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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL

OLD SERIES, VOL. XV - No. 4
NEW SERIES, VOL. IV.—No 4.

APRIL, 1894

PRICE 10 CENTS
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CANADIAN

ELECTRICAL NEWS

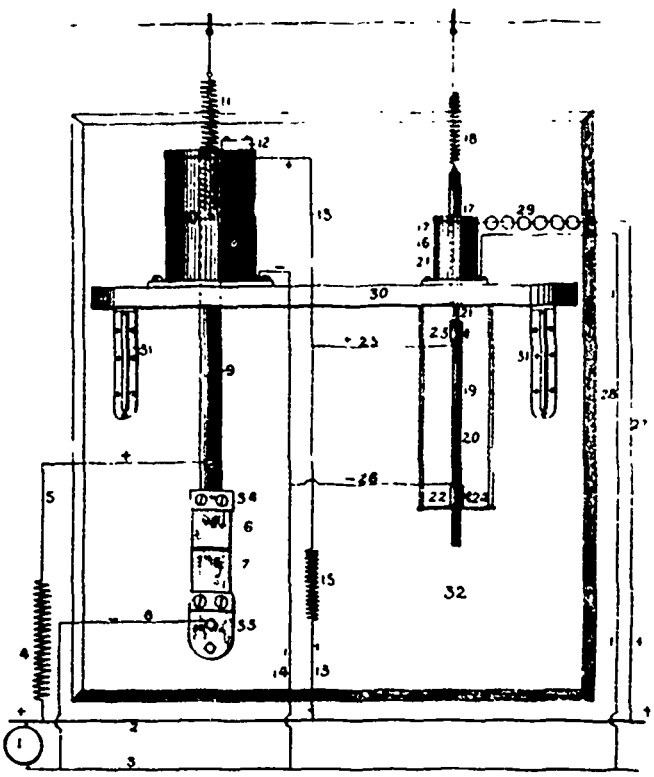
AND

STEAM ENGINEERING JOURNAL.

VOL. IV. APRIL, 1894 NO. 4.

SPEED AND VOLTAGE REGULATOR.

WE illustrate herewith a speed and voltage regulating device which has been in satisfactory operation for a year past in the water power station of the Niagara Falls Park and River Railroad Co. at Niagara Falls, and a patent for which has lately been granted at Ottawa. It is the invention of E. A. Barber, electrician of the Watertown, N. Y., Street Railway. In this method the speed is kept constant by automatically throwing in a dead resistance, when the load is small, and throwing this resistence out when the load is large. In the engraving, 1 is the generator, 2 and 3 the mains. The regulating resistance, 4, is thrown in and out by the contacts, 6 and 7. A solenoid, 16, is connected across between the mains, and hence its pull will vary with the voltage. When the voltage rises above a certain point, the iron core, 17 (which is normally held by the spring, 18), is drawn down, so that the contract is made between 19 and 20. These contacts is the coil 10, which is in parallel with the mains through a high resistance, 15. The coil, 10, being short circuited, the iron plunger, 9, is let down, the contacts 6 and 7 come together, and the load of dead resistance is thrown in. A piece of iron, 12, is put on top of 10 to assist in lifting the iron core, 9, and also to act as a stop when it is lifted. It is manifest that a number of these regulators can be used and adjusted to different voltages, so that more resistance can be cut in with each rise of voltage.



SPEED AND VOLTAGE REGULATOR.

It has been found necessary to make the contacts of carbon, to prevent the injurious arcing. The many unsuccessful attempts that have been made to regulate successfully with water power make the results attained by this device especially gratifying.

THE ASSESSMENT OF GAS AND ELECTRIC LIGHT PLANT.

A strong deputation representing the gas and electric companies of Ontario waited upon the Ontario Government on March 14th, to urge that the street plant of gas and electric companies should not be made subject to taxation. In support of their contention the deputation submitted the following substantial reasons:

1. The business carried on by these companies, is of a hazardous nature. Under the most favorable circumstances, frequent alterations and renewals of plant are required. Their works and plant are liable to serious injury from various causes. In the case of companies using or producing electricity, and of gas companies, the depreciation of plant is specially great. New inventions in electricity are yearly being made, and plant which has cost a large sum, after having been in use but a short time, is rendered practically valueless, by being superseded by new inventions.

