers for the big freight ferry boats which ply between Windsor and Detroit. Later he was in partnership with J. W. Killey, and had works on Barton street. For some years he has been before the public as the promoter of the Beckett drive, along the mountain side.

There was a big sensation in civic circles in Ottawa last month. Early in March Assistant City Engineer Perreault was suspended for making errors in measurements. A little later City Engineer Galt was advised to reinstate him, but Mr. Galt, having previously been given full power to deal with his subordinates as he thought proper, called for Mr. Perreault's resignation. This angered Mayor Payment, whose friend Mr. Perreault is, and the mayor suspended Mr. Galt for "having usurped the authority of the council," and placed Mr. Perrealt in charge. The city council promptly resented this action on the part of the mayor and appointed a new assistant engineer.

J. T. Nicolson, head of the department of Mechanical Engineering at McGill University, Montreal, since 1891, has resigned on account of receiving an Appointment in Manchester, Eng., as head of the Mechanical and Electrical Departments of the Municipal Technical School there. For his experiments in compression, which threw added light on geology, and for his work with Prof. Callender in preparing the paper on the steam engine read before the Institute Civil Engineers, Great Britain, in 1897, Mr. Nicolson has received well-merited honors. For the paper Mr. Nicolson was awarded the Watts gold medal and a Telford premium of £20, by the Institute of Civil Engineers, London, and for the two researches he obtained the degree of D.Sc., from Edinburgh last summer.

Early on the morning of March 7th A. Galloway, foreman of a gang of men at the Imperial Oil Company's works, Sarnia, Ont., ordered some of his men to clean out one of the oil tanks in the company's yards. James McCue proceeded down into the tank. When he reached the bottom he was seen by his fellow workmen to fall down. Another workman named John Carter went down to rescue McCue, but no sooner reached the bottom of the tank than he too was overcome by the gas. The foreman, Galloway, was the next to attempt the rescue of the men, and he shared the same fate as the preceding two men. Henry Willis then came to the unfortunate men's rescue, but he, too, was overcome, as was also another employee, named William Brimbs. By this time the alarm had been given that some men were being smothered in a still, and a gang of men from the boiler-shops were soon on the scene and proceeded to tear the covering from the still to allow the gas to escape, and thereby make it safe for men to descend into the still. Before this work was completed William McCue attempted to go down the ladder, but when half-way down he fell, being almost overcome, but managed to climb part way up again, and was pulled out of the still just in time, as he fainted when he reached the ground. After the covering had been torn away, and the gas allowed to escape, other employees went into the still, and the five men who were lying in a heap at the bottom were hoisted to the top, and all that was possible was done for the unfortunate men. Doctors, who were hastily summoned, worked over the poor fellows from that time until late in the afternoon, when their efforts were finally successful. The courage of the men who went down to face what seemed probable death one after another cannot be too highly praised.

Marine News.

Matthew's Line, Toronto, Ont., has appointed to the steamers "Niagara," Capt. Jas. Morgan, Engineer Thos. Mills; "Clinton," Capt. John Fahey, Engineer J. M. Donaldson.

Alexander Horn, of Oldrieve & Horn, sailmakers, Kingston, Ont., has been notified of his appointment as Government inspector of hulls in succession to Thomas Donnelly, resigned.

Merchant's Line, G. E. Jacques & Co., Montreal, have appointed to the propellers "Cuba," Capt. Henry Chestnut, Engineer William Kennedy; "Melbourne," Capt. Fred. Elliott, Engineer Thos. Milne.

Lake Ontario & Bay of Quinte Steamboat Co., Kingston, Ont., has appointed to the steamers "Hero," Capt. Wm. Bloomfield, Engineer Robt. McEwan; "North King," Capt. John Jarrell, Engineer O. J. Hickey.

Canadian Pacific Steamship Co., Montreal, has appointed to the steamers "Manitoba," Capt. E. B. Anderson, Engineer W. Lewis; "Athabasca," Capt. G. McDougall, Engineer W. Lockerbie; "Alberta," Capt. J. McAllister, Engineer Angus Cameron.

