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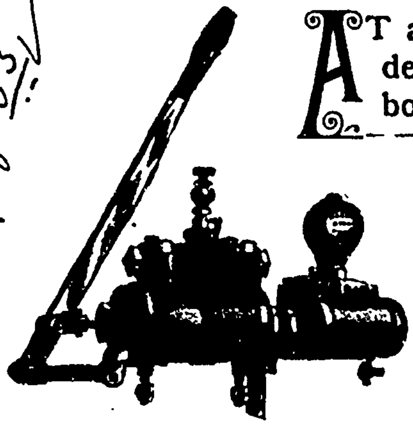
OVER 2,000 MARSH PUMPS SOLD IN THE UNITED STATES DURING 1890



THIS CUT SHOWS SMALLEST SIZE MARSH PUMP, WITH HAND LEVER.

AT a recent test by Prof Cooley, of Michigan University, 48 degrees of temperature was added between condenser and boiler in passing through pump.

Absolute Actuation and Regulation without the use of Tappets, Levers, or other Mechanical Construction.

As the exhaust mingles with feed water and returns to boiler, there is no loss of heat, hence it is the most economical pump in use. For hot or cold water or liquids, with or without Hand Pumping Attachment, NO PUMP EVER MADE THE RECORD OR BECAME SO POPULAR AS THE "MARSH."

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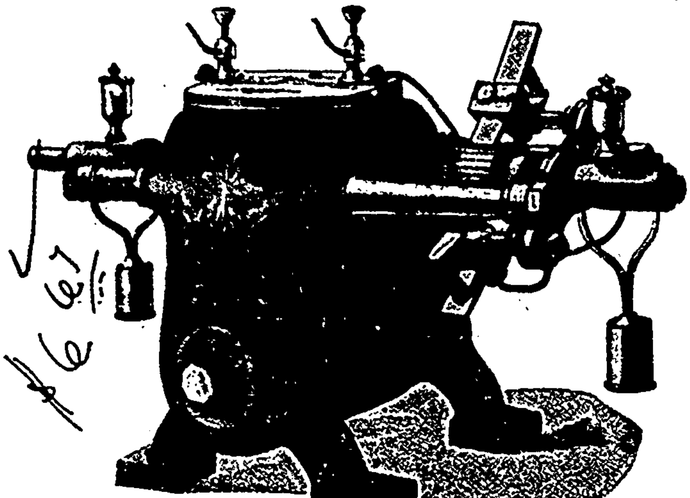

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ELECTRO PLATING MACHINES AND GENERAL ELECTRICAL APPLIANCES. SPECIAL ATTENTION TO MILL AND FACTORY LIGHTING.

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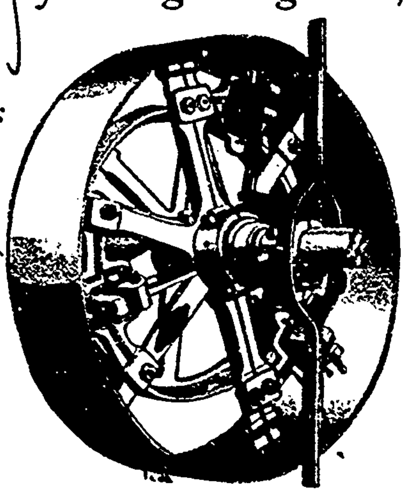
By lifting a tightner, throwing off the heavy belt, or stopping the engine? All of these are objectionable.



We have patented a Friction Grip Pulley, —compact, simple, durable, large frictional area, ample clearance when out of engagement, powerful gripping mechanism.

We guarantee this pulley to work satisfactorily and to be thoroughly reliable.

Made split when required, and with 2, 3, 4, 6 grips for any class of work. Also a Cut-off Coupling of the same design.

Send for circulars and prices.

THE WATEROUS ENGINE WORKS CO., BRANTFORD, CANADA.

CANADIAN

ELECTRICAL NEWS

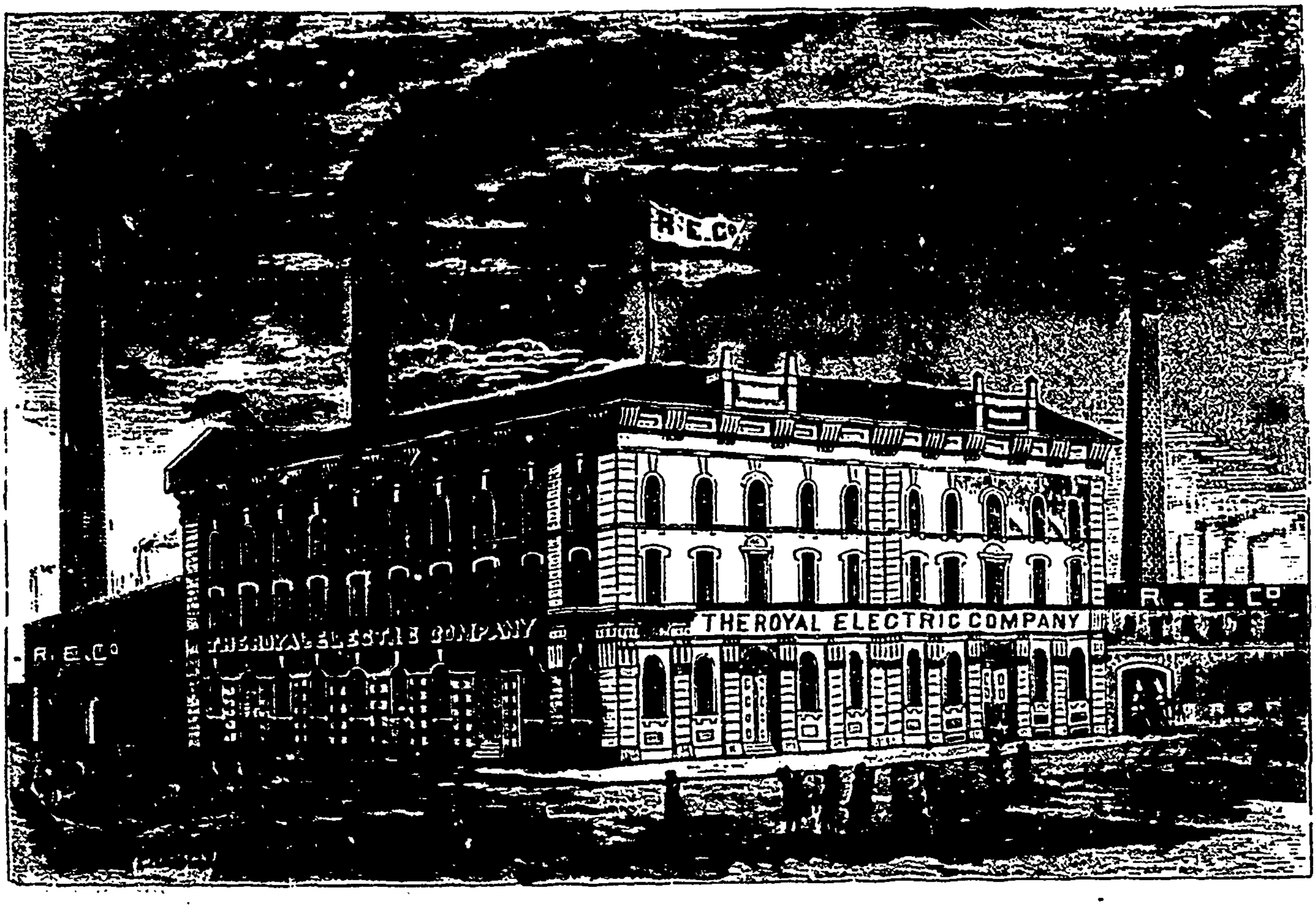
AND

STEAM ENGINEERING JOURNAL.

VOL. I. TORONTO AND MONTREAL, CANADA, MARCH, 1891. NO. 3.

ROYAL ELECTRIC COMPANY.

THE Royal Electric Company, of Montreal, cuts of whose premises, lighting station and testing room appear in this issue, was first started as the Thomson-Houston Company of Canada, in the year 1883, and was afterwards transferred to the American Illuminating Company, which was afterwards re-transferred to the Royal Electric Company, of Montreal, under whose management the largest electrical business in Canada is now being carried on.



The capital stock of the Royal Electric Company was originally $250,000, which has since been all paid up and increased to $350,000. This company manufactures the celebrated Thomson-Houston system of arc lights and the Thomson system of alternating and direct current incandescent lighting, as well as motors, generators, etc., for the transmission of power.

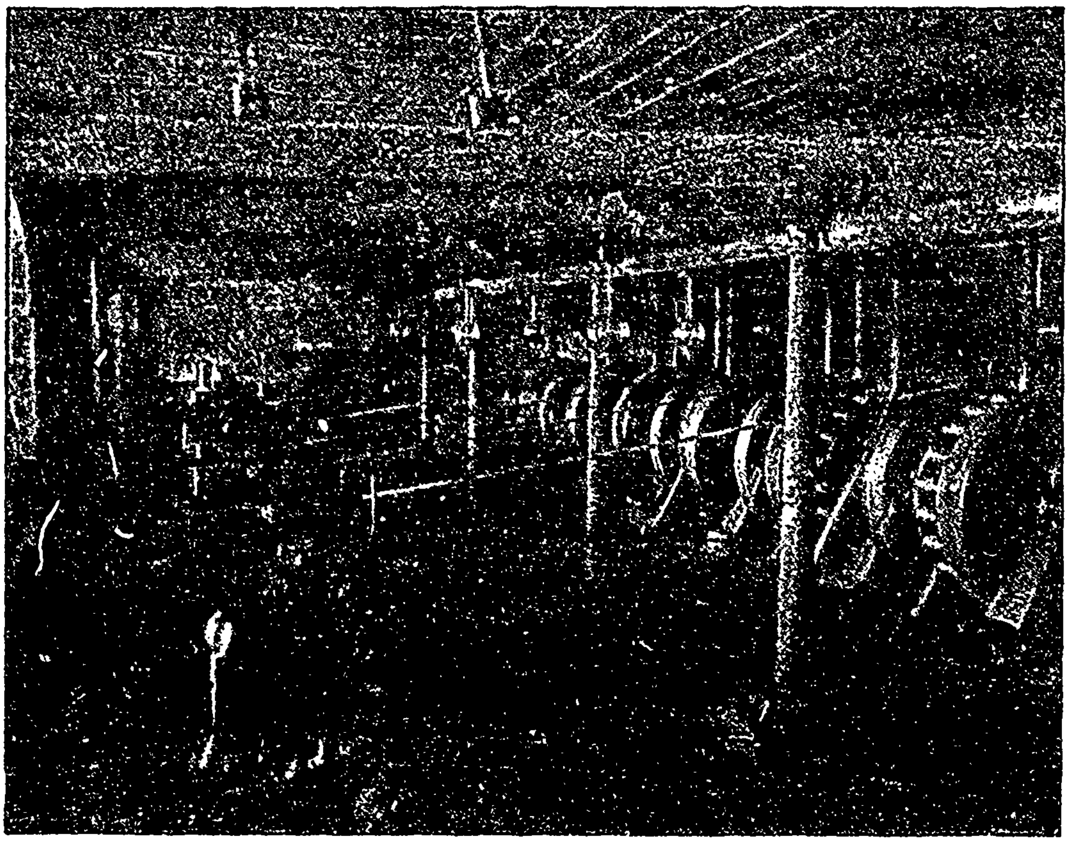
Their business has grown to such magnitude that their present large quarters are too small for the growing demand for goods of their manufacture.

Their sales to outside companies during the fiscal year ending March, 1890, amounted to about $300,000, and for the year ending March, 1891, their sales will have amounted to something like 50 per cent. over last year.

This company confine themselves entirely to the manufacture of electrical apparatus for the trade with the exception of the city of Montreal, which city they light almost exclusively. They have at present running nightly in the streets the equivalent to 1,000 arc lamps, and have two stations for generating the electricity to supply them. The station and factory, of which we show cuts to-day, is situated in Wellington Street, near the Lachine Canal, and during 1890 they erected a large station at Hochelaga, which is one of the finest and best equipped electric light stations in America.

Their steam plant in both these stations aggregates about 2,500 horse power, and the city lighting is so arranged that in case of a conflagration at either station, the city would not suffer, as there is capacity enough at either station to fill the needs of street lighting.

The electrical machinery turned out by this company is so well known that very little is necessary for us to write on the subject. The company have manufactured and have now in operation in the different cities in Canada upwards of 6,000 arc lamps run from central stations and 1,000 run from isolated plants. Although it is now only two years since they started to manufacture incandescent machines, they have upwards of 20,000 incandescent lights run from central stations and 7,500 run from isolated plants. This makes a total of 27,500 incandescent lights, which is a very good record for two years' work. The stock of the company is held almost entirely in the cities of Montreal, Toronto, Quebec, and a few other cities in Canada, and the company is exclusively a Canadian one. The president, the Hon J R Thibaudeau, Senator, is a very efficient officer of the company, and his genial face can be seen almost any day at the head offices on Wellington Street. A great deal of the prosperity of the company is due to his untiring efforts in



ILLUMINATING STATION, ROYAL ELECTRIC COMPANY, MONTREAL.

its behalf. The Board of Directors is composed of representative mercantile gentlemen of Montreal. Mr. W. J. Withall is the vice-president, and Messrs. Geo. R. Robertson, E. A. Small, Wm. Cassils, J. A. L. Strathy and F. L. Beique compose the board. Mr. Hagar, the general manager, has been with the company almost from the start. The other officers are: Mr. H. H. Henshaw, treasurer; Mr. David A. Starr, general agent, and Mr. Fred. Thomson, the chief electrician, who is a brother of Prof. Elihu Thomson, the inventor of the system. The lighting department is under the superintendence of Mr. D. Thomson, with Mr. F. H. Badger as electrician.

The company have a large staff of electrical engineers and experts who are trained and qualified to install their plants and carry out their contracts, and in some cases remain to operate the plants for the local companies who install them.