2. It is a mistake to assume that the business of any of these companies has been unduly profitable, and it can be truthfully asserted that the returns to those who have invested money in such enterprises, have been, and continue to be very moderate, even in the most successful cases. In many cases the returns have been much below what should have been received, and in not a few instances, there has been a direct loss. In this respect the returns from the investment in such enterprises, have been much less than those from investment in banks, loan companies and other corporations, whilst there is always the risk of the loss of the whole or a large part of the capital.

3. These companies are not free to do business where and with whom they wish, as ordinary trading companies are. They are more or less subject to municipal and legislative control, and are restricted to localities, and therefore have a common interest with the public, not an adverse one.

4. None of the companies engaged in lighting are able to oppress the public, because of the keen competition amongst themselves, and with other illuminants. The municipality in which a water company exists, has by law, the right to acquire its property and works. There is no monopoly on the part of telephone companies unless the municipalities think proper to grant them such, and in all cases in which exclusive rights have been granted, the municipalities derive a yearly revenue therefrom.

5. The present charges for gas, water, electric light and telephone service are reasonable. In many cases the companies concerned do not derive a fair return for their investment, while in some cases they are unable to meet expenses. The companies recognize the necessity of reducing rates from time to time, as much as is consistent with a fair return. If any additional burdens be cast upon them by an increase in taxation, their ability to reduce present rates would be interfered with and in some cases the result would be an increase in the rates.

6. Gas is now largely used for fuel, not only by those in good circumstances, but it is rapidly finding its way into the houses of persons in moderate circumstances. To increase the taxation of gas companies, may in some cases cause an increase in the cost of gas for this purpose, and in all cases, must postpone the reduction in the price, whereby its general use as a fuel must be delayed.

7. With regard to any proposal involving the casting of increased burdens by taxation, upon the companies in question, they submit that to do so would be an unjust discrimination against vested interests, and would check the investment of capital in such enterprises. If there is to be one general principle, upon which all property, and income derivable from property, real or personal, is assessable, then these companies must submit to such a law; but so long as special interests, such as banks, loan companies, railways, vessels, manufacturing companies, and others to-day enjoy certain exemptions, the companies in question, with at least equal force, are entitled to claim equal consideration, and would feel the injustice of being subjected to further burdens of taxation.

These reasons were supplemented by a statement from the various interests that they would be willing to be taxed on their net income. In this way taxation would be equalized and companies best able to bear the burden would pay the most.

A young subscriber of the ELECTRICAL NEWS, who has had about two years practical experience in electrical work is desirous of finding an opening for his services in an electrical manufactory, or in default of that, electrical employment of any kind. We shall be pleased to send his name and address to anyone who may desire to open correspondence with him.

CORRESPONDENCE.

METHODS OF BOILER FIRING.

WALKERVILLE, ONT., Feb. 27, 1894.

Editor ELECTRICAL NEWS.

SIR,—I notice in the last number of the NEWS an item signed "R. B.," the writer of which gives his method of firing slack coal. I cannot agree with him on some points. In the first place he says he keeps his fire about 7 inches thick; I have fired slack coal for the last eleven years, and if my fire got 7 inches thick I would think it needed cleaning badly. I have found by experience that the thinner the fire the better as long as the grates are kept covered. Now, "R. B." says he stirs his fire every second fire he puts on; that will mix the cinders with the fire, and very soon he will be burning more coal, almost one third more than is necessary. When his fire gets a little thick if he would take a slice bar with a flat hook and run it under the fire it would force the dirt through the grates, then break the fire down and fire argued exactly the same points before the Railway Committee, at Ottawa, on several occasions between September, 1892, and very light, he will have no trouble to make steam if his boilers are large enough.

H. K.

RIGHTS OF ELECTRIC RAILWAYS CROSSING STEAM RAILWAYS.

TORONTO, March 3rd, 1894.

Editor CANADIAN ELECTRICAL NEWS.