St. Lawrence & Chicago Steam Navigation Co., Ltd., J. H. G. Hagerty, mgr., Toronto, Ont., has appointed to the steamers "Algonquin," Capt. James McMaugh, Engineer James H. Ellis; "Rosedale," Capt. James Ewart, Engineer Ed. O'Dell.

Hepburn, A. W., Picton, Ont., has appointed to the steamers "Alexandria," Capt. E. B. Smith, Engineer Chas. McWilliams; "Aberdeen," Capt. M. Heffernan, Engineer Frank Theriauld; "Water Lily," Capt. M. Hicks, Engineer George Gerow. Schooners "Rob Roy," Capt. Homer Peron.

McKay R. O. & A. B., Hamilton, Ont., has appointed to the steamers "Sir S. L. Tilley," Capt. W. O. Zealand, Engineer Joseph Boulanger; "Lake Michigan," Capt. Arthur Lefebvre, Engineer Joseph Dawson; "Myles," Capt. John S. Moore, Engineer Jas. Smeaton. Schooner "T. R. Merritt," Capt. William A. Corson.

North Shore Navigation Co., Collingwood, Ont., has appointed to the steamers "City of Collingwood," Capt. W. J. Bassett, Engineer Chas. Robertson; "City of Midland," Capt. F. X. La France, Engineer Wm. Whipps; "City of Toronto," Capt. John O'Donnell, Engineer D. McQuade; "City of Parry Sound," Capt. Ernest Walton, Engineer J. L. Smith; "City of London," Capt. W. W Storey, Engineer Jas. Crossland.

The Richelieu & Ontario Navigation Co. has made the following appointments to the various steamers of the fleet for the season:

Steamer.	Captain.	Engineer.
"Quebec"	L. O. Boucher	F. Gendron
"Montreal"	L. St. Louis	F. X. Hamelin
"Canada"	J. Dugal	E. Denis
"Saguenay"	C. Lapierre	
"Carolina"	G. Riverin	M. Latulippe
"Three Rivers"	F. St. Louis	J. Matte
"Berthier"	C. Gouin	E. Arcaud
"Terrebonne"	F. E. Gouin	G. Gendron
"Chambly"	Geo. Paulch	C. Gendron
"Laprairie"	P. McLean	N. Beaudin
"Cultivateur"	O. Raymond	H. Noel
"Longueuil"	F. Jodoin	N. Beaudet
"Hochelaga"	H. Maudeville	F. Chapdelaine
"Hosanna"	D. Mongeau	E. Gendron
"Mouche-a-Feu"	— Crepeau	P. Boucher
"Sorel"	— Berthiaume	— Beaueage
"River-du-Loup"	— Faubert	L. Godin
"Toronto"	H. Esford	Wm. Black
"Spartan"	H. P. Grange	
"Algerian"	D. Mills	
"Bohemian"	A. Dunlop	A. R. Milne
"Hamilton"	A. J. Baker	L. Marshall
"Corsican"	John McGraw	Wm. Parker

Calvin & Co., Garden Island, Ont., have appointed to the steamers "D. D. Calvin," Capt. A. H. Malone, Engineer T. C. Smith; "Bothnia," Capt. G. A. Brian, Engineer R. Veech; "Armenia," Capt. Chas. Coons, Engineer W. Cunningham; "Reginald," Capt. John Doyle, Engineer J. Kennedy; "Chieftain," Capt. John Sullivan, Engineer T. Gray; Parthia, Capt. David Lefavre, Engineer G. Sauve; "W. Johnston," Capt. Ed. Phelix, Engineer T. Harper; "Bluehell," Capt. John Dix. Engineer C. LeRiche.

At the meeting of representatives of the Canadian Marine Engineers' Associations of Toronto, Vancouver, B.C., and St John, N.B., last month, in the Confederation Life Building, Toronto, it was unanimously decided to amalgamate the three distinct societies. About 60 delegates were present, and the chair was occupied by Harry Parker, president of the Toronto organization. At a meeting held in the morning of the visiting delegates, a report was drawn up and plans agreed upon for presentation before all the members. After three hours' discussion the entire meeting agreed on an amalgamation. Harry Parker, S. G. Mills and Robert Craig were appointed an Executive Committee, to meet in Montreal next autumn, and arrange a new constitution for the organization. The name will hereafter be the National Association of Canadian Marine Engineers, and it at present boasts of a membership of 350. Branches will also be instituted in Kingston and Montreal. The meeting then adjourned.