The staff of machinists and laborers number over 400, and a visit to the factory will repay anyone for his trouble; in fact to anyone interested in any way in electrical machinery, a visit there is a rare treat. The staff is courteous and obliging, and unlike many of the institutions of a similar nature in the United States and elsewhere, there is no difficulty for strangers to gain admission. This factory compares very favorably in equipment with the largest factories in the world, and is the fifth largest establishment of the kind in America.

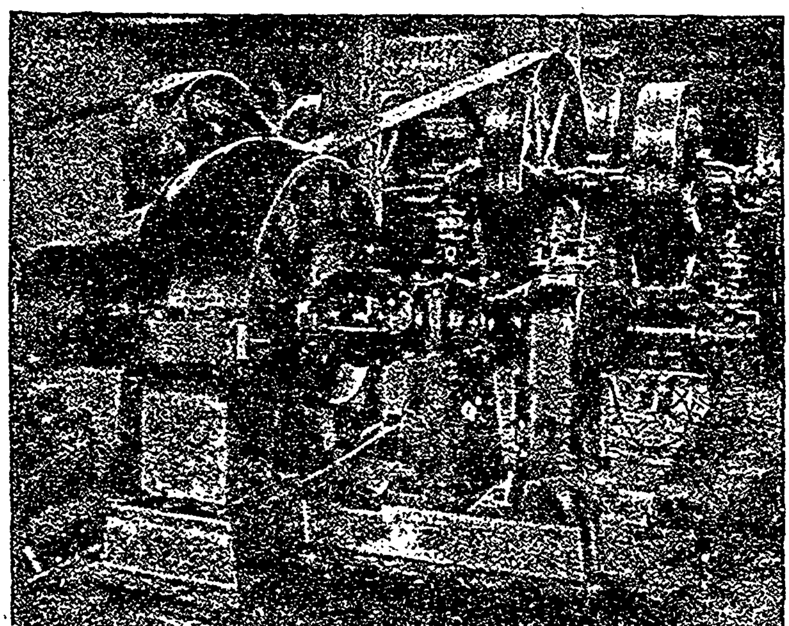
At their works can be seen all classes and sizes of dynamos, from the small fifteen light incandescent dynamo up to the monster 1,500 light alternating machine, which weighs in the vicinity of seven tons. On a recent visit to the establishment, we saw on entering the factory proper, castings for machines of all sizes waiting their turn on the large planing machines.

On ascending to the first storey we enter the tool and stock room, which is by no means the smallest feature in this establishment. Here are seen drills, dies, jigs and all manner of machinists' tools. In the lathe and drill room, which is 125 by 60 feet, the entire space is taken up by lathes of all descriptions, drills, from the light and sensitive one to the large radial, small planers, stamping presses and other appliances necessary for machine work. In a large room adjoining this are the cutters and large ovens, where armatures, transformers and kindred articles are baked. In the flat above this is a large space seventy five by sixty feet where the brass workers and finishers are. Here we see many more lathes and other machinery. In a room adjoining this is the carpenter shop. Here are all the large patterns, wood-turning machinery, circular saws and carpenters' benches.

The lamp and transformer testing room is well worth a visit. The arc lamp rack accommodates 100 lamps, and the immense incandescent lamp racks cover the whole side of one wall. The armature winding room is another very interesting department to the visitor, all descriptions of armatures, from the smallest incandescent up to the largest arc and alternating, are wound here.

The chief electrician has his own "den" and laboratory on this flat. His shelves are replete with all the latest periodicals and books on the subject of electricity. His stock of testing instruments is one of the largest in America. The list of these expensive articles is too numerous to chronicle here.

On the fourth storey is situated the wire covering department,



TESTING ROOM, ROYAL ELECTRIC COMPANY, MONTREAL.

where there are forty different machines for covering wire of all sizes with all sorts of covering and insulation. The company have covered an immense quantity of wire within the last two years, which has been used almost entirely by themselves and in their installations. The offices are situated on the ground flat, and the rest of the building, which covers in the vicinity of 60,000 square feet, is taken up by two large stations.

The great success which has attended the efforts of this company to supply the public with first-class electric light apparatus has been mainly due to the superiority of their system, and that they keep in view the fact that any inferior work will reflect discredit on the apparatus. Their business has grown to such an extent that they contemplate an early removal to larger and more extensive premises. We wish them every success in their undertakings, and may their efforts continue to be crowned with success.

ENGINEERS' COMPETITION.

THE publisher of the ELECTRICAL NEWS invites engineers throughout Canada to compete for the solution of the following problems:

1. What is a horse power as applied to a boiler?

2. How much is gained if feed water can be had at 120° temperature instead of 40°?

3. With water at 40° fed into the boilers, and steam taken off at 90 lbs. pressure, how much coal should be required for each thousand gallons of water used?

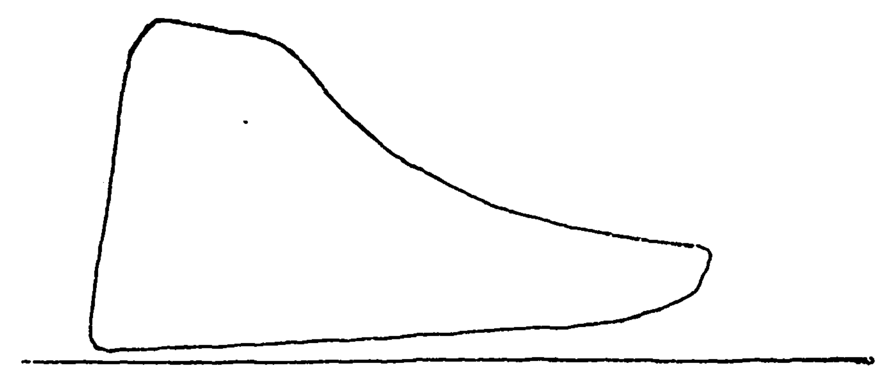
4. What would be the safe working pressure for a horizontal tubular boiler, 64 in. diam., 14 feet long, with 90 tubes, 3 in. diam., shell made of 60,000 lbs. steel plates ⅜ in. thick, and double rivetted in longitudinal seams?

5. Give size of furnace for soft coal for such a boiler, and size of smoke pipe, and area and height of chimney for a range of six boilers of same dimension?

6. An engine has cylinder 18 in. diam. and 18 in. stroke, and makes 240 revolutions per minute. Steam is supplied at 90 lbs. pressure in boilers, 30 feet away. What size should steam pipe be?

7. With steam cut off in above engine at ⅙ of the stroke, and discharged into a heater open to the atmosphere, what horse power can be got?

8. If a condenser be added, maintaining a vacuum of 26 in. on the gauge at the condenser, what *additional* power could be got from engine?



9. What difference to the amount of fuel per horse power per hour should there be between above engine using a heater giving water at 190° and using a condenser, maintaining a vacuum of 26 in., and supplying feed water at 100°?

10. If engine speed varied while the pressure of steam and load were constant, what should be done to remedy the defect?

11. In a high speed automatic cut-off engine, what is the effect of the weight of the reciprocating parts on the steadiness of motion?

12. The duty of the governor is said to be to regulate the speed; upon what conditions does its power to regulate depend?

13. What are the advantages of "compression" in the steam cylinder?

14. Describe the defects in the annexed diagram, and state what should be done to remedy them.

Cash prizes of $15 and $10 respectively will be paid to the competitors whose answers to the above questions shall be found by the judges to be deserving of the highest number of marks, and who shall have complied with the undermentioned conditions.

CONDITIONS OF COMPETITION.

1st. Competition is open only to subscribers to this journal actually engaged in the charge of steam boilers or engines within the Dominion of Canada.

2nd. Answers must be received at the office of the ELECTRICAL NEWS, not later than April 15th, marked "Engineers' Competition."

3rd. The answers will be judged and marked by points, in accordance with the merits of each.

4. Allowance will be made for neatness of writing, etc., as well as for correctness of answers.

5th. As a guarantee that answers are from the men intended, each competitor must send with his paper the name and address of his employer.

Messrs. Geo. C. Robb, Chief Engineer of the Boiler Inspection and Insurance Co., Toronto, and Mr. A. M. Wickens, ex-President Toronto Branch No. 1, Canadian Association of Stationary Engineers, have kindly consented to act as judges in this competition, and their decision will be final.

PUBLICATIONS.

We have been favored by Messrs. F. E. Dixon & Co., manufacturers of leather belting, Toronto, with a copy of "Dixon's Leather Belting Hand-Book," which contains a considerable amount of information of various kinds of value to users of belting.

KEEP YOUR BOILERS CLEAN.

A STEAM boiler is a vessel in which water and heat are mixed in order to make steam. Heat is produced by means of combustion of fuel of some kind in a furnace and is made to bear upon one side of the metal plate forming the boiler, while the water is on the other side. The heat passes through the metal, and entering the water, raises the temperature as observed by an ordinary thermometer. When a temperature of 212° Fahr. is reached, particles of steam are formed, and appear as small globules in the water. These steam globules are formed in some parts of the boiler long before the whole mass of water has reached 212°, and attempt to rise up through the water to the surface, but until the water is hot enough not to condense them as they rise, they cannot reach the surface and no steam is formed.

As the temperature rises within the boiler, currents are induced, the colder water going down and the hotter rising up. These currents will continue so long as steam is being made, hence in designing any steam boiler provision should always be made for the descent of colder water as well as for the ascent of hotter water and the globules of steam.

There are two practical difficulties that interfere with the steam-making powers of boilers. The first is, that in burning the fuel the boiler plates and flues become coated with dust and tarry deposits, which, being poor conductors of heat, prevent it from entering the metal as freely as it otherwise would. The careful and skillful engineer in charge of steam boilers knows this difficulty and regularly cleans out the tubes and sweeps or scrapes the dust and other deposit from every part of the heating surface of the boiler. Any one who neglects to keep the boilers under his charge clean in the tubes and heating surfaces gives plain proof either of ignorance of his business or of indolence; and an ignorant and lazy man should be anywhere else than in charge of steam boilers. The other difficulty is the formation of scale and deposit inside the boiler. It is easier to know this trouble than to find a cure for it. Boiler purgers, scale solvents, sediment preventers, have been made and patented and sold by the thousands and yet scale forms inside, even in the best regulated boilers, when certain kinds of water have to be used. Every true engineer knows that the more scale and dirt inside the boiler, the more heat goes up the chimney, and the less the steam made out of the coal burned.

The best "scale solvent" and "feed water purifier" combined, but not patented, is an honest, intelligent engineer who will regularly open up his boilers and clean them. He may or may not use purger or a "scale preventer," but he will know how to get the scale off or prevent it getting on, so as to make the most of the coal burned.

Every engineer should pride himself on the cleanliness of his boilers, both inside and outside, and in having an ash-heap with nothing in it but ashes.

Every boiler owner is not competent to judge whether or not his engineer is cleaning the boilers properly and keeping them in good condition, but let any man find unburnt coal and clinkers forming the main part of the ash-heap, and he will not, as a rule, be far astray if he concludes that it is time he had a better engineer.

PERSONAL.

Our thanks are tendered to the publishers of the *Electrical World* for a copy of the Bulletin issued by them at the National Electric Light Convention.

Two chemists are reported to be experimenting at Freeport, Pa., with the object of producing carbon points for electric lighting from natural gas. It is said that by burning the gas in a specially prepared furnace pure carbon is obtained, but as yet at a cost too great for practical purposes.

SAFETY VALVES—THEIR HISTORY, ANTECEDENTS, INVENTION AND CALCULATION.

By William Barnet Le Van.

Continued from January Number.

VALVES.

THE bellows was probably the first instrument of which they formed a part. No other machine equally ancient can be pointed out in which they were required. That the bellows is of antediluvian origin, there can be little doubt, for neither Tubal-Cain nor any of his pupils could have reduced and wrought iron without it.

Strabo attributes the bellows to Anacharis, who lived about 600 years B. C. Pliny (B. vii., 56), attributes it to the fabled Cyclops of Greek mythology. The prophet Jeremiah, who lived long before Anacharsis, speaks of it in connection with metallurgical operations. "The bellows are burned, the lead is consumed of the fire; the founder melted in vain." Isaiah, who lived still earlier, namely, in the eighth century, B. C., alludes to the blacksmith's bellows. "The smith that bloweth the coals in the fire." Job, nine or ten centuries before the Scythian flourished, speaks of the blast furnace as common. "They gather silver, and brass, and iron, and lead, and tin, into the midst of the furnace, to *blow the fire* upon it to melt it." Homer, as might be supposed, could not fully describe the labor of Vulcan without referring to this instrument. His account of the great mechanical work is equally descriptive of a smith and his forge of the present day.

> "Obscure in smoke, his forges flaming round,
> While bathed in sweat from fire he blew,
> And puffing loud, the roaring bellows blew.
>
> Just as the gods direct, now loud, now low,
> They raise a tempest, or they gently blow."
>
> [*Iliad*, xviii. 435, 545. *Pope.*

The most important improvement on the primitive bellows, or bag, was the admission of air by a *separate* opening—a contrivance that led to the invention of the *valve*, one of the most essential elements of steam or water, as well as pneumatic, machinery. The first approach to the ordinary valve was a device that is still common in the bellows of some African tribes. A bag formed of the skin of a goat, has a reed attached to it to convey the blast to the fire, and the part which covered the neck of the animal is left open for the admission of air. This part is *gathered up* in the hand when the bag is compressed, and opened when it is distended. (Ewbank's Hydraulics, 235).

The principle of the *valve* has always been in use for a variety of purposes. Doors are *valves*, and were so named by the ancients. Those of the private apartments of Juno were contrived by Vulcan to close of themselves. Thus, Homer sings:

> "Touched with a secret key, the doors unfold,
> Self-closed behind her shuts the valve of gold."
>
> [*Iliad*, xiv.