SIR,—In your issue of March, I notice you repeat what a number of newspapers also stated, that Mr. B. B. Osler "raised a novel contention" in stating that an electric car on a highway was under same conditions and rights, as to carrying passengers, as any carriage or bus, etc. While all electric railway men quite agree with Mr. Osler in this respect, it is not a "novel contention," as a reference to the proceedings of the Railway Committee will show that Mr. A. W. Atwater, barrister, of Montreal, who was acting for the Davenport Street Railway Co. and City and Suburban Electric Railway Co., of Toronto, April, 1893, and his skill in advocating this "novel contention" doubtless gained for his clients the concessions from the steam roads that were made.

Yours truly,

ELECTRICIAN.

THE NEW BLAKE PUMPING ENGINES AT TORONTO.

TORONTO, March 16, 1894.

Editor ELECTRICAL NEWS.

SIR,—I notice a communication in the March issue of the NEWS from "J. W. R.", Hamilton, Ont., re the new Blake pumping engines at the main pumping station, Toronto water works.

In addition to your answer to the enquiry contained in this communication, I would like to say that the new cylinders are now being placed on the pumps at the suggestion and cost of the manufacturers. The engines were not shut down from the fact that they were not considered safe, but the other three set of pumps were in good condition, and in the winter months are perfectly able to handle sufficient water to supply the city.

I feel perfectly safe in saying that these pumps are the most economical pumping engines in Canada to-day. The duty of a pump is the amount of foot lbs. that can be got for every one hundred lbs. of coal burned. Now according to a test made by Mr. John Galt, C.E. and M.E., Toronto, these pumps are giving a duty of 132,056,000 ft. lbs. for every 100 lbs. of coal burned, being in this respect fully up to the guarantee of the Blake Co. The officials of the Toronto Water Works Department must be perfectly satisfied, as I understand they have duplicated the order, the building having been prepared for two set of pumps.

I am satisfied also that neither the Hamilton, Kingston or London pumps can give any such duty as this with their present construction of steam valve mechanism. With the consent of Mr. Galt I will send to the Hamilton Association of Stationary Engineers a copy of the official test for their discussion and *benefit*.

I might add that this test has already been read and discussed in Toronto Association No. 1, C. A. S. E.

G. C. MOORING.

HIGH VERSUS SLOW SPEED ENGINES FOR ELECTRICAL WORK.

Editor ELECTRICAL AND ENGINEERING NEWS.

SIR,—In consequence of being otherwise employed I have been unable to write in answer to Mr. Robb's criticisms of a former letter. I do not propose to enter into a technical controversy as to the merits or demerits of the high speed engines as compared with smaller number of revolutions and longer stroke ones. Most of the long stroke engines are run with a greater piston velocity than the short stroke, quick running ones. I think the commercial appreciation of one kind or the other of these engines will determine their relative position more satisfactorily than any amount of argument on the question by rival claimants, who are liable to be warped in their reasons or judgement by circumstances that do not appear in the discussion.

I stated in a former letter that I knew of many places where the high speed engines had been replaced by the slow speed ones, yet I did not know of any place where the long stroke automatic engine had been replaced by the high speed one. By your permission I will mention a few of these places, which, if space allowed, or the merits of the question demanded it, could be extended indefinitely. When first I visited the Toronto Electric Light and Power Company's works on Sherbourne street, the current was generated by five or six high speed engines; in their new works there are no high speed engines—Brown and Corliss engines made by the Polson Company taking their place. Their works are conducted by one of the best electrical and mechanical engineers in Canada, and we must assume that his judgment on this matter is correct, as the work have been a commercial and mechanical success.

The Toronto Electric Railway Company have a number of quick running Armington & Sims (United States) engines at work. They are now about to increase their power by 6000 h. p., and intend to put in engines of the slow speed type now building at Bertram's works, Toronto.

The Montreal Electric Railway Company are placing six Corliss engines of 600 h. p. each in position, two of which are now at work. These engines were built in Montreal as called for by the company's agreement with the city.

The Hamilton Street Railway Company have four automatic engines, three being Wheelock and one Corliss, the last put in being built by John Inglis & Sons, Toronto. The same makers are now building two Corliss engines for the Hamilton, Grimsby and Beamsville Electric Railway, and have placed two in position for the Kingston Electric Light and Power Company and one in Gananoque for the same purpose. So far as I am able to judge without prejudice one way or the other, I do not think any high speed engine in Canada can approach these for economy of fuel, oil and attendance.