Brief, but Interesting.

The purchase of the Havana street railway by the Harvey syndicate of New York has been declared void by the Cuban courts, and the Canadian capitalists may now have an opportunity of exploiting the transportation facilities of the island.

Alternating current apparatus for all purposes is making progress in Canada, and it is said that before many months there will be alternating current street railway apparatus in use in Canada. It is already extensively used in Europe, especially in Switzerland, and the larger companies in the United States are experimenting with it, and have already built a new road entirely equipped with alternating current apparatus, which is giving satisfaction.

The most complete telephone system in the world has just been inaugurated in Stockholm, Sweden. It is not in the hands of a syndicate or a trust, but under the immediate control of the Government. There is hardly a residence in Stockholm and the neighboring towns not connected with central offices. The telephone tax is levied in the same manner as the water tax and amounts to only $5 a year. In this connection it is interesting to notice the large appropriations made at the present session of the British Parliament for the establishment of a Government telephone system in connection with the postoffice and in opposition to the private companies, whose inadequate service has been the cause of so much complaint on the part of the public.

H. W. Wood, instructor in physics in the University of Wisconsin, has originated the idea of thawing out water pipes with electricity, and has made successful experiments. He takes the electric current used for street lighting purposes, attaches one wire to the frozen pipe inside the cellar of one house and the other wire to a similar pipe in the adjoining or any other house, thus completing the circuit. A current of about fifty volts is then turned on, heating the pipes and melting the ice within. At Chatham, Ont., experiments in this method were made under the direction of Superintendent Jones of the Waterworks Department, and Manager Coate of the Gas Company. Two hydrants, 280 feet apart, were connected to the electric lighting circuit, and were thawed out in 45 minutes. Another hydrant, distant 129 feet from the first, was also connected, and thawed out in 24 minutes.

Ball bearings have been little used on heavy vehicles because it is difficult to make them endure the great pressure. A form of ball bearing devised by Schuppiser has been tried on street cars of Zurich, at first unsuccessfully, as in other experiments, but more satisfactorily since balls to take up side pressure have been employed in addition to those carrying the weight. In their present form, the bearings have two rows of sixteen ¾-inch balls, and two rows of twenty-six ½-inch balls each. To distribute wear, the bearings are arranged so that they can be moved into four different positions. Some of the bearings have now been under test more than two years, Podoski reports, but much trouble was at first experienced with the bearings for the balls. For a few months these have been made of Krupp's crucible steel, which is thought to have quite overcome the difficulty. It is found that an average saving of 15 per cent. of the total power has resulted on the four electric railways experimented on, and as high as 24 per cent. on one line, with 35 per cent. under the most favorable conditions. In every case a saving has been shown, even on steep grades.

Mining Matters.

It is reported in Quebec that gold yielding $20 a ton has been discovered near Lorette, Que.

Bonham & Munroe have commenced business as mining brokers with offices in Canada Life Building, Montreal.

A very rich strike of placer gold is reported from Tete Jeune Cache at the headwaters of the Fraser river, B.C.

The Newcastle Coal Co. at Port Morien, C.B., has given a contract for a considerable amount of mining machinery again.

The Crow's Nest Pass Coal Co. turned out 2,000 tons of coke from the oven at Fernie, B.C., in the month of February.

The Crow's Nest Coal Co. has secured the contract to supply the British fleet at Esquimault with coal for the present year.

A letter from A. P. Low, of the Geological Survey staff, which is wintering on Hudson's Bay, confirms previous reports of the existence of deposits of magnetic iron ore on the shores of the bay.

At the annual meeting of the Mining Society of McGill University Dr. Harrington was elected honorary president, Mr. McMillan was elected president, Mr. Cowans, vice-president, and Mr. Archer, secretary-treasurer.

It is stated that work will soon be started upon the erection of a 400-ton smelter at Greenwood, B.C. The capitalization of the company is $400,000, and J. P. Graves, prime mover of the Old Ironsides and Knob Hill, is the promoter.