It is probable that all valves were originally in the form of doors; that is, mere flaps or clacks moving on a hinge, and either lying horizontally, like a trap-door; inclined, like some of our cellar doors; opening vertically, as an ordinary door; or suspended by hinges, from the upper edge; and sometimes they consisted of two leaves like folding doors. Examples of all these are still common. Isis was represented by the ancient Egyptians with "the key of the sluices of the Nile" in her hand, the instrument by which the doors or valves, like the locks in our canals were opened and closed.

The most ancient musical wind instruments known in the Eastern world are provided with valves, as the primitive bag-pipes, and the Chinese variation of this instrument, which Toreen describes as consisting of "a hemisphere to which thirteen or fourteen pipes are applied and catching the air blown into it by valves." The pastorial flute of Pan, from its expressing thirty-two parts, he supposes to have been of a similar construction, (Osbeck's Voyage, ii. 248). Valves were, of course, employed in the organs of Jubal, as well as in the bellows belonging to his celebrated brother, and other antediluvian blacksmiths. The ninth problem of the *Spiritalia* relates to valves. Conical metallic valves were used by Ctesibius, of Alexandria, one of the most eminent mathematicians and mechanicians of antiquity, in the construction of *clepsydræ*. (Instruments used by the Greeks and Romans, for measuring time by the gradual discharge of water from a large vessel through a minute perforation in the bottom).

The spindle valve, or such as have a long shank to prevent their rising too high, and guiding them when descending, is said to be of French origin.

EARLY SAFETY VALVES.

The liability of alembics and stills to burst, led the old chemists to apply plugs to the openings in these vessels, that the vapor might raise or dry them out and escape ere the pressure exceeded the strength of the vessels. In old works on distilling, conical plugs, or valves, are shown as fitted into cavities on the top of boilers, and, in some cases, were loaded. In the *Maison Rustique de Maistres Charles Estienne et Jean Liebault, Docteurs en Medecine* (Paris, 1574), are figures of two *close* boilers, in which the distilling vessels were heated; one formed a water, and the other a vapor, bath. On the top of each is a conical valve, opening upwards. These served both to let out the superfluous steam and to introduce water. Glauber, who contributed several valuable additions to the mechanical department of chemistry, has figured and described in his "Treatise on Philosophical Furnaces," the modes by which he prevented glass retorts or stills from being burst by the vapor. A long stopple, or conical valve, was fitted to the neck of each, being ground air-tight to its seat, and loaded with a "cap of lead," so that, when the steam became "high," it slightly raised the valve, and a portion escaped. The valve then closed again of itself, "being pressed down with the leaden cap, and so stopped close." English translation, London, 1651, page 306). The safety valve on Newcomen's first engine was of this description.

The above safety valve is now known as a "positive safety valve," the valve as now made being flat, conical, or spherical, thus exposing a greatly increased area when opened. This is a meritorious feature, as the experiments of Baldwin, Richardson, Adams, and numerous safety-valve makers have proven. In these, the weight is either placed directly above or below the valve, and acts without the aid of levers.

In the same work, Glauber describes the most philosophical of all safety valves—namely, a column of mercury enclosed in a bent tube, which communicates with the boiler or still, somewhat like the modern mercurial guage. He also describes that beautiful modification of it known among chemists as the "water lute," or "quicksilver lute," which is made as follows: Around the mouth or neck of a vessel, a deep cavity is formed and partly filled with water or mercury, as the case may be. A cylindrical vessel, opened at the top and closed at the bottom, form the cover; it is inverted, the open end being placed in the cavity and dipping as far into the liquid as the internal pressure may require. In "The Art of Distillation; or, A Treatise of the Choicest Spagyrical Experiments," etc., by John French, Doctor of Physic, London, 1651, the author describes the same devices for preventing the explosion of vessels as those mentioned by Glauber. Speaking of the action of such safety valves, he observes: "Upon the top of a stopple [valve] there may be fastened some lead, that if the spirit be too strong, it will only heave up the stopple and let it fall down again."

LEVER SAFETY VALVE.

The common lever safety valve was invented by a Frenchman, Solomon Decaus, and was improved by Denis Papin. Through the influence of the celebrated Boyle, whom he assisted in his experiments with the air pump, Papin was elected a Fellow of the British Royal Society in December, 1680. He was an active and useful member, and contributed several interesting papers to the society's transactions. In 1861 he invented a method of softening bones, with a view to extract nourishing food from them—namely, by submitting them to the action of steam at high temperatures (pressure), in close vessels named *digesters*.

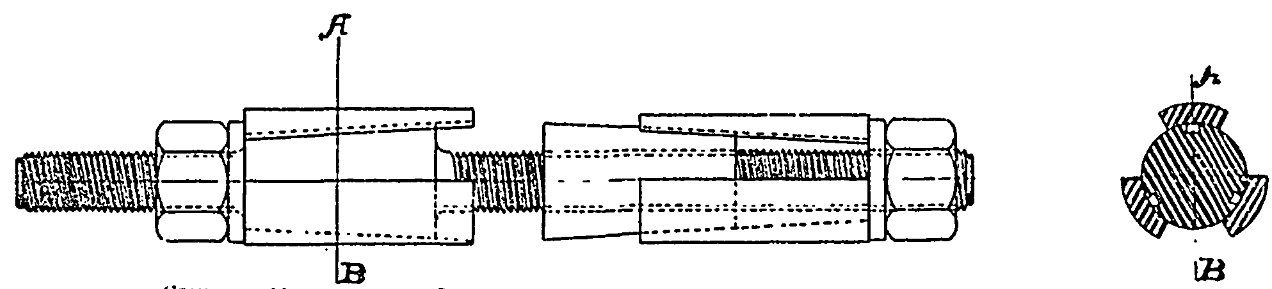
Papin's first digesters were liable to be rent asunder by the high pressure of steam accummulating in them when in place on the fire with their orifices stopped. They are shown in detail in Poliniere's "Experience de Physique," second edition, Paris, 1718. Each consisted of a short but very thick tube, of bell metal, about a foot in length and five inches in diameter, with one end closed. The open end had a collar cast on it, to which the cap or cover was secured by clamps and a screw. The cover and end of the tube were ground together, so as to fit air-tight, like a valve to its seat. A few bones and a little water were put in, and the cover screwed down; the vessel was then laid in a horizontal position on a bed of charcoal in a long iron grate. The almost unavoidable rupture of these vessels, led Papin to the invention of the common lever safety valve, which he first applied to them, and afterwards to machines for raising water by steam.

(To be Continued.)

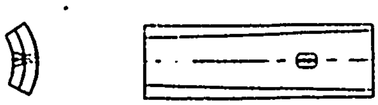
DUBRULE'S EXPANDING MANDREL.

THE accompanying sketch illustrates some improvements in an expanding mandrel, which were patented in Canada Oct. 6th, 1890, by J. D. O. Dubrule The patent has also been granted in the United States.

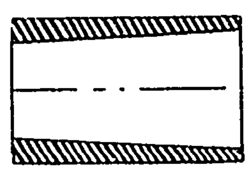
The drawing shows a double ended mandrel with one solid and one adjustable cone Each cone is of the same diameter, and intended to be used on a long slieve, bushing, or any hole that might be cored in the centre. They are also made single ended, viz., with one solid core. This mandrel overcomes the necessity of hammering the ends and burring up the centres, for by screwing up the nuts it forces the wedges up the cone, thus causing them to expand, and tightening the work on as securely as desired without injury to the mandrel. To loosen off the work, it is only necessary to unscrew the nut, and draw off the work, which will never jam sufficient to require heavy hammering.



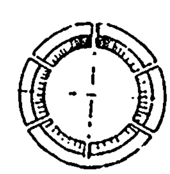
COMPLETE MANDREL, WITH ONE SOLID AND ONE ADJUSTABLE CONE.



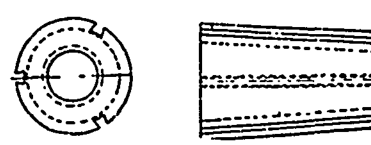
WEDGE.



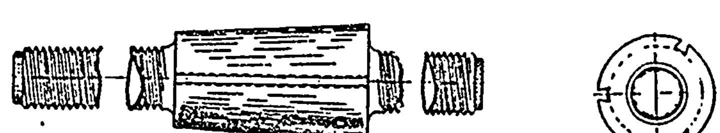
TURNED BUSH IN SECTION.



END VIEW OF BUSH, CUT IN SEGMENTS.



ADJUSTABLE CONE.



MANDREL WITH SOLID CONE.

The wedges are held in place on the mandrel by a pin fitted to a dovetail slot, cut the whole length of the cone, with a pin driven in at one end to keep the wedges from falling off, while the nut serves the same purpose at the other end. Thus there is no danger of any of the parts being lost. The wedges are segments of a steel bushing turned inside to fit the cone and turned parallel outside. The three wedges are cut from the same bush, therefore are perfectly true with each other.

The mandrel has been thoroughly tested and found to turn out perfect work, with a great saving of time. These mandrels are made to any specified sizes. The cones can be made any desired length, and tapered to take a larger or smaller range of holes, can also be made any length over all, to suit the machine over which they are to be used. Any further particulars may be obtained by applying to J. D. O. Dubrule, 206 Champlain Street, Montreal.

According to *Le Genie Civil*, a French machine tool builder, M. Burot, of Angouleme, is turning out paper pulleys for power transmission, based on the principle of the paper car wheel. The pulleys have metal hubs and arms, on which the soft paper is melted and then compressed. After drying the paper pulley is treated in a bath of linseed oil and resin, to give it greater resistance against the influence of moisture. The pulleys are said to be very light and of low price, and to have given excellent results in practice.

WANTS TO BE PUT ON THE LIST.

MR. Wm. A. Sweet, of Hamilton, Ont., writes: "I hereby tender you my thanks for having sent me the two first numbers of the ELECTRICAL NEWS, and wish your journal the greatest prosperity. I have found some useful articles in it, and you may mark me as another of your subscribers."

CANADA FIRST.

MR A. Marshall, in forwarding his subscription to the ELECTRICAL NEWS, writes. "I am very well pleased with your paper, and think it will take well in Hamilton. I am sure that by lowering your price you will receive more subscribers. I will do all that I can to uphold our Canadian paper, which gives us home news. I am pleased to see that you are affording the opportunity to engineers to show how much they know about engineering. I wish you every success."

RUBBER BELTING RULES.

Q. What are the rules for estimating horse power, thickness, width, and speed of three-ply rubber belts say 7-32 of an inch thick, the lacing being single leather?

A. 1. The cross section in square inches needed is equal to 155.46 times the horse power, divided by the speed in feet per minute.

2. The horse power is equal to the cross section in square inches, times the velocity in feet per minute, divided by 156.46.

3. The speed in feet per minute is equal to 156.46 times the horse power, divided by the cross section in square inches.

4. The width is got by dividing the cross section by thickness.

5. The thickness is got by dividing the cross section by the width.

Examples under the following rules are herewith given so as to show more clearly their simplicity and the method of using them:

Q. How fast would a ten inch rubber belt 7-32 inch thick have to travel to carry 100 horse power, if it wrapped 135 degrees on a cast iron pulley and was fastened with single leather lacing?

A. 156.46 × 100 ÷ 70-32 = 15646. × 16-35 = 7152 feet. (impracticable.)

Q. What is the horse power of a ten inch three-ply rubber belt, 7-38 inch thick, running 3,000 feet per minute on a cast iron pulley; the arc of contact being 135 degrees and the fastenings single leather?

A. 70-32 × 3,000 ÷ 156.46 = 6562.5 ÷ 156.46 = 41.94 horse power

Q. What cross section of rubber belt would be required to drive 100 horse power at 3,000 feet per minute, with 135 degrees contact on a cast iron pulley, the fastenings being single leather?

A. 155.46 × 100 = 3000 = 5.182 sq. inches.—*Power and Transmission.*

HAMILTON, Ont., Feb. 18th, 1891.

Editor ELECTRICAL NEWS

DEAR SIR, —Seeing by your paper that efforts are being made to establish a Canadian Electric Light Association, I beg to state that you can count on me as being an active supporter of any such movement, and as being ready to assist in any way that lies in my power.

I remain, yours very truly,

W. J. CLARKE.

KIND WORDS FROM BRANTFORD.

BRANTFORD, Feb. 16th, 1891.

Editor ELECTRICAL NEWS.

SIR,—I am in receipt of first two issues of the ELECTRICAL NEWS and I must say it is interesting and instructive. The dynamo is fast finding its way into our factories, and every engineer interested in his calling should connect himself with a source from which he can obtain the necessary knowledge to qualify him to take charge of electrical machinery in connection with steam plant.

Wishing the NEWS success, and trusting it will receive the support it so justly deserves,

Yours truly, ARTHUR AMES.

TORONTO, Feb. 16th, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR, I beg to call your attention to question 7 in "Enquirer's Competition." The question reads "With steam cut off at 1/6 inch of stroke." Should it not be one sixth (1/6) of stroke?

Also in the first number of your paper, in the article on "Care and Management of Dynamo Electric Machinery," it reads. "If it (commutator) should get rough from the electric spark, it is necessary to smooth it by pressing a block of wood with fine emerycloth covered against it." Now, as emery is a conductor, if any of it should get between the segments of the commutator it would cause trouble by short circuiting. The best thing to use for this purpose is No. 00 glass or sand paper, as it will do the work well if used once or twice a week, and being a non-conductor, will cause no trouble. I am of the opinion that emery might get someone into a hole.

I was glad to see you talk "business" to the storage battery man. Now, then, if he has such eternal faith in his accumulators, let him come out with them and take up your offer. Will he? Yours truly,

SAFETY.

[Our correspondent has rightly surmised that the insertion of the word "inch" between the words "one-sixth" and "stroke" was an error.—ED. E. NEWS.]

MERITS OF STORAGE BATTERIES.