The London, Ont., Electric Light and Power Company have up to a recent date run with high speed automatic engines. Recently they have put into operation two compound Wheelock engines. The Leamington Electric Light Company have also replaced theirs by a long stroke engine; the manager told the writer with a reduction of one third on their fuel bill.

The Montreal Electric Light Company also had high speed engines; they are at present running with larger and economical slow speed ones.

I will not continue this list as your space forbids. The tendency of modern electrical engineering is towards larger generators and slower speeds. With regard to the high speed economical engine referred to by Mr. Robb, I assume he means the engine designed by the late Mr. Willans, of London, England. All Mr. Robb has stated in his letter has been claimed for the Willans centre valve engine, the facts of which I would not for one moment deny. I have a sectional elevation of this engine in its latest form; it is a tandem vertical triple expansion one designed for 160 to 180 lbs. steam pressure, has nine steam cylinders in three vertical rows, high, intermediate and low, acting on three cranks on the down stroke only. The central valve which distributes the steam on each side of cylinder is worked from an eccentric turned out of the solid on the centre of each crank pin, and connects to the valve through the centre of the piston rods, or what answers as a piston rod. The work on this engine is of the most elaborate description and could only be done by special tools adapted to the purpose, as all joints and surfaces have to run steam tight without packing. The greatest care would also be necessary in running them, as any want of oil or forming steam might ruin them.

These engines are very costly, very much more so than the same power would cost say of the Corliss design, and without any more economy. They would also be shorter lived as to their wear and maintenance. They are, however, sold to the navies of the world for electric purposes through the small amount of space they occupy for power and light developed.

In my letter I referred to the Armington & Sims engines running the electric light at the Parliament buildings at Ottawa. Mr. Johnson, who has charge of the electric plant there, informed me that they burned 4½ lbs. of coal per 1 h. p. per hour. Since I wrote you I have been employed to test an Armington & Sims engine built by Messrs. Nye & Whitfield, of Hamilton, two boilers built by John Inglis & Sons, Toronto, and the electric installation by the Kay company, Hamilton. I will condense my remarks by stating that a careful trial gave the following results:

The engine was 6 × 8, making 336 revolutions per minute, which speed was practically maintained under all loads. It ran with great smoothness loaded or light. The power developed taken from the diagrams—14.85 h. p.; the coal burned 3.78 lbs. per indicated h. p. per hour; ten, 16 candle lights per 1 h. p.; thirteen do. per electrical h. p. There was no sparking at the commutator and very little heat of armature or field windings.

I have thought it my duty to mention this in justice to those engaged in building this class of engine. This plant is in the Bank of Hamilton, Hamilton.

Although this result is a good one for a small engine, it is a long way off what can be got out of a Corliss compound or an equally good engine of any other design running at slow speed.

I have read with much interest the communication from the stationary engineers on boiler setting and kindred subjects. I

agree with your correspondent, Mr. George Gilchrist, as to his idea of the form behind the bridge and space from the fire bars to the boiler. The distribution of the heat on this plan will be equalized on the bottom plates and not concentrated on one spot. In your next number, by your consent, I may be able to throw some light on boiler construction that will occupy the attention of those interested. Allow me to congratulate the stationary engineers on the educational work they are doing in raising their members to a higher plane in their business. The result should be a public and industrial benefit.

Yours respectfully,

J. H. KILLEY.

Hamilton, March 14, 1894.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of the various Associations are requested to forward to us matter for publication in this Department not later than the 20th of each month

TORONTO ASSOCIATION NO. 1.

At the regular meeting on Feb. 23rd, Mr. W. J. Hursley was initiated and propositions for membership received from Mr. J. Mart, of the Incandescent Electric Light Co. and Mr. Meacham of the Don Valley Pressed Brick Co.

A committee was struck to look into the by laws of the Association and make a report thereon after a discussion had taken place on the meaning of one or two clauses which some of the members objected to.

Mr. Gilchrist promised to read a paper at the next meeting on "Shafting." Mr. McLaughlin also promised a paper in the near future on "How to Run an Electric Plant." The question box brought out the following query "What is the greatest percentage of strength of joint compared with solid plate which it is possible to make in constructing longitudinal seams of steam boilers?" Mr. Edkins answered as follows.—A double strap butt joint with eleven sixteenths of an inch thickness of steel plate and eleven-sixteenths of an inch diameter of rivet, pitch 4.56 inches, straps .52 of an inch thick, will give a percentage of strength of 84.9 compared with the solid plate.