The following gentlemen are interested in active mica mining near Kingston, Ont.: Kent Bros., bankers; E. H. Smyth, Q.C., I. Franklin, merchant; Mr. Chown, of the Webster Co., Sydenham, and J. L. Gemmill, Perth, Ont.

The zinc mine situated between Rossport and Schreiber on the C.P.R., about twelve miles from the mouth of the Gravel river, which was sold to a Belgian syndicate last year by Jno. McKellar, Fort William, Ont., is shipping freely to Belgium, where it is stated the ore nets almost $40 per ton.

W. C. Caldwell and T. B. Caldwell, accompanied by Arch. Blue, director of the Ontario Bureau of Mines, made a visit to the gold mines at Ardoch, Addington county, Ont., owned by the Boerth Mining Co., Detroit. A boarding house has been erected and some sixty men are at work. Five large furnaces and a pulverizer are used in reducing the ore, which has proved to be rich, assaying from $24 to $160, and $50 to $500 per ton. The mine is situated not far from the Kingston & Pembroke Railway, and is on the Mississippi river.

The lead and zinc deposits in Tudor township, Hastings county, Ont., are beginning to attract attention. The Hollandia and Catharine mines are said to have assayed very heavy values in lead and zinc. This is the first discovery of zinc in Hastings county, although its presence in the mineral belt was referred to about twenty years ago in a paper read by T. Campbell Wallbridge before the Royal Geological Society of London. One of the deposits is only ten miles from Millbridge on the Ontario Junction Railway.

The summer mining class of McGill University, which proved so successful last year, will be continued this year. The party will leave McGill, under Dr. Porter, about the 25th of April and will spend about four weeks in the work. This year they go to the United States and will visit the anthracite mines of Central Pennsylvania. Here they will be able to see some of the largest coal mines in America, and will be able to observe the railway transportation there carried on, as well as the actual mining operations. Exactly what mines will be visited is not yet definitely settled, but invitations have been sent to Dr. Porter from several mines.

Railway Matters.

One thousand freight cars are to be built by the C. A. and O. A. & P. S. Railways this year.

The Central Vermont Railway was bought at auction by a representative of the G.T.Ry., March 21st, for $7,000,000.

G. L. Mattice, Montreal, is engineer-in-charge of construction of the Rutland & Canadian Railway from Aldburgh to Novar Junction.

It is said that the C.P.R. will build a coal wharf and sheds at St. John, N.B., so that it may be in a position to send 200,000 tons of coal per annum to Montreal.

—The judicial enquiry into the composition of the reports on the efficiency tests of the Green's Economizer at the Toronto waterworks main pumping station is proceeding before Judge Macdougall. The city engineer has ended the state of hostilities among the staff at the high level pumping station by discharging the whole staff and appointing Wm. Hall from the main pumping station in charge, and Woodward, of the Niagara Nav. Co., and McKeown, G.T.R., to fill the vacancies.

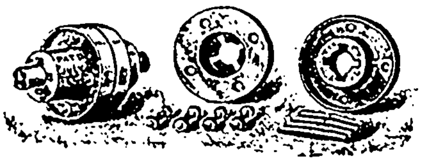
—The provisions of the Ontario Act dealing with the Niagara Power question rushed through by the Government at the end of the session are mainly two. The first provides that the Commissioners of Queen Victoria Niagara Falls Park may, with the approval of the Lieutenant-Governor-in-Council, enter into an agreement with the Canadian Niagara Power Company for the surrender by the latter of its sole right to use the waters of Niagara river within the limits of the park, upon such terms and conditions as to abatement of rent, extension of time for carrying out the agreement of 1892, variation of that contract, etc., and that any arrangement so entered into shall be binding. The second resolution provides, in brief, that the Park Commissioners may enter into contracts with other persons or companies to enable such persons or companies to use the waters of the Niagara within or without the park for power purposes, but it does not add, as in the case of the former resolution, that any such contract is to be binding.

FIRES OF THE MONTH.