MONTREAL, Feb. 5th, 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—Noting your remarks *re* storage batteries, and Mr. Roberts' reply thereto, perhaps I may be allowed to ask a few further questions:

1st. Has Mr. Roberts reduced the weight of his cells under those of other manufacturers in any way? Judging from what I have seen of it, in comparison with others, it looks heavier on the average. Is this weight not a serious drawback to the general adoption of any system of storage battery traction?

2nd. Mr. R. states his plates do not buckle? Is this an experimentally proved fact, as I note his plates have very thin centres and much heavier edges.

3rd. Is it not so that owing to the peculiar style of plate adopted by him, that through use there will be insufficient contact between the paste and the metal grid?

I admit my experience is limited in practice, having only handled a few E. P. S., and other cells, but have made considerable study of different types. I do not wish to advertise any maker in particular, but have found in my experience that, in so far as storage batteries go, the Julien, if not in the lead, are certainly not far in the rear.

To *guarantee* any storage cell unless the care of same be entrusted to one of the firm's own experts, seems to me to be risking considerable, as it is well known that storage cells need more than ordinary care in their manipulation. Storage batteries as they are to-day will require to undergo great modifications before becoming a thoroughly useful and economical article, although I admit they are a convenient source of power in many ways.

Mr. R. has modified things a little perhaps, and changed the form, whether for better or worse remains to be proven, but the fact remains that he has made no great radical change in them from what they are and have been for some time past.

Yours very truly,

"ACCUMULATOR."

MERITS OF THE STORAGE BATTERY.

HAMILTON, Ont., Feb. 27th, 1890.

Editor ELECTRICAL NEWS.

DEAR SIR, A letter over the signature of Wm. Roberts calls for an explanation on our part, otherwise we might be considered dangerous to have any communication with. We do not lay claim to that magnetic or even electric power to run or even overthrow a mind that has such confidence in its ability to supersede all other systems, and with one stroke throw in the background all other investigators.

When in another place, in the letter referred to, the assertion is made that statements regarding new storage batteries are worthless, we would ask: How long has the one in question been in actual use? Will the writer of that epistle state where and when and under whose care the plate spoken of has been in constant use and travel for two years?

We are not speaking disparagingly of the storage battery in question, or any other. Our motto is "Live and let live," but when Mr. Roberts assumes to be the originator of storage batteries, and states that what he has done can or may be improved upon by others, let us ask the question. Did he not in the construction of his battery try to improve on what had been solved long ago?

The facts of the case in regard to the offer of car, track and motor for a test in Hamilton, was a mutual agreement between our company and the Roberts Storage Battery Company, our company to furnish motor and their's the batteries, and together to share the expense of the other equipment of the car. We had the motor ready and were prepared to carry out our part of the agreement. As to why it was not carried out, you have the statement of Mr. Roberts. We have ample testimony and evidence that our part of the contract would have been successful. The other parties to the agreement, according to their letter, will demonstrate to you very soon their ability to carry out their part, which we sincerely trust will be successful.

Trusting we have not encroached on too much of your valuable space, as we have no desire for controversy,

We are, yours truly,

KAY ELECTRIC WORKS.

ELECTRIC LIGHT INSPECTION.

WINNIPEG, Feb. 11th, 1891.

Editor ELECTRICAL NEWS.

SIR,—I cannot agree with your editorial article on the inspection of electric light. I consider it just as necessary for the consumer who agrees to pay a certain price for a 16 c. p. light to be satisfied that he gets what he pays for, as it is for the consumer who buys a pound of sugar to be able to know that he is getting a pound of sugar.

You say "the owner offers to a storekeeper or a business man his electric light and asks for it a price commensurate to its size or the hours used, so much per light per month, and nobody is compelled to take it." That is true. But the canvasser gets the consumer to sign a contract to take the light for a year, and agrees to supply him with 15, 24 or 32 c. p. lights, as the case may be, at a stated price; but the question is, does the consumer get what he pays for? I know that very frequently he does not. Very often he only gets a 10 c. p. light when he pays for a 16. The greatest electrical experts state that in the course of their experiments they find that the light given by nominal 16 c. p. lamps varies from 8 c. p. to 16 c. p. But how can the consumer prove that his lamps are not 16 c. p.? Again, if he has to pay by the meter, the meter is set to figure one hour for one hour's burning of a so-called 16 c. p. lamp, but there is no certainty that he has been given a 16 c. p. light; in fact, it may be only 10 c. p. light, yet the meter will register one hour's burning of that 16 c. p. Then, how is a consumer to know that those chemical deposit meters register and and are computed correctly? I know one instance where the consumer refused to pay, and he kept account of the lights and number of hours used, and the company accepted half of the bill they had rendered.

What is wanted is an inspector to see that so called 16 c. p. lamps actually give 16 c. p. light, and also to test meters and prove that they register the actual number of hours that a 16 c. p. light burns correctly. That is what is done with gas consumers. The inspector sees that 16 c. p. gas is supplied, and tests the gas meters to ascertain that the amount used is correctly registered. I consider that any electrician who opposes such an inspection is the worst opponent of his business, as thereby he would lead the public to infer that it was only by fraud and deception that it could compete against gas.

The far better plan is to force those companies who now palm off 10 c. p. lights for 16 c. p. to give an actual 16 c. p. light, and compete fairly against those who supply honest light either in gas or electricity.

Yours, etc.,

WM. BATHGATE,

Man.-Director Manitoba Electric and Gas Light Co.

QUERIES AND ANSWERS.

Editor ELECTRICAL NEWS.

SIR, – Please tell me where I may obtain works treating on the management of electric machines, lamps and devices. Your paper helps me considerably, but I wish something simple, which a person with common school education can understand. Would also like to get a book describing use of electric measuring instruments. Wishing success to your enterprise, I am,

Yours sincerely,

A DYNAMO TENDER.

[Our correspondent may obtain catalogues of such books as he requires, together with prices, by addressing "The Electrician" Publishing Company, 1, 2 and 3 Salisbury Court, Fleet St., London, E. C.; the W. J. Johnston Company, *Times* Building, New York City, or H. E. Hafferkorn, Milwaukee, Wis.

A DIFFICULT PROBLEM.

QUEBEC, Feb., 1891.

Editor ELECTRICAL NEWS.

DEAR SIR,—Encouraged by your kindly invitation to propound questions, the answers to which may be of scientific interest, and reminded by the locomotive boiler explosion, an engraving of which appears in the last number of the *Scientific American*, that I am still without an answer to a question I propounded at the time in relation to a similar occurrence in Quebec some years ago, I now beg to renew the query.

From what height must a portion of boiler plate (one quarter inch thick, some fifteen feet in area, and therefore weighing about 150 lbs.), torn from an exploded stationary steam boiler and launched into the air, have fallen to have been found by me standing upright in a log of white pine timber twenty-four inches square, into which it had penetrated to a depth of fourteen inches, almost exactly at right angles to the grain of the log.

The base of the parabola described by the missile did not exceed 100 feet. The ragged piece of plate had been blown out almost to a plane by the force of the explosion, and must have descended in an almost vertical direction, as that in which it would meet with the least resistance from the retarding atmosphere, or in a plane parallel to the falling leg of the parabola, whatever its position may have have been in the ascending branch of the course.

If it be considered that a good man with all his might could hardly drive the sharp edge of an axe into a stick of timber, across the grain, to more than half an inch, it will be admitted that the blunt-edged piece of plate alluded to must have descended from an immense height, thus to imbed itself to such a depth as fourteen inches in a log of two feet in breadth.

This occurrence took place at Archer's steam mills at Sillery Cove, some five miles from the city, killing the engineer in charge; and it was on the occasion of my appearing before the coroner's jury that I visited the premises immediately after the accident.

C. BAILLAIRGE,

City Engineer, Quebec.

[The reply to the above enquiry will be found in our editorial pages.—ED. ELECTRICAL NEWS.]

POSSIBILITIES IN ENGINE ECONOMY.

SPEAKING of economy in railway management, the *Railway Master Mechanic* says that very careful and long-conducted investigation into railroad accounts have shown to the officials of at least one railway system, that the most important single item wherein saving may be effected is to be found in the coal bill. If the same investigation could be made into the accounts of the average stationary steam power plant, the same conclusion would doubtless be reached, and for the same reason, because the item of fuel is the largest item in the expense account of the power plant. Economy in manufacturing processes in all lines of manufacture is carefully studied and the utilization of waste products, the odds and ends of raw material, is looked after sharply, but it is not every manufacturer or owner of a power plant that looks after the economy of the engine and boiler rooms. In fact, except in scattering individual instances it may be questioned if the possibility of economy in this direction is much thought of after the first selection of the plant. If there is any thought of economizing in this direction it generally takes the shape of cutting down wages paid to engineers and firemen, on the principle that the amount of coal and supplies is a fixed thing, no matter who is in charge. It is, however, gratifying to note that in some quarters there is a growing appreciation of the economy of employing competent men at good wages. It will generally be found in such cases that the higher wages paid carry with them a holding of the engineer responsible in a large measure for the economical working of the plant. Engineers are therefore interested in studying the possibilities of economy in the plants under their charge, and if they take hold of the subject in earnest they will find the study an interesting one.

In considering this subject, if the engineer will make it a home question he will find it to branch into two directions. The first question that naturally arises is whether the plant as it is at present, can, by more careful management, be run with less fuel, less supplies, less stoppages, and fewer breakdowns and repairs. The engineer must be more than ordinarily careful, if he does not find where, by closer watching and more careful study of his plant, he can improve its operation. It may be in the firing, it may be in the adjustment of the engine valves, it may be in the lubricators, or in any one of the minor details of the plant. When, and only when, he is sure that he has done all that he can do with the plant as it is, should he consider the second branch of the question, and ask what can be added, what changes should be made, and what should be thrown out and replaced by new. There are doubtless thousands of plants in which worn and leaky boilers and wasteful engines could be replaced at a steady profit to the owner, but until the engineer has made a study of the plant, and can back up his requests by strong arguments, he cannot hope to have much attention.

In considering what is possible in the way of economy in any plant the engine must have some standard of comparison. If he is running an ordinary tubular boiler he should know that such boilers when properly set and fired have evaporated eight, nine or possibly more pounds of water per pound of coal. If he finds that he is only evaporating five or six, he has before him the problem of how to make the boiler do eight or more. The boiler may be full of scale, the setting may not be right for the fuel, the chimney or stack may be too small, but so long as he is not doing as well as he knows can be done he has a fruitful subject for study and experiment. So if he is running an engine which takes 35 pounds of water per inch horse-power per hour, and, other engines of same kind have done the same work with 30 pounds, he should know why, and better the record if in his power. It is not necessary for him to waste time in speculating on what point of perfection the steam plant of the future may reach. His individual plant is the one that requires his attention, and its possibilities in economy his careful study. There are two extremes to be considered: first, the certain amount of power that must be delivered; second, the coal pile. All between is intermediate, and every attention to detail that will reduce waste and increase efficiency will, with the same power delivered, lessen the drain on the coal pile. Leaky boilers, unprotected or leaky steam pipes, too tightly packed stuffing boxes, bearings poorly oiled or too snugly fitted, poor firing, dirty boilers, all these cost fuel and fuel costs money. The possibilities of economy in these directions are a most proper subject of study on the part of the engineer who has an ambition to rank high in his calling.

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EDITOR'S ANNOUNCEMENTS.

Correspondence is invited upon all topics coming legitimately within the scope of this journal

A CONTEMPTIBLE practice resorted to by some journals that lay claim to respectability is to print the original articles of contemporaries without giving proper credit. The *Western Electrician* of Chicago, in a recent issue, publishes the editorial from this journal on the subject of a Canadian Electrical Association, with the introduction "A Canadian exchange says." Our contemporary is evidently more deeply impressed with the advertising value of its columns than with a sense of what constitutes just treatment of others.

FOR the information of those who feel an interest in the success of the NEWS, we desire to state that the results thus far achieved are entirely satisfactory. The number of subscribers received during the last month is gratifyingly large, and betokens a list of healthy proportions in the near future. It is a pleasure to note the careful interest with which the paper is read, and the commencement already made by subscribers in the direction of using its columns for the expression of their opinions. With co-operation on the part of our friends we hope to make each successive number increasingly valuable.

IF the storage battery as now constructed ever comes into general use, there is one point that must not be lost sight of, and that is the risk of explosion. Do not start, gentle reader, but calmly look into the thing. There is no mysterious inherent danger in the storage cell *per se*, but just a plain everyday blow-up. The reason is this. During the charging process a considerable amount of gas is liberated, and if the cells are located in a confined space, or even a small room, if there are cells enough, the contained air soon becomes charged with the requisite quantity of gas to make a very pretty demonstration on the introduction of the necessary spark or match to inaugurate the proceedings. Moral: Ventilate the apartment in which you keep your storage batteries while in process of charging.

WE are glad to see that our friends of the Edison Company have decided to abandon their "fly on the wheel" policy of condemning everything electrical that had an E.M.F. of over 220 volts, and have come squarely out with a 50 light arc machine which must necessarily employ an electromotive force of at least two thousand. Verily, the world moves. A year or two ago and Thomas A. would have held up his hand in holy horror at the mention of such a sacrilege, but we fully expect in the near future to hear that he has exploited a full-fledged alternator, "with all that the name implies. The philanthropist Brown will now have to take a seat in the rear, or else hunt for fresh fields and pastures new. Time is a great avenger, though we see nothing derogatory to the company in all this. They simply are enterprising enough to recognize the advancement of public opinion in the matter, and put themselves in a position to supply the popular demand.

WE congratulate Mr. Albert J. Corriveau that, as the result of persistent effort on his part, the city of Montreal has been selected for the summer convention of the National Electric Light Association. The Association will no doubt feel like congratulating itself after the convention is over upon the wisdom of its choice. Montreal is not only a city of much interest in itself, but it is so situated as to afford visitors easy access to many outside points of interest. There is no reason to doubt that every needful preparation will be made to render the visit of the association both pleasant and profitable. The result of the gathering upon electric interests in Canada cannot be other than highly beneficial. We quite agree with Mr. Corriveau in the opinion that the event should stimulate our people to organize a purely Canadian association. Every Canadian interested in electricity should endeavor to attend this convention, observe the lines upon which the National Association is working to advance electrical interests in the United States, and seek to be of assistance in applying the knowledge thus gained to the advantage of the industry in Canada.