At the regular meeting on the 9th of March the initiations of John Marr and Mr. Meacham took place. Two more propositions for membership were received. Brother Bredmas in a short speech bade farewell to the members as he is going away from Toronto to take charge of the Napanee paper mills. Mr. Gilchrist in a letter stated that owing to illness he was unable to get to the Association to read his paper on "Shafting," therefore it was postponed to a future meeting. Mr. Wickens read the proposed amendments to the Act relating to engineers, now before the Ontario Legislature. A long discussion took place thereon. Many of the members gave their views for or against the measure; several took petitions in favor of licensing engineers with them to obtain signatures from their fellow workers.

CHAS. F. KINNEY,
Corresponding Secretary.

WINNIPEG ASSOCIATION NO. 11.

Following are the names of the charter members of the above Association Chas. E. Robertson, Luersidge Brandon, Thos. Gordon, Wm. Kennedy, John G. Kemp, Ed. Doran, John Stanley, James T. McDonald, John Harrison, Dan Doran, Thomas Grant, Ed. Alberg, Chas. R. Forge, Arthur Harper, James Albert Binns, Michael J. Sanders, J. R. Alexander, W. F. Brown, Thos. Hanes, Robert Hall, James Stuart, J. W. Schneider, R. Douglas, Amrud Schmidt, Robert Sutherland, Thomas Brown, Thomas Dalziel, James Whyte, J. B. Crawford, Geo. M. Hazlett, Jos. Mills, Wm. Drever, Alex. Leighton, John Whittacker, Frank Thompson, D. Ramsay, W. C. Holder. The Association has elected the following officers: President, Chas. E. Robertson, Dominion steamboat inspector; first-Vice President, James Whyte, chief engineer Ogilvie's mill; second Vice-President, G. M. Haslett, Northwest Electric Light Co.; Recording Secretary, L. Brandon; Financial Secretary, Arthur Harper; Treasurer, James Stuart; Conductor, Walter Alexander; Doorkeeper, W. L. Brown, engineer Clarendon hotel. At the second meeting eight additional members were received into the Association.

OTTAWA ASSOCIATION NO. 7.

Editor ELECTRICAL NEWS.

SIR, I have pleasure in saying that Ottawa No. 7, although one of the baby Associations, is not taking a back seat in the way of increasing its membership, which is due to the remarkable good will and activity of its members. Interesting meetings is what brings members, and the instruction received at each meeting is what adds to the membership.

As stated in my last letter, we were favored with Bro. Latour's paper on the "Steam Indicator." Before entering into the details of the indicator he explained how heat could perform a relative quantity of work after being converted into steam, which is a medium of conveying the heat into the cylinder in which the motion of the piston converts a proportion of heat into work. After referring to different ways of measuring the work done by an engine he proceeded to show that the only accurate one was by the indicator By blackboard illustration, a diagram similar to one made by the instrument showed very clearly even to the unexperienced how to discover if the valves, either steam or exhaust, are working as they should when correctly adjusted. The engineer of the present, he said, began to realize that the indicator and the understanding of its diagram was an absolute necessity, for no man could conceive what took place in the cylinder without its use. For example he used some cards taken from his engine, which is compound condensing, whilst showing the defects of admission, steam expansion, exhaust, back pressure, and compression lines, and how to remedy the faults, some half a dozen or more cards were vouchers for the improvements on his engines, and the difference as Bro. Latour said, was very worthy of note, for with the same steam pressure and load the speed was increased by 12 revolutions per minute. The next question of importance was, should a steam dome be single or double rivetted to the shell? I may say here that our new mode of procedure in dividing the meeting on the subject taken, has revived more than ordinary interest in bringing out the two sides of the question and at the same time training the members to debate, for it is a well-known fact many a good engineer has an opinion but cannot very well express it. Bro. Robert conducted the affirmative or single row, and Bro. Latour the negative or double row. Bro. Donaldson, of Toronto, was appointed judge.