March 3rd. J. Stuart's machine shop, Thorold, Ont.; damages, $18,000; insurance, $10,000.——March 12th. Hamilton Radial Railway Co.'s workshop, Hamilton Beach; damages, $5,000; fully insured.——March 22nd. Elliot & Brooks' paper box factory, Adelaide street west, Toronto; damages, $25,000; insurance, $16,000.——March 28th. G. G. Bryant's sash and door factory, Sherbrooke, Que.; insurance amounting to $5,300 will not cover loss.

THE NICHOLSON PATENT FLANGED FACE COMPRESSION SHAFT COUPLING.

The makers of this coupling claim for it that in design, construction and general operation, it more completely meets the requirements of a first-class shaft coupling than any other on the market. In appearance it resembles the ordinary flanged face coupling. The two half castings are bored tapering, and have flanges on rim to cover bolt heads and nuts. The outer faces of hubs are closed almost to shaft by a rib or projection, through which slots are cut to space the jaws a uniform distance apart and hold them in position while coupling is being fixed on the shaft. The steel jaws have double taper, turned to fit bores of castings, and are concaved on their inner



faces a trifle less than the radius of shaft, which makes the grip positive when flanges are drawn up by the bolts. The couplings are fitted so that flanges stand from ⅛ to ¼ of an inch apart when drawn tight with the bolts, thus enabling a trifle larger or smaller size of shaft than gauge to be coupled. Owing to this feature extra couplings may be carried in stock, so that in case of an accident they can be immediately applied to the shafts that have been broken and twisted off, or another shaft may, it is stated, be coupled on without the necessity of key seating the old shaft or making exact measurements to ensure a perfectly tight fit. The Nicholson patent flanged shaft coupling is placed on the market by the Fairbanks Co., Montreal, and is, we are told, being installed by the company in place of less up-to-date appliances.

CANADIAN PATENTS.

The following patents of interest to engineers were issued in January:

No. 62,176.—Electric arc lamp; The British Blahnick Arc Light Co., Westminster, London, England.

No. 62,177.—Rail joint for electric railways; The firm of Ausfuhrungenfur Eisenbahn, Oberban, Abtheilung "Stossfangschienne," Seigm, Eppenstein, of 45 Wilhelmstrasse, Berlin, Germany.

No. 62,181.—Acetylene gas generator; Isidore Therien, Quebec, Que.

No. 62,186.—Acetylene gas generator; Francis Xavier Nadon, Maniwake, Que.

No. 62,194.—Acetylene gas generator; E. J. Dolan, Philadelphia, Pa.

Nos. 62,199, 62,200, 62,201.—Motor; Zdzislav Maevsky, St. Petersburg, Russia.

No. 62,203.—Acetylene gas generator; J. W. Scarth, Pudsley, York, England.

No. 62,207.—Turbine; Jos. Chew, Orillia, Ont.

No. 62,214.—Telephone transmitter; F. A. Ray, Boston.

No. 62,217.—Railway rail joint; T. C. H. Gray, Gray Bridge, Mass.

No. 62,219.—Trolley connection for canal boats; F. J. Shewring, Toronto.

No. 62,224.—Solenoid blow-out for displacing, dispersing, or extinguishing, formed in breaking electric circuits; S. H. Short, Cleveland, O.

No. 62,243.—Drill clutch; W. L. Hirlinger, Luzerne, Penn

No. 62,249.—Device for moving dredging machines; J. W. Pike, Vancouver, B.C.

No. 62,262.—Insulator; E. Renault, Florida, U.S.A.

No. 62,264.—Electric arc lamp; Thos Spencer, Philadelphia, Pennsylvania.

No. 62,269.—Smokeless furnace; Ed. Gessner, No. 60 Krona, Brunn, Austria.

No. 62,278.—Railway tie and clamp; Chas. A. Cole, New York.

No. 62,281.—Acetylene gas making machine; A. Holland, Ottawa, Ont.

No. 62,282.—Acetylene gas lamp; John Zimmerman, Chicago, Ill.

No. 62,283.—Acetylene gas machine; P. H. Mace, Paris, France.

No. 62,293.—Track clearer; James C. Cameron, Montreal.

No. 62,294.—Acetylene gas generator apparatus; Jean A. Plantin, Ottawa, Ont.