MOST people can look after their enemies themselves, but require to be saved from their friends. We are moved to make this remark by the action of a company engaged in an electrical manufacturing enterprise in this province, who have recently offered to furnish a small municipality with eight or ten electric lights for eleven cents per night each. They know well that it is impossible to make any profit at a price like this, and must therefore depend on unloading the plant on some unsuspecting party by means of representations that, to say the least of it, economize very much in the matter of truth. The harm done does not stop here, for this false price is bandied about and quoted by municipal busybodies and others as a genuine thing, and strikes at the very root of the industry which it should be the province of these manufacturers to foster. The field is large enough and the business sufficiently progressive to provide ample scope for legitimate enterprise without the necessity of resorting to a cut-throat policy which must only end in disaster to those engaged in it. Legitimate competition on fair and honest lines is all right, and is usually considered to be the life of trade, but when it involves the necessity of some unsuspecting purchaser being made the victim, it is time to draw the line. All who are interested in electrical enterprise and development should unite in condemning this injudicious depreciation of values, which it is of the most vital interest to themselves should be maintained.

WE print in this issue a letter from the manager of a combined electric light and gas company, taking exception somewhat to our remarks on electric light inspection. We have pleasure in giving space to the communication, though we are afraid our correspondent is looking at the matter more especially from the standpoint of the gas department. If a consumer foolishly signs a contract for a year to take his pork in the original package without examination, it is only what is accomplished every day by oily-tongued and unscrupulous salesmen. If men are to be protected from their own foolishness it would require a government inspector at every man's door to keep watch and ward. If *light* were a monopoly, and could only be obtained from one source, a paternal government might properly interfere to regulate its distribution, but as in this enlightened age there are various sources from which it may be obtained, it may safely be left to take care of itself. The ordinary laws of business competition will regulate both its price and quality. The doctrine of "the survival of the fittest" will apply in this as in all things else, and the instance our correspondent mentions of the customer keeping track of his light and the company being compelled to accept only what was right, completely bears out the position we took. The customer probably told the company in effect that "this business is too thin, and if you don't come down off your horse, I will go back to the gas people," and down they came accordingly. Precisely what we said. The government inspector would have been completely *de trop* in this transaction, and if any short-sighted people have signed a contract for a year, why, the year will soon have expired, and then our Winnipeg friend may rest assured that the best and cheapest light will undoubtedly take front rank without any assistance from Her Most Gracious Majesty or any of her minions.

THE drum armature will have to go. Of course all manufacturers make armatures that "never burn out"--at least their's do not, it is only the "other fellow's." Users of dynamos must therefore come to the conclusion that it is the "other fellow's" armatures that they have got, for the burning out process comes around pretty regular. This much being admitted, that will be the most successful machine that in case of accident admits of easy repair. The superposed coils of the Siemens wound or drum armature make it an expensive affair. It is usually the inner coil, or the one next the core, that gets into trouble, either by making contact with the core itself or by reason of undue heating by not having an equal chance with the outer coils to radiate its self-generated heat. When the inner coil goes it necessitates the unwinding of the whole armature to get at the trouble, and the expense of complete re-winding. The ring or Gramme armature, on the contrary, admits of any particular coil being unwound and replaced without disturbing the rest, and is for that reason an advance on its competitor. But the Gramme ring armature that is constructed with a sectional core, admitting of a coil being taken out and a new one inserted entire, has claims to superiority that will enforce recognition. The drum armature, like the memorable deacon's one-horse shay, may be constructed according to the nicest calculations, and the durability of its different components figured down fine, but the fact remains that when it does go it goes all over, and the unfortunate manipulator thereof is left with a wreck as total as that which overtook the deacon's masterpiece. The owners of electric plants of every description will agree with us that the makers of fireproof armatures had better go out and take in their signs. There is no reason why a dynamo should be exempt from the influence of wear and tear, or should be any less liable to accident or decay than any other creation of man's hand. This being admitted, the armature that is repaired at the least expenditure of time and money, when in the ordinary course of human events it has become necessary to do so, will be the one to attain the greatest degree of popularity with the electricians.

THERE have been in use in the large cities of the United States for some time various systems of automatic fire-alarm for stores, warehouses, etc. Some of these are now being brought forward in this country, and it is usual for the insurance companies to make some inducement to their clients when they are employed. When the alarm gong is located in the room or residence of an employee or some person connected with the concern, they would no doubt serve a useful purpose. It has been the practice in some cases to connect the building by means of a wire with the nearest fire station, but such a method cannot be too strongly deprecated. To do this it is necessary to sneak a wire over house tops or by some similarly devious route. This wire is liable to be a continual trouble. On the one hand, too much reliance may be placed on its being in order, and necessary vigilance in other directions relaxed, when through some cause it is incapable of transmitting a signal, and on the other, a false signal may be sent in, causing the brigade a run for nothing. This would not be of much moment except for the fact that some day a genuine alarm might be sent in, and on account of the previous cries of "wolf" when there was no wolf, a fatal amount of credulity might be attached to the warning. A preferable plan would be to place a continuous ringing gong on the outside of the house itself to call the attention of all and sundry to the fact that something was wrong within. The action of the sun on a flat roof has frequently been the means of sending in an alarm of fire when the thermostats have been closely adjusted, and if they are not closely adjusted, a fire might make considerable headway before notice was given. The proposal to connect these thermostats with the nearest fire alarm box to spring the alarm from the box, cannot be too strongly condemned. The less complication there is about a city fire alarm system the better, and the more likely it is to remain in working order when actually needed. The automatic fire alarm is good in its place, and might frequently be the means of saving a large amount of property, but keep it separate from the municipal system by all means.

A CORRESPONDENT writes that after a boiler explosion he found a piece of boiler plate one quarter of an inch thick and weighing about 150 pounds, which had fallen almost perpendicularly on a log of square timber twenty-four inches thick, with such force that the plate had imbedded itself into the log for fourteen inches, and that across the grain. He asks from what height must it have fallen in order to have such force stored in it as to cut a channel across the grain twenty-four inches wide and fourteen inches deep with a cutting edge one-quarter inch thick. It would be almost impossible to calculate the force necessary to make such a cut without making some experiments in order to form a sound basis for the calculation. However, some idea of the force may be formed in another way. We may assume that when the boiler exploded there was not less than eighty lbs. pressure shewn on the steam gauge. The sudden rupture of the boiler would permit its contents to escape into the atmosphere. Experiments in the flow of steam have shown that steam at eighty lbs. pressure will flow into the atmosphere through a safety valve at a rate equal to a velocity of 1,456 feet per second. This being the case, it is not unlikely that the piece of boiler plate started on its upward flight with an initial velocity not less than 1,000 feet per second. Leaving out of account the resistance of the air, a body projected vertically into the air at such a velocity would go up three miles before it stopped and began to fall. If we allow one-third of the force to be absorbed by the friction of the air, it would ascend two miles and then begin to fall. Again deducting the one-third for friction of the air while descending, the plate would strike the log with a velocity of nearly 550 feet per second. This velocity of a body of 150 pounds weight would be approximately represented by a pressure of 700,000 pounds on the surface of the log. The surface struck by the plate would be twenty-four inches by one-quarter inch, making six square inches, and the force of the blow would therefore have been about 116,600 lbs. per square inch, and we need not wonder that the log was cut to a depth of fourteen inches before all the energy was expended.

WITH the expiration of the year eighteen hundred and ninety closes the first decade of the existence of the electric lighting industry. Its marvellous growth has been unexampled in the history of invention and the adaptation of Nature's forces to the requirements of the higher civilization of the human race. While it has taken centuries for the evolution and development of its ally, the steam engine, from the crude and cumbrous machinery of Newcomen and Lavery, through the intermediate researches and improvements of Watt and Stephenson to the magnificent results attained by the triple and quadruple expansion machines of to-day, but ten short years have elapsed since the electric light commenced to become a factor in the commercial world. Now many millions of capital and some of the most brilliant intellects of the age, together with thousands of intelligent workers, are engaged in the industry. And it appears to us that the threshold has but scarcely been crossed, and as the vista of unlimited possibilities opens up more widely the nearer it is approached, it requires not a prophet's skill to foretell that the termination of another decade will have in store for us further developments of the industry of which until recently we have scarcely dared to dream. The magnificent possibilities that may arise from the theorizing of Hertz on the line of the identification of electricity with the etheric waves of light, the adoption of electricity in the manipulation of metals throughout the whole range of the mechanic arts, from the smelting furnace to the delicate finish of the most costly and elaborate piece of jewelry, after the manner of melting and uniting similar and dissimilar metallic substances by the process originated and elaborated by Professor Thomson, of Lynn; and the adaptation of electricity as a transmitting agent for the power required in the operation of railroad trains with greater speed and safety, are all within measureable distance of the production of grander results than have even yet been attained. Ten years ago the pioneer manipulator of the electric light machine was to the uninitiated looked on as being molded of superior clay, now the mysterious apparatus is handled by the mechanic in almost every mill and machine shop in the land, and while the more abstruse problems of the science may still be confined to the "upper tendom" of its votaries, they are very rapidly becoming the property of the rank and file of the army of workers, and it will not be long before every intelligent mechanic will understand the principles that underlie the manifestation of the force he will be frequently called upon to handle. Magnificent as have been the realizations of the past, we are on the threshold of still greater developments to-day. And we say to all who are interested in electrical enterprises—keep abreast of the best that is doing, and be prepared to sieze the golden opportunity that will come with the further developments of this marvellous science.

FIRST ANNUAL DINNER OF MONTREAL BRANCH C. A. S. E.

THIS event, which had been looked forward to with pleasant anticipation by Montreal engineers, took place at the Hotel Riendeau, in that city, on the evening of February 14th. The members and guests numbered fifty-three, with the genial president of the association, Mr. Geo. Hunt, presiding. Letters of regret were read from A. E. Edkins and A. M. Wickens, president and past president respectively of the Toronto branch of the association, his worship the Mayor, Prof. McLeod, Mr. Champagne, city boiler inspector.

On the tables, in addition to the choice viands which formed the subjects for discussion during the earlier part of the evening, were displayed, as appropriate emblems of the occasion, models of engines, indicators, injectors, steam gauges, whistles, etc.

On the removal of the cloth, Mr. T. Regan briefly reviewed the progress of the association since its organization in 1885. The membership had largely increased, and it was gratifying to see present some of the original charter members. The principal object for which the association exists, namely, to improve the efficiency of its members, was dwelt upon.

Mr. Thos. Clark responded on behalf of "The Brotherhood of Locomotive Engineers," and in doing so said that under the rules of that organization none but competent men could obtain certificates.

Mr. Walter Laurie responded for "Mechanica and Steam Engineering," pointing out many of the improvements made during the past half century.

"The Manufacturing Interests" were ably represented by Mr. Hugh Vallance.

Mr E C Robinson, of the Royal Electric Co., and Mr. J. Mortimer, of the ELECTRICAL NEWS, had a few words to say in response to the toast of "Electrical Engineering."

The President, in proposing the toast "The License and Inspection Law," said it was the duty of every engineer to see that his boilers were regularly inspected and repaired. Had there existed an inspection act for the province similar to the measure in operation in the city, the recent explosion at Quebec, with its terrible consequences, would probably not have occurred.

Mr. Samuel Fisher responded to the toast.

"The Canadian Association of Stationary Engineers," "Our Guests," and "The Press" were all duly honored.

At intervals during the evening a pleasant variation in the program was introduced by Messrs. Donnen, Buckle and Hunt singing some capital songs.

The evening throughout was one of solid enjoyment, intermingled with not a little profit. An excellent commencement has been made in the direction of an annual reunion which will doubtless be found among the bright spots of the future.

The Kerr Engine Company has succeeded the firm of Kerr Bros., engine builders, at Walkerville, Ont.

MR. GEORGE HUNT.

THE subject of this sketch was born in the town of Whitehaven, in the North of Scotland, some thirty-two years ago. He was brought to Canada when a young lad and put to work in a machine shop, but working in a machine shop was not congenial to his tastes. He decided to adopt the profession of stationary engineering, so went into the boiler room as fireman.

That his experience, mechanical skill and reliability have been appreciated, is evidenced by the fact that he is now chief engineer of the Royal Electric Light Co.'s plant, which is the largest steam plant in the City of Montreal. His position is no sinecure—he is a very busy man.

He has a sturdy, methodical thoroughness about him, an unflinching devotion to duty which can be seen as he sits in his cosy office receiving the reports from his subordinates and attending to the duties which devolve upon the chief of a great plant. He is married, is revered by his loving wife and family, honored and looked up to by his brother engineers and members of Montreal No. 1 Canadian Association Stationary Engineers, of which he has the honor to be President. He is rugged, honest and true in every fibre, a magnificent specimen of old British oak.

Mr. Hunt loves his steam engine indicator, and to see him at his best is when he is indicating an engine, explaining to his brother engineers the lines on the indicator card—showing those who are not so well posted the admission line, the steam line, the cut-off, the expansion curve, etc. He well deserves to have prospered, being an honor to his profession and the country of his adoption.

MR. GEORGE HUNT.

TORONTO BRANCH NO. 1, C.A.S.E.

At the last regular meeting of the above Association, after a long discussion, the following resolutions were unanimously adopted:

Resolved, That the city of Toronto absolutely requires more pumping capacity at once, and any further delay in providing it will be a dangerous and unwarranted risk.

Resolved, That Lake Ontario is the natural reservoir for the city of Toronto, and with suitable modern pumping machinery will be the cheapest and best place from which to procure water for all purposes.

The principal points brought out were the probability of accidents to the present pumping plant during the summer months, thus causing a water famine; also that the rapidity with which the city is growing demands that some measure should be taken at once to procure the necessary machinery to insure a bountiful supply of *pure* water.