Bro. Latour opened the debate by saying that the two rows of rivets were preferable for many reasons, first, that the cutting of the plate under the dome weakened it to such an extent that it needed reinforcement and that the additional width of joint strengthened that part of shell to a degree that should not be left out of consideration. He also referred to the uneven and trying strains on that neutral part of shell under the dome.

Bro. Robert took the stand and contended that if it was necessary to strengthen any weak part of the shell there were many ways to do it either by having stays or bars of tee irons as the case might require. By making a rough sketch on the blackboard he showed how to stay that part of shell, if necessary, by calculating the upward pressure on any size dome and also the tensile strain on the rivets. It was argued that since one row of rivets was more than sufficient to resist the upward pressure, there was no necessity of having the shell weakened by the additional holes required for two rows of rivets, and furthermore the extra labor and material meant extra cost and nothing in return for it. After the other members had been heard from on both sides of the question, Bro. Donaldson decided that the weight of argument was in favor of the affirmative or single row A vote of thanks was tendered Bro. Donaldson for acting as judge and taking such a general interest in the welfare of engineers, after which the meeting closed to be reconvened on the 13th of March.

A few meetings ago Bro. Hill directed our attention to a paragraph in the daily papers stating that His Excellency, Lord Aberdeen, the Governor General, had many times stood on the foot plate of a locomotive in the Old Country and was thoroughly acquainted scientifically and practically with the science of engineering and took much interest in the modern steam engine. In view of this, Bro. Hill suggested that our Recording-Secretary be instructed to write asking His Excellency to extend His Patronage to Ottawa No. 7, C. A. S. E. It is needless to say that every member present at the meeting on the 13th of March was highly pleased to learn that a favorable answer had been received from His Excellency.

The following resolutions were adopted at the regular meeting on March 13th.

Whereas, it has pleased Almighty God in His infinite mercy and goodness to remove from our midst the beloved and affectionate daughter of our esteemed Bro. J. H. Thompson,—therefore

Resolved—That we the officers and members of this Association do sincerely sympathize with our brother and his family in this their hour of affliction, and be it further

Resolved—That it is but a just tribute to the memory of the departed to say that in regretting the removal of this loving daughter we mourn for one who was in every way worthy of our most profound respect, and be it

Resolved—That a copy of these resolutions be transmitted to Bro. J. H. Thompson as a token of our respect and veneration, and that they be spread upon the records of our Association and published in the ELECTRICAL NEWS, Toronto

Committee { FRANK ROBERT, Pres.
J. O. B. LATOUR, Rec. Sec.
THOMAS WEBSTER

Yours truly,

Ottawa, March 19th, 1894. PROGRESS.

WORK OF THE EXECUTIVE.

Mr. John J. York, Executive Secretary, writes as follows; The last month has been a very busy one in this office. Some time since we opened correspondence with Mr. Chas. C. Robertson of Winnipeg, who, by the way, is an honorary member of old Montreal No. 1, the result of which has been the foundation of an association in that city under the most favorable circumstances, there being 39 charter members, and I have to-day received word that they admitted eight others at their last meeting. It has created quite a stir among engineers in that city. I enclose you a list of the charter members and also a list of the officers of this new association to be known as Winnipeg No. 11.

A short time ago Bro. A. M. Wickens, of Toronto, paid a visit to Kincardine, and his labor has already borne fruit, as I have to day received an application for a charter signed by the following well known engineers John Cress, Daniel Bennett, Percy C. Walker, John Gillespie, Andrew Beadle, Andrew T.

Scott, Sam. McClure, Jos. Walker, John Campbell, Percy Ashton, Andrew Scott. This will make the third charter issued this year, and there are good prospects of others coming in. I am expecting every day to get news from Sherbrooke, P. Q.; there are a fine lot of engineers there who stand high in the profession, and if they will only form a branch of the grandest of all educational societies they will find it greatly to their gain. There are other towns in Quebec and Ontario that I am sure only need to be shown the great advantages to be derived from the C. A. S. E., when they will at once form themselves into branch associations. The Souvenir of the Fourth Annual Convention gotten up by Montreal No. 1 has been handed over to the executive to be run in the interest of the whole Dominion. I am at present getting out circulars, etc.

AN ENQUIRY.