No. 62,312.—Motor vehicle; The Prelot Motor Syndicate, Butolph House, Eastcheap, London, England.

No. 62,336.—Electric engine; Marcy Lelland Whitfield, Chicago, Ill.

No. 62,339.—Steel manufacture; Thos. J. Heskett, 50 North Terrace, Adelaide, South Australia.

No. 62,341.—Steam boiler furnace; Geo. N. Robinson, Brooklyn, N.Y.

No. 62,356.—Flat-railed railway; H. L. Stillman, Charlestown, Rhode Island.

No. 62,359.—Car coupler; Philip Hien, Chicago, Ill.

No. 62,361.—Brake shoe; A. J. Allen, Chicago, Ill.

No. 62,377.—Telephone; R. W. Wallace, 21 De Vere Gardens, Kensington, London, England.

No. 62,378.—Furnace grate; Henry Truesdell, Toronto.

No. 62,385.—Heater and radiator; Chas. Ellingsen, Ashby, Minn., U.S.A.

No. 62,389.—Instrument for determining the amount of elongation and compression of railway rails under moving trains; P. H. Dudley, New York, N.Y.

No. 62,390.—Electric track circuit rail joint; Wm. H. Talley, Waco, Texas.

No. 62,392.—Heater; John A. Markle, Birtle, Man.

No. 62,410.—Compound steam engine; Jos. Hardell, Stratford, Ont.

No. 62,416.—Car pushing device; Wm. L. Joy, Toronto.

No. 62,424.—Boiler; Calixte Cauchene, St. Gabriel de Brandon, Que.

No. 62,440.—Telephone number and address: Annunciator; Wm. J. Walsh, Hamilton, Ont.

No. 62,447.—Steam boiler and furnace; Wm. Hopkins, Dubuque, Iowa.

No. 62,449.—Electric railway truck; Geo. J. Capewell, Hartford, Conn.

No. 62,450.—Gas generating process; Samuel H. Wood, Wilmette, Ill.

No. 62,451.—Steam boiler; David Fitzgibbons, Oswego, N.Y.

No. 62,453.—Steam boiler; N. F. Anderson, Hardid, Ill.

No. 62,455.—Steam boiler; R. Hutchinson, Somerville, Mass.

No. 62,456.—Steam boiler; Geo. H. Watson, Chicago, Ill.

No. 62,457.—Boiler; R. W. Innes, Omaha, Neb.,

No. 62,458.—Steam generator; Henry Hening, Paterson, New Jersey.

No. 62,463.—Acetylene gas lamp; Geo. D. Pearson, Montreal, Quebec.

No. 62,464.—Acetylene generator; F. Cortez Wilson, Chicago, Ill.

No. 62,466.—Process of, and apparatus for, the manufacture of metallic carbides.

WANTED—Agents in Montreal and Toronto to push the sale of a high-grade English Leather Machine Belting in the Dominion. Commission only. Apply "X.L.," care of The Canadian Engineer.

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A good Water Power, 500 horse, situated one-half mile from railway, every facility for making siding to power. Address

J. D. THEUNISSON, Cookshire, Que.

Village of Hintonburgh.

TENDERS FOR WATERWORKS

Tenders for constructing a system of waterworks for the Village of Hintonburgh, sealed, and endorsed "Tenders for Waterworks," will be received until noon of Saturday, 15th April, 1899, addressed to W. A. Mason, Esq., Village Clerk, Hintonburgh, Ontario.

Each tender must be accompanied with an accepted bank cheque for an amount equal to five per cent of the amount tendered and made payable to the order of W. A. Mason, Treasurer of the Corporation, which cheque will be forfeited if the contractor declines to enter into a contract when called upon to do so.

The Corporation reserves the right to reject any or all tenders.

Plans and specifications can be seen, and printed specifications and forms of tender obtained at the office of the Clerk, Town Hall, Hintonburgh.

Dated at Hintonburgh this 23rd day of March, 1899.

(Signed) D. H. McLEAN, Reeve.

(Signed) CHARLES H. KEEFER, Consulting Engineer, Ottawa.

The Canadian Engineer

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