The following resolution was also adopted:

Resolved, That in view of the many boiler explosions that have occurred so recently in the Dominion of Canada, with their attendant loss of life and property, the Governments at Ottawa and Toronto be memorialized to pass some measure under which boilers may be operated with safety.

A joint stock company is being incorporated at Kamloops, B.C., to operate the electric light plant recently established there.

Messrs D. W. Clark & Sons are putting a new seventy horse power steel boiler in their electric light works at Carleton, N B.

In describing a visit to Logelbach the home of Mr Hirn a writer in *Industries* refers to an arrangement for superheating steam in an engine which has been in use for forty years. This plan of Mr. Hirn's was one of the first put to the test and practically applied, is still always in use, and is considered to give a greater economy of feed-water than the steam jacket. The amount of superheating is about 140 Fah. The superheating apparatus consists of a series of pipes, and is invisible, as it is placed toward the end of the boiler where the hot gases play constantly over its surface. This method involves no additional expenditure of fuel or labor The mere fact that the superheating arrangement has been in constant operation for so many years, without more detriment to the valves, gear, etc., than is incidental to any engine when at work, proves that the system is of real practical advantage, and deserves more attention than it has hitherto received.

SPARKS.

The Royal Electric Company have this week shipped a complete outfit, consisting of a 300 light alternating dynamo, steam engine, boiler and complete electric equipment, to Moose Jaw, N.W.T.

The large new building of Messrs. Morgan & Campany, of Montreal, which is to be a second "Wannamakers," is now being equipped by the Royal Electric Company with the necessary boilers, dynamos, etc.

The Montreal Water Power Company have been granted incorporation for the purpose of constructing and operating water and electric light systems throughout the province. The capital stock is $2,000,000, and the names of the directorate are: Messrs. Thos. J. Drummond, Raymond Prefontaine, R. White, Geo. E. Drummond and James T. McCall, Montreal; John F. Moffett, Watertown, N.Y.; H. C. Hodgkins and Charles T. Moffett, Syracuse; Emily C. A. Woltman, J. V. Clark and George T. Keith, New York.

The Standard Electric Company, of Ottawa, which has recently been formed, propose going very extensively into incandescent electric lighting and power. This company was organized last week with the Hon. E. H. Bronson, M.P.P., president; Mr. Pattee, vice-president; Mr. C. Berkely Powell, managing director; Mr. J. Bronson, sec.-treasurer; Mr. C. H. Mackintosh, M.P., and Mr. Perley, directors. The capital stock is $500,000. The company have closed a contract with the Royal Electric Company, of Montreal, for all their dynamos, generators, motors, etc. They propose installing from 12,000 to 15,000 incandescent lights and about 500 horse power during the coming year. This is one of the largest contracts ever made by one company in Canada.

THE STREET CAR HORSE AND THE ELECTRIC CAR.

I'm the happiest horse in town to-night!
  I go with flying feet!
For I have seen the gladdest sight
  Way up in north Yonge street.
And what it means I know full well,
  And when I've said my say,
Down where I dwell at the Horse-Hotel,
  There will never a horse say "neigh."

I know I'm right; and now for the sight
  At the C. P. crossing I saw—
A street car with a brilliant light,
  But never a horse to draw.
It rolled along, now fast, now slow,
  Steady and straight on the track;
But what makes it go, I'm sure I don't know—
  There was no horse, front or back.

It looked like the other cars in town
  Yet there is something strange, I feel:
To-night I saw, on looking down,
  The lightning under the wheel.
I heard things out of the common rule—
  Strange words I never knew;
Yet I'm not a fool, I've been to school
  To Mister Bartholomew.

I'm simply a slave; but my freedom is won;
  The thought thrills through my soul!
If without a horse one car can run
  Why cannot two hundred roll?
I am tied to the track, one day from my back
  The harness will drop at my feet,
And I shall be free, no work then for me
  On the track of the stony street.

With a sniff and a snort and a toss of my head
  And a flirt of my flying feet,
I will take my bones from the pavement stones
  To the country soft and sweet!
And day and night I shall owe my flight,
  The joys I there shall meet,
And my freedom bright, to the strange, strange sight,
  That I saw in north Yonge-street.

—Toronto *World*.

BRITISH COLUMBIA MARINE ENGINEERS' ASSOCIATION.

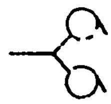
MR. W. P. LINDLEY, Secretary of the British Columbia Marine Engineers' Association, writes, enclosing subscription on behalf of that organization, a copy of the constitution and by-laws under which its proceedings are conducted, and a copy of the first annual report. From the latter we learn that since the association was organized a year ago, its growth has been satisfactory beyond the brightest anticipations of its promoters. Starting with a few engineers employed on the steamers sailing from the port of Victoria, B.C., which is the association's headquarters, it has added member after member, until at present the membership numbers upwards of 90. The association is endeavouring to demonstrate to the public that membership in the association is a guarantee of ability and good character. This is working on right lines, and leaves little room to doubt that the association has a long and useful career awaiting it. The members are comfortably housed at No. 76 Yates Street, with a snug balance in the treasury. The officers for the current year are: James A. McArthur, president; William Steele, 1st vice-president; Alex. M. Fraser, 2nd vice-president; P. M. Butler, treasurer, and W. P. Lindley, secretary. We are sure the older organizations in the East will join the NEWS in wishing this young and energetic association continued success.

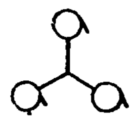
CALCULATING SIZES OF WIRES.†

PLANS AND SYMBOLS.—When the wire contractor has decided upon the general system to be followed in running wires and in locating switches and cut-outs, he should make a general plan. This plan should show the location of each incandescent outlet with the number of lamps, and give in each case the distance from the dynamo or main dristributing point. The following symbols are generally used in such a plan:

 Sixteen candle power lamp without key.

 Sixteen candle power lamp with key.

 Two-arm bracket with key-holders.

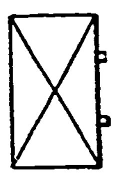
 Three-light chandelier with key-holder.

 Ten candle power lamp.

Thirty-two candle power lamp.

 Wall switch.

 Safety plug.

 Dynamo.

DROP OF POTENTIAL AND LOSS OF ENERGY.—If a current of constant strength is passing through a circuit of uniform resistance, the potential will fall uniformly.

A B, Fig. 1, represents a wire of uniform thickness, marked off into 10 equal parts. If the potential or e.m.f. between *A* and

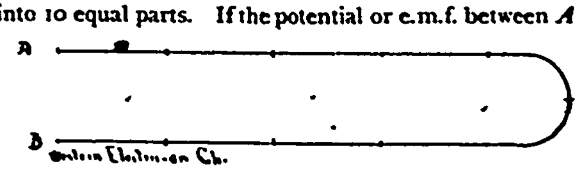


FIG. 1.—FALL OF POTENTIAL ALONG A CIRCUIT.

B measures 100 volts, the e.m.f. measured at the terminals of each of the equal divisions will be $\frac{100}{10} = 10$ volts.

If the circuit offers uneven resistances to the passage of the current the potential will fall unevenly; and it will be found it will fall most rapidly through that part of the circuit which offers the greatest resistance. In fact, the fall of potential in any part of a circuit is in every case proportional to the resistance of that part of the circuit.

A C and *B D*, Fig. 2, are conductors of 10 ohms' resistance each. *C D* is an incandescent filament of 180 ohms resistance hot.*

The total resistance of the circuit would be 10+180+10=200 ohms, or in other words, 20 ohms or 10 per cent. is represented in the conductor and 90 per cent. in the lamp.

Assuming the e. m. f. between *A* and *B* to be 100 volts, 10 per cent. or 10 volts will be lost in overcoming the resistance of the conductors and 90 per cent. or 90 volts will be expended in the lamps. The loss in the wire of course is not desired, but is a necessary evil, hence the resistance of the wire conductors might be termed the wasteful resistance, and the resistance offered by the lamp as the useful resistance.

* NOTE.—In these calculations the resistance of an incandescent lamp is assumed as that of the carbon filament when hot. Carbon filaments when cold are of much higher resistance than when hot.

† From "Incandescent Wiring Hand-Book."

The percentage of the total potential which is wasted in the conductors is called the "Drop of Potential," or briefly the "drop."

As the loss of energy for the same current strength in any particular case is proportional to the "drop," it is correct to speak of the "percentage of energy" lost in the conductors. In

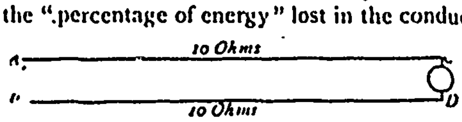


FIG. 2.—DISTRIBUTION OF RESISTANCES AND POTENTIALS.

the last example we may therefore say either that there is a 10 per cent. drop, or that 10 per cent. of the energy is lost in the conductors.

Electrical energy may be found by multiplying the current in amperes by the e. m. f. in volts. According to Ohm's law $C = \frac{E}{R}$ or using the figures of the last example, $C = \frac{100}{200} = \frac{1}{2}$ ampere. If we now multiply ½ by the e. m. f. we get the energy in watts: $\frac{1}{2} \times 90 = 45$ watts, the energy expended in the lamp: $\frac{1}{2} \times 10 = 5$ watts, the energy lost in the conductors. We see that 5 watts form 10 per cent. of the total energy of 50 watts, and that therefore 10 per cent. of the energy is lost in the conductors.

It may now be readily understood how the sizes of wires for certain percentages of loss may be determined. Let us take 100 lamps of 180 ohms' resistance each. The total resistance of these lamps, joined in multiple, is $\frac{180}{100}$, or 1.8 ohms.

The problem is to lose 10 per cent. of energy in the conductors; in Fig. 3, 1.8 ohms represent then 90 per cent. of the *total* resistance, which includes lamps and conductors. The total resistance of lamps + conductors is therefore $\frac{1.8 \times 100}{90} = 2$ ohms and the resistance of the conductors $= \frac{2}{10}$ or .2 ohms. Suppose the distance from dynamo to lamps 500 feet, the whole length of the circuit is 1,000 feet. The problem is now to determine the size of a copper wire whose resistance for 1,000 feet of length

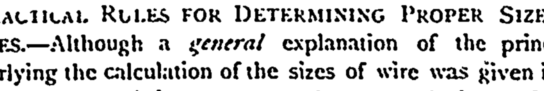


FIG. 3.—DISTRIBUTION OF RESISTANCES AND POTENTIALS.

is .2 ohm. We may use Table II. In column No. 11 the resistances of copper wire per 1,000 feet are given. The nearest number to .2 in that column is found to be .205, which corresponds to No. 3 B. & S. wire. This is the required size of the wire.

PRACTICAL RULES FOR DETERMINING PROPER SIZES OF WIRES.—Although a *general* explanation of the principles underlying the calculation of the sizes of wire was given in the previous chapter, it is necessary to have *practical* rules for this purpose—rules which will enable us to determine the size of wire without the aid of a table.

The resistance of a unit wire, *i. e.*, a pure copper wire 1 foot long and 1 circular mil in cross-section, measured at 75° Fahrenheit, is 10.79 ohms.

Suppose in Fig. 4 *a* represents the unit wire; *b* a wire of the same cross-section (one circular mil) but 2 feet long. If the resistance of *a* is 10.79 ohms, it is obvious that the resistance of

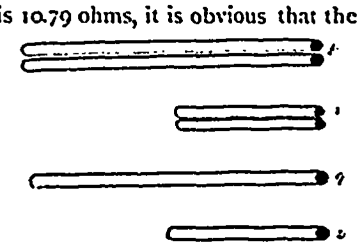


FIG. 4.—RESISTANCES OF WIRES.

b will be twice that of *a*. Let us assume farther that *c* is a cable 1 foot long and of two circular mils cross-section. Its resistance naturally will be ½ that of *a*. Suppose *d* is a cable 2 feet long and of two circular mils cross-section, its resistance will then be equal to *a*. This demonstration leads us to the first rule:

Rule 1. The resistance of a copper wire is equal to its length in feet multiplied by 10.79, and divided by its cross-section in circular mils.

We may write this rule in symbols thus:

$$R = \frac{10.79 \times L}{d^2}$$

in which R is the resistance in ohms, L the length of wire in feet, and d^2 the square of the diameter in mils.

We can also write the formula thus: $d^2 = \frac{10.79 \times L}{R}$ from which we may deduce:

Rule 2. The cross-section of a copper wire in circular mils is found by multiplying 10.79 by its length in feet and dividing the result by its resistance in ohms.

Example.—Find the cross-section of a wire 1,000 feet long and of a resistance of 100 ohms.

$$d^2 = \frac{10.79 \times 1000}{100} = 107.9 \text{ circular mils.}$$

In incandescent wiring, however, the resistance of this wire is a certain percentage of the total resistance of conductors and lamps.

The total resistance of a certain number of lamps joined in multiple arc is found by:

Rule 3. The total resistance of lamps in multiple arc is found by dividing the resistance of one lamp when hot by the number of lamps.

We may also write this as a formula thus:

$$\text{Total } R = \frac{r \text{ of lamp hot}}{\text{number of lamps}}.$$

It may be mentioned that the resistance of a lamp when hot *may be found by dividing the e.m.f. by the current.* (Compare Ohm's law).

Example.—Find resistance of a lamp hot of 110 volts e. m. f. and .55 amperes of current:

$$r = \frac{110 \times 100}{55} = 200 \text{ ohms.}$$

Example. Find the total resistance of 50 110 volt lamps connected in multiple. $R = \frac{200}{50} = 4$ ohms.

It will be remembered that the joint resistance of the lamps is only a part of the total resistance of the circuit, which includes wires and lamps. (See Fig. 3).

Rule 4. The resistance of the conductor is found by multiplying the total resistance of the lamps by the percentage to be lost, and by dividing the product by 100 minus the percentage of loss.

Written as a formula, this rule becomes:

$$R = \frac{r \times \%}{100 - \%}$$

If we combine rules 3 and 4 we obtain:

$$R = \frac{r \text{ hot}}{N} \times \frac{\%}{100 - \%}, \text{ or in words:}$$

Rule 5. The resistance of the conductor is found by dividing the resistance of one lamp hot by the number of lamps (N) joined in multiple arc, and multiplying the quotient by the percentage of loss, divided by 100, minus the percentage.

Example.—Find the resistance of a conductor for 50 lamps, each of 200 ohms' resistance hot, with 10% loss.

$$R = \frac{200}{50} \times \frac{10}{100 - 10} = 4 \times \frac{10}{90} = \frac{40}{90} = \frac{4}{9} \text{ or .44 ohm.}$$

It is not sufficient, however, to find the resistance of the copper conductor. It is also necessary to determine its cross-section in circular mils.

It is stated under Rule 1 that $d^2 = \frac{10.79 \times L}{R}$. The explanation of the symbols is repeated: 10.79 ohms represent the resistance of a unit wire, L is the length of a circuit which is twice the distance, R is the resistance of conductors.

If for L in the formula we substitute twice the distance, 2 D, we have $d^2 = \frac{10.79 \times 2 D}{R}$ and if we now insert for R the value as given in Rule 5 and multiply 2 by 10.79, we find that

$$d^2 = \frac{21.58 \times D}{\frac{r \text{ hot}}{N} \times \frac{\%}{(100 - \%)}}$$

We can simplify this and obtain the general important wiring rule:

Rule VI. $d^2 = \frac{21.58 \times D \times N}{r \text{ hot}} + \frac{(100 - \%)}{\%}$ in which d^2 = circular mils; D = distance in feet; the distance is ½ the full length of the circuit; N = number of lamps; r = resistance of one lamp hot; % = desired percentage of loss in conductor given as a whole number and not as decimal fraction.

Example: 150 lamps are to be run 400 feet with 5 per cent.

loss. The voltage of the lamp is 110 volts, and the current per lamp is ½ ampere.

Demonstration: We must first find the resistance hot of one lamp: resistance hot$=\frac{\text{volts}}{\text{amperes}}=\frac{110}{½}=220$ ohms.

Working by rule VI we obtain

$$d^2=\frac{21.58\times 400\times 150}{220}\times\frac{(100-5)}{5}$$

$$d^2=\frac{21.58\times 400\times 150}{220}\times\frac{95}{5}=111,823 \text{ circular mils.}$$

By referring to Table 1 we find that this wire is a little larger than No. 0 B. & S. gauge.

Rule 6 will hold good for all lamps and for every percentage of loss. The cross-section of the wire is found in circular mils, and no table is necessary.

Rule 7. Where lamps or groups of lamps are placed at different distances from the dynamo, determine first the proper wire for each lamp or group of lamps if placed on independent circuits starting from the dynamo, then combine all wires running in the same direction.*

Fig. 5 shows three groups, 1, 2 and 3, of 50 lamps each. D is the dynamo, and + and − its positive and negative binding posts. The first group is 100 feet from the dynamo, the second 250 feet, and the third group 350 feet. We figure on lamps of 220 ohms resistance hot and 5 per cent. loss. Take the most distant group first. Proceeding by Rule 6 we find

$$d^2=\frac{21.58\times D\times N}{220}\times\frac{100-5}{5}$$

As we desired to figure on the same kind of lamps and same percentage of loss we may simplify our calculations by first figuring out the constant part of our formula or "a constant" and subsequently multiplying D × N × constant.

$$K\text{ (constant)}=\frac{21.58}{220}\times\frac{100-5}{5}=1.86$$

$d^2 = D\times N\times 1.86$. $d^2=350\times 50\times 1.86=32,550$ circular mils for Group 3. Taking Group 2 we find:

$d^2=250\times 50\times 1.86=23,250$ circular mils.

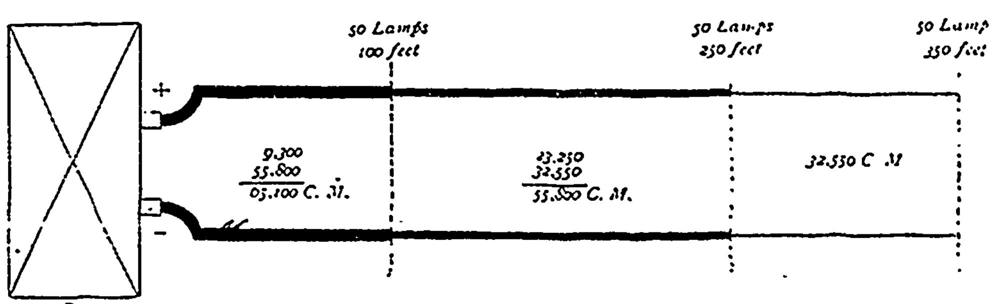


FIG. 5.—CALCULATING SIZES OF WIRES FOR GROUPS.

Adding to this total 32,550 we have a wire of 55,800 circular mils to be used for Section 2.

Proceeding in the same way with Group 1 we find:

$d^2=100\times 50\times 1.86=9,300$ circular mils, which added to the total in the last case gives 65,100 circular mils.

From these data we conclude that we must use a wire of 65,100 circular mils between the dynamo and Group 1; a wire of 55,800 circular mils between Group 1 and Group 2, and a wire of 32,550 circular mils between Group 2 and Group 3.

Rule 8. First calculate the sizes of mains and feeders; then determine the sizes of branches. Not more than 5 per cent. loss must be allowed between the main distributing point and lamp outlets.

In the closet system, for instance, 3 per cent. loss may be

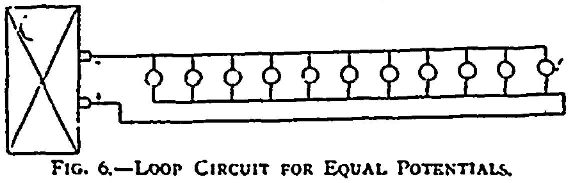


FIG. 6.—LOOP CIRCUIT FOR EQUAL POTENTIALS.

allowed from the dynamo or main distributing point to the closets and 2 per cent. from the closets to the lamp outlets.

*By groups of lamps is meant a number of lamps comparatively near each other, as for instance, lamps in a room of a building or on a chandelier, or, in station lighting the lamps in one store. Up to the first group, the mains must be of sufficient size to carry all the lamps or groups of lamps in circuit. Beyond the first lamp or group the mains may diminish as the number of lamps or groups diminish.

The percentage of loss in the wires should be made as small as possible, for two reasons: In the first place, a large drop in the wires involves considerable waste of energy, and secondly the system will not admit of automatic regulation of the pressure. Complaints are often made that an incandescent dynamo does not regulate very closely, i.e., when a number of lamps are thrown on or off, the remainder of the lamps become dimmer or brighter as the case may be. *It is obvious that, no matter how efficient* the dynamo or the transformer may be, a considerable loss in the wires will interfere with the maintenance of even pressure throughout an entire system.

Suppose we have figured mains for 100 lights on a basis of 20 per cent. loss; lamps to be of the 112 volt class. In this case the dynamo must run at 140 volts, with 100 lamps in the circuit; 20 per cent. of 140=28 volts, which is the drop in the wires. If 50 lamps are switched out, and the potential of 140 volts at the dynamo remains unchanged, the voltage at the lamps will increase 50 per cent. of 28 volts, or to 112+14=126 volts.

This condition of course would be fatal to the life of the lamps. Again it may happen that while on one branch all the lamps are running, on another, only a small fraction of the total number of lamps is switched on. The lamps on one circuit would thus burn at nominal pressure or candle power, while on another circuit they would be far above the nominal candle power. *If only* a small percentage of loss has been allowed in the wires, this condition cannot ensue, as the maximum difference in the potentials of the different circuits must necessarily be within the percentage of loss allowed in the wires.

The foregoing considerations lead us to:

Rule 9. Calculations should be so made that substantially the same potential (within two or three volts), may be maintained at every point in the circuit, no matter how many or how few lamps be burning at different points.

It can easily be seen that that would be an ideal system, where each lamp was provided with a separate circuit direct to the dynamo. No matter how many lamps were switched on or off, the percentage of loss in the other circuits would not be altered. Of course such a system is impracticable. The next best thing is the subdivision of the system of wiring into as many independent circuits as possible. The adoption of this plan will result in many advantages, for example, faults in the insulation will be more readily located and the use of large fusible safety

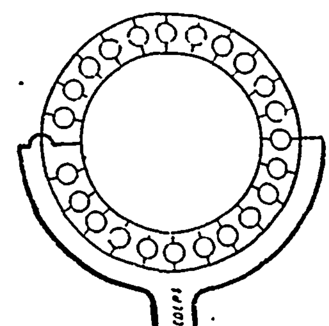


FIG. 7.—CLOSED LOOP CIRCUIT.

plugs, which act very sluggishly when of large cross-section, will be avoided. Fifty lamps should be the maximum number on a single circuit within a building.

Many plans have been proposed for the maintenance of an even potential, but the best made is to keep the percentage of loss in the wires very low. The only objection to the plan is that it involves very additional cost for large copper wires. This expense, however, is small in the wiring of a building in comparison with labor and other items of expense. There is another

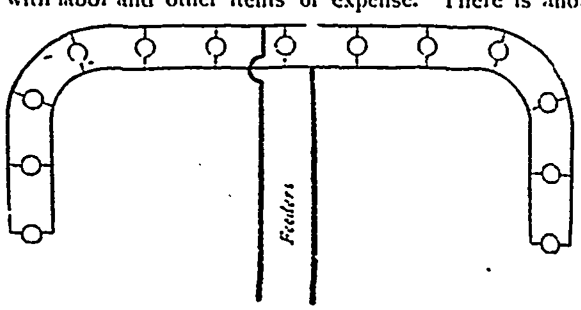


FIG. 8.—LOCATION OF FEEDERS.

reason why the loss within a building should be kept very small, which will be taken up in another chapter.

Fig. 6 represents a plan on which equal potentials must necessarily be obtained at all lamps.

Fig. 7 represents the so-called closed loop plan, with feeders diametrically opposite each other.

It might be stated that as a general rule in order to secure an equal potential, it is advisable to cross-connect the mains whenever possible and attach separate feeders at the centers of distribution.

Fig. 8 shows the proper location of feeders.

GAUGES IN CIRCULAR MILS AND SAFE CARRYING CAPACITY

TABLE No. 1.

	B.&S.	B.W.G	E.S.G.	Safe Carrying Capacity — Wire heated to 30 deg. F. above temperature of surrounding air.			
da Circular Mils.	Brown & Sharpe Gauge.	Birmingham Wire Gauge	Edison Standard Gauge	Number of Amperes.	Number of 55 Volt Lamps. 16 c. p.	Number of 75 Volt Lamps. 16 c. p.	Number of 110 Volt Lamps 16 c. p.
220,000			220	203	203	278	406
211,600	0000			197.3	197	270	395
206,116		0000		193.5	193	261	387
200,000			200	189.15	189	259	378
190,000			190	183	183	249	364
180,618		000		179.3	179	245	359
180,000			180	174.8	175	240	350
170,000			170	167.4	167	229	335
167,805	000			165.8	166	227	332
160,000			160	160	160	219	320
150,000			150	152.5	152	208	305
144,400		00		148.2	148	203	297
140,000			140	144.8	145	199	290
133,079	00			139.4	139	190	279
130,000			130	136.9	137	188	274
120,000			120	129	129	177	258
115,600		0		125.4	125	171	251
110,000			110	120.8	121	166	242
105,592	0			117.2	117	160	234
100,000			100	112.5	112	153	225
95,000			95	108.2	108	148	216
90,000		1	90	103.9	104	142	208
85,000			85	99.5	99	136	199
83,694	1			98.4	98	134	197
80,656		2		95.7	96	131	191
80,000			80	95.1	95	130	190
75,000			75	90.6	91	125	181
70,000			70	86	86	118	172
67,081		3		84	84	115	168
66,373	2			83.1	83	114	166
65,000			65	81.4	81	111	163
60,000			60	78.4	78	107	157
56,644		4		73.4	73	100	147
55,000			55	71.8	72	99	144
52,634	3			69.5	69	94	139
50,000			50	66.8	67	92	134
49,400		5		65.2	65	89	131
45,000			45	61.7	62	85	123
41,742	4			58.4	58	79	117
41,209		6		57.8	58	79	116
40,000			40	56.5	56	77	113
35,000			35	51.1	51	70	102
33,102	5			49.1	49	67	98
32,400		7		48.3	48	66	97
30,000			30	46.6	46	63	93
27,225		8		42.4	42	57	85
26,250	6			41.2	41	56	82
25,000			25	39.7	40	55	79
21,904		9		36	36	49	72
20,816	7			34.6	34	47	69
20,000			20	33.6	33	45	67
17,956		10		31	31	42	62
16,509	8			29.1	29	40	58
15,000			15	27.1	27	37	54
14,400		11		26.3	26	36	52
13,094	9			24.4	24	33	49
12,000			12	22.9	23	31	46
11,881		12		22.7	23	31	46
10,381	10			20.3	20	27	41
9,025		13		18.5	18	25	37
8,234	11			17.3	17	23	34
8,000			8	16.9	17	23	34
6,889		14		15.1	15	20	30
6,530	12			14.5	14	19	29
5,184		15		12.2	12	16	24
5,178	13			12.2	12	16	23
5,000			5	11.9	12	16	24
4,225		16		10.5	10	14	21
4,107	14			10.3	10	14	20
3,364		17		8.8	9	12	17
3,257	15			8.6	9	12	17
3,000			3	8.1	8	11	16
2,583	16			7.2	7	10	14
2,401		18		6.8	7	10	14

1. In this table it is estimated that 1 55-volt, 16 candle power lamp requires about 1 ampere of current; 1 75-volt, 16 candle power lamp requires about .73 ampere of current; 1 110-volt, 16 candle power lamp requires about .5 ampere of current.

2. Lamps supposed to be in multiple arc. On the three-wire system the same current in amperes will suffice for a series of two lamps. Hence twice the number of lamps as given in the above table can be safely carried on the same size wires.

TABLE No. 2.

ELECTRIC LIGHT CONDUCTORS.

I.	II.	III.	IV	V	VI.	VII.	VIII.	IX.	X	XI	XII	XIII.
Brown & Sharpe	Diameter		Square of Diam.	Sectional Area.	Weight.			Length.		Resistance of pure copper wire at 75 degrees F (23.89 deg. cent.)		
					Naked.		* Insul.	Naked.	* Insul.			
No.	Mils.	Millimetres.	Circular Mils.	Square millimetres.	Grains per Foot.	Pounds per 1000 ft.	Pounds per 1000 ft.	Feet per Pound.	Feet per Pound.	Ohms per 1000 ft.	Feet per Ohm.	Ohms per Pound (naked)
0000	460.000	11.684	211600.0	107.219	4475.33	639.33	....	1.56	......	.051	19605.69	.0000798
000	409.640	10.405	167805.0	85.028	3549.07	507.01	.....	1.97	......	.064	15547.87	.000127
00	364.800	9.266	133079.4	67.431	2814.62	402.09	440.6	2.49	2.27	.081	12330.36	.000202
0	324.950	8.254	105592.5	53.504	2238.28	319.04	355.9	3.13	2.81	.102	9783.63	.000320
1	289.300	7.348	83694.2	42.409	1770.13	252.88	284.8	3.95	3.52	.129	7754.66	.000510
2	257.630	6.544	66373.0	33.632	1403.79	200.54	235.3	4.99	4.25	.163	6149.78	.000811
3	229.420	5.827	52634.0	26.670	1113.20	159.03	190.5	6.29	5.25	.205	4876.73	.001289
4	204.310	5.189	41742.0	21.151	882.85	126.12	158.0	7.93	6.33	.259	3867.62	.00205
5	181.940	4.621	33102.0	16.773	700.10	100.01	126.9	10.00	7.88	.326	3067.06	.00326
6	162.020	4.115	26250.5	13.301	555.20	79.32	101.7	12.61	9.83	.411	2432.22	.00518
7	144.280	3.665	20816.0	10.548	440.27	62.90	85.7	15.90	11.67	.519	1929.75	.00824
8	128.490	3.264	16509.0	8.366	349.18	49.88	68.8	20.05	14.54	.654	1529.69	.01311
9	114.430	2.907	13094.0	6.635	276.94	39.56	53.8	25.28	18.58	.824	1213.22	.02083
10	101.890	2.588	10381.0	5.260	219.57	31.37	46.9	31.88	21.33	1.040	961.91	.03314
11	90.742	2.305	8234.0	4.172	174.15	24.88	36.4	40.20	27.46	1.311	762.93	.05269
12	80.808	2.053	6529.9	3.309	138.11	19.73	30.9	50.69	32.38	1.653	605.03	.08377
13	71.961	1.828	5178.4	2.618	109.52	15.65	25.5	63.91	39.25	2.084	479.80	.1332
14	64.084	1.628	4106.8	2.081	86.86	12.41	20.3	89.59	49.21	2.628	380.51	.2118
15	57.068	1.450	3256.7	1.650	68.88	9.84	15.8	101.63	63.29	3.314	301.75	.3368
16	50.820	1.291	2582.9	1.309	54.63	7.81	14.8	128.14	67.60	4.179	239.32	.5355
17	45.257	1.150	2048.2	1.038	43.32	6.19	12.6	161.59	79.58	5.269	189.78	.8515
18	40.303	1.024	1624.3	.8230	34.35	4.91	10.8	203.76	92.46	6.645	150.50	1.354
19	35.390	.899	1252.4	.6346	26.49	3.78	9.3	264.28	107.83	8.617	116.05	2.277
20	31.961	.812	1021.5	.5176	21.61	3.09	9.1	324.00	110.25	10.566	94.65	3.423

* Approximate.

(To be Continued.)

BELTS FOR DYNAMOS.

THE success of electrical generating apparatus required high speeds, and to transmit the power a belt both light and strong was necessitated. The belt manufacturers, realizing the demand, devoted their energies to produce the desired article, and the double dynamo belt has been the result of the evolution. There are many makes of belts on the market, and even in the individual belts of the same make a difference in quality will be found. To make a durable belt for high speeds, writes "M," in *Electrical Industries*, the greatest care must be taken in preparing the stock, and the best of stock chosen, and dynamo belts are of this class. If a belt does its work satisfactorily, the engineer or operator of a station will call it a good belt, but if he should desire to make any comparison, or desire to use belts for other machinery, unless he made observation, he would have to refer to antiquated tables to figure his belting. How many engineers running stations know but little or nothing of the actual work their belts are doing.

The stretching of a belt means loss of power, a wasted expenditure of energy. The slipping or creepage of a belt is also another loss, and not one to be overlooked. The weight required is another loss. Poor belts that have to be made heavy to stand the strain are not desirable. No tables are prepared that will give the engineer any but approximate data, and even then the conditions are not considered. Every station man has the opportunity to compile some valuable information and be able to say why his belts are good, and to know what he can do with them in other cases. He should obtain the following: The length of the belt, the power transmitted, the speed of the belt, the weight of the belt, and the loss due to slippage and creepage; that is, the loss in the speed of the driven pulley, ascertained by finding its actual speed and the speed it would run should there be no loss. The strength of the belt, also the thickness and width of the belt. With this data he would know just what the belt was doing per unit of section, and would be able to figure up his own experience rather than upon the data of others who never knew what conditions he had to overcome or purpose he had in view.

NOTES.

An exchange remarks: The price of boiler material in this country fifty years ago was: Copper plate, 34 cents; iron, 16 cents; cast-iron, 6 cents per pound. Boilers were costly luxuries in those days.

Messrs. A. A. Dion, Moncton, N.B.; Albert J. Corriveau, Montreal; T. Ahern, Ottawa; Frederic Nicholls and Hy. S. Thornberry, Toronto, attended the recent convention of the National Electric Light Association.

A committee of the Council of St. Thomas, Ont., has been appointed to ascertain the cost of an electric fire alarm system. The purchase of an electric fire alarm will result in placing the city in class "A" for fire insurance purposes.

Mr Charles D. Warren, president of the Metropolitan Street Railway Co., Toronto, in giving testimony recently before the Toronto street railway arbitrators said that since the introduction of electricity on their road their business had increased by one hundred per cent.

The following are the officers elect for the current year of the Canadian Marine Engineers' Association, Toronto: President, J. Baird; first vice-president, S. A. Mills; second vice-president, P. J. Kenney; members of council, Messrs. E. W. Fox, D. H. Fraser, D. L. Doley, J. J. Winnert and S. Gillespie; treasurer, J. H. Ellis; secretary, F. E. Smith; auditors, C. E. Morgan, J. Harrington. The association is in a prosperous condition.

The system of municipal inspection of steam boilers appears to work satisfactorily in Montreal. Mr. E. O. Champagne, the civic inspector, reports that during the past year he made 1,381 visits of inspection, 689 examinations of boilers, 427 hydraulic tests, discovered 110 imperfect boilers, of which seven were condemned, attended to the erection of 37 new and 15 second-hand boilers, served 169 inspection and issued 393 certificates. During the year applications were made for certificates by persons desiring to take charge of stationary engines and boilers, of which 303 were granted. Mr. Champagne states that his work continues to increase, and congratulates the city on its immunity from accident. He also refers to the fact that the wharves, where formerly many unsafe boilers were used, are now under his jurisdiction, and the danger of accident thereby lessened. He indicates a number of amendments which he would like to see adopted.

The annual dinner of the Kingston branch of the Amalgamated Society of Engineers, held a few days ago, proved to be a very enjoyable affair. The chair was occupied by Mr. Thomas Barlow, the president.

The C.P.R. Telegraph Company have just removed into new offices in the Toronto Board of Trade building. The wires enter by a tower on the roof and are distributed to the tables under a false floor, which is removable. The battery room contains 2,500 batteries, all in use.

Mr. Thos. Tickurr, of Parkhill, is the inventor of a diminutive steam engine, which works, it is said, with the accuracy and ease of a Corliss. The dimensions and capacity are as follows: Diameter of cylinder, 1-48 of an inch; weight, ½ of a grain; bore of cylinder, .3125 of square inch; revolution, 17.60 per minute; horse-power, .12,490 part of h. p. The "Little Jumbo," as it is called, is so small that it can easily be covered with the shell of a 22-calibre cartridge, being two-thirds smaller than the famous Waterbury engine that attracted so much attention at the Centennial.

SPARKS.

The Edison General Electric Co will supply the appliances necessary for the electric tramway at New Westminster, B. C.

New buildings and increased motive power have been added by the Royal and Ball Electric Companies to their plants at London, Ont., to enable them to carry out the contracts recently entered into with the city.

After ten years of construction, an elaborate telephone system connecting all the forts and military establishments of Belgium with the city of Antwerp, has just been completed. The system was specially devised to prevent the tapping of the lines by an enemy in time of war.

Incorporation has been granted the Toronto Construction and Electrical Supply Company (limited), with a capital stock of $250,000 in 2,500 shares. The first subscribers are W. D. Matthews, W. R. Brock, Frederic Nicholls, Robert Jaffray, Hugh Ryan, H. P Dwight and J. K. Kerr.

Mr. Jules Myers, engineer-in-charge of the construction of the Edison Company's new works at Peterboro', Ont., has gone to Milwaukee to supervise the execution of a contract for the Company. On the eve of leaving Peterboro' he was entertained by leading citizens at a banquet.

As regards their capacity for conducting electricity, the principal metals rank thus: Silver, 100, copper, 96, gold, 72, aluminum, 52, zinc, 26; platinum, 16; iron, 15; nickel, 12; tin, 11; lead, 7 Copper and iron are the only metals that have commercial value as electrical conductors.

The city council of St. John, N. B., recently decided that the New Brunswick Electric Co. should be given the contract to supply 123 lights on the east side of the harbor, and 25 additional lights for the north end For supplying current to the latter a new 30 light dynamo will be purchased.

A correspondent writes to the *American Machinist*: Not long ago I turned off the commutator of an electric motor, and then proceeded to file it smooth with a single-cut file, but little particles of copper would stick in the cuts of the file and scratch the copper sections, so, after trying several other fine files with the same results, I finally thought of using the file backwards, which made a good job of it.

At the recent annual meeting of the Guelph Gas and Electric Company, a satisfactory report was presented. The increase in the electric light department has been satisfactory, and the incandescent lighting is growing in favor. A dividend of 3 per cent. for the half year was declared, making 5½ per cent. for the year. The skillful management of Mr. Yule received proper recognition from the directors. Mr. Guthrie was re-elected President, and Mr. Chadwick, Vice-President.

The electric tramway has scored another success at Victoria, B. C. A year ago some stout-hearted citizens in the face of numerous prophecies of failure, embarked their capital in the enterprise. The cars commenced running on the 22nd of February, 1890, and the event was followed by an appreciable advance in the prices of real estate lying contiguous to the new road. The city lines, which cover about five miles of the principal streets, have yielded a fair return since the opening day; and encouraged by the results in the city, the directors began the construction of the Esquimault division in July. On the 12th day of October this division was quietly opened without any flourish of trumpets or fuss, and has since been in successful operation. The Company have also made arrangements to supply electric light to the citizens. The total expenditure on all branches of the service, to the end of the year 1890, reached $200,000. The Company carried over their lines within a period of ten months, without serious accident, 720,000 passengers, and the financial results are understood to be satisfactory. It is said to be their intention to extend their lines during the coming summer.

SPARKS.

The Reliance Electric Light Company will locate in St. Catharines.

The Bell Telephone Co.'s line is to be extended from Shelburne to Orangeville, Ont.

The damage caused to the electrical industries of Connecticut by a recent storm is placed at $250,000.

A sixty-five horse power engine has been purchased in Toronto to run the Napanee electric light plant.

On January 31st the Royal Electric Company declared a quarterly dividend to shareholders of 2 per cent.

A new water wheel has recently been placed in position at the electric light station at Carleton Place, Ont.

The Peterborough Street Railway Co. have ordered five electric cars, and expect to have their line in operation this year.

Mr. W. S. Battin will, it is said, establish in Toronto a rival telephone company, charging a certain fixed rental and a small amount for each call.

On account of a series of mishaps the contractors for the electric lighting of Coaticook have been given an extension of sixty days to complete their work.

Mr. Harry Abell, son of Mr. E. R. Abell, of Selkirk, Man., is studying electrical engineering in Chicago, and is reported to be making rapid progress.

Mr. J. A. Culverwell, son of Mr. J. T. Culverwell, of Toronto, has received the appointment of contract agent with the Edison General Electric Company, Canadian district.

The Edison General Electric Company have leased a four storey brick building on Bay street, Toronto, which will be used as the business headquarters of the Company in Canada.

The Sun Life Assurance Co. are having an electric elevator, the first to go into operation in the city, put into their new building in Montreal. Messrs. Miller Bros. & Toms, Montreal, have the contract.

For accepting commissions from manufacturers who were desirous of supplying the city with electric fire alarm apparatus, Mr. Crawford has been dismissed from the position of city electrician of London, Ont.

The stockholders of the Edison General Electric Company, New York, ratified the action of the directors in increasing the capital stock from $12,000,000 to $15,000,000. It is stipulated that $1,000,000 shall be kept as a reserve fund.

The Bell Telephone Co. have 136 miles of wire and 271 instruments in use at Brantford, Ont. The daily calls average 2,000. At Kingston the Company have $30,000 invested. There are 300 subscribers, 290 miles of wire and 3,000 feet of aerial cable.

The Abbe Leflamme, vice-president of the Royal Society, in an article on the census in Canada, strongly recommends a special return showing the progress of electrical enterprise in the Dominion. He further presses on the attention of electrical engineers the immense field that exists in the Province of Quebec for power suitable for small workshops such as electricity can supply.