Editor Electrical News

DEAR SIR When are the new associations at Sherbrooke, St. Johns, Montreal, &c., in the Province of Quebec going to materialize? I presume I should address this query to the President of the Executive Council, Bro. Geo. Hunt, of Montreal. One of our members was down in Montreal last October, and when he returned he informed us that Bro. Executive President Hunt was going to organize some new associations in the Province of Quebec. We have been waiting in vain to hear of this being done, but have been disappointed. Come friend Hunt, bestir yourself, we want to see an addition of 100 per cent. to the members of the C. A. S. E. when the convention meets next year.

Yours truly, ENGINEER.

GROWTH OF THE ASSOCIATION.

139 Borden St., TORONTO, March 23nd.

Editor Electrical News.

DEAR SIR. It will interest many of your readers, particularly those of them who are members of the C. A. S. E., to know that there is every likelihood of there being a very substantial addition of new associations especially in the Province of Ontario. I have just returned from a trip on the G. T. Railway east, during which I attended a meeting of Engineers in Peterborough, at which it was decided to form a branch association there and apply for a charter immediately. Steps are also being taken to form associations in Belleville and Brockville. At the time of writing I have in my possession the charter for a new association at Kincardine, Ont., which will be known as Kincardine No. 12, C. A. S. E.; I have also an application for a charter from Wiarton, Ont., this charter will be issued in the course of a few days. There are daily enquiries regarding the C.A.S.E., and also the examinations of the Ontario Association, which goes to show that the engineers of Canada are working up all round, and are beginning to appreciate the work of the Association. I firmly believe that when the convention of 1894 meets in Toronto in September next, we shall be in a position to present a statement showing that during the present year there has been an addition of new associations far outnumbering that of any previous year.

I am just in receipt of a letter from Bro. J. J. York, our enterprising Secretary of the Executive, who informs me that he has just issued a charter for a new association at Winnipeg. I am in receipt of a letter from Bro. Jas. Stuart, engineer Winnipeg Electric & Gas Light Co., who is a member of the new association there, asking for information regarding the educational work of the C. A. S. E. It is evident he intends the Winnipeg association to start aright, and wishes to benefit by the experience of the older associations. To use a common pharse the C. A. S. E. is booming, and there is every likelihood of the boom lasting. The Ontario Association is also doing well, and a large number of engineers are applying for examinations.

Yours very truly,

A. E. EDKINS, Prov. Deputy, Ontario.

QUESTIONS AND ANSWERS.

J. Fielding, Hamilton, Ont., writes: I am poking into electricity. I am puzzled to know what prevents the armature from going around. Men around the dynamos say it is magnetism. I cannot see how the magnetism reaches out from the field and puts as it were a break on the armature when nothing touches it but the brushes. I cannot conceive how a space containing nothing visible can have a something in it that takes in some instances hundreds of horse power to overcome. I once saw a dynamo short circuited. The belt an 8 inch one, slipped on the dynamo wheel and the engine, a 50 h. p. one, was fetched up standing. I do not want to be told that magnetism does this. I want to know how and by the aid of what it does do it, as I cannot see anything connecting field and armature.

ANSWER. If Mr. Fielding ever handled a five cent magnet from a hardware store in his youthful days he surely must have noticed that it exerted an attractive force which could be felt at some little distance from the magnet, although nothing tangible intervened. He cannot understand how anything can be there because he cannot *see* it. Did he never feel the gentle breezes of heaven wafted over his classic brow, but did he see them? Will he not believe anything unless he sees it? Did he ever see the bark of a dog? The field magnets of a dynamo when in operation are very powerful and exert a retarding effect upon the armature but when we are asked what this magnetism is, we give it up.

TORONTO TECHNICAL SCHOOL.

THERE can be but one idea with references to the usefulness of technical schools, and we believe that the majority of the people in civilized countries hold to that idea, namely, that when managed by competent bodies of men forming the board of management, with zealous instructors, duly qualified, under them, nothing could be of greater advantage to the mechanic, anxious to obtain an education in his particular trade, which he could not possibly obtain without them. When in addition to the facts that a technical school exists in any city, and is well governed and managed, the instruction is given absolutely *free*, the boon to the working man is simply immense. That a man should be able to acquire not only an insight into, but a thorough training in the science of his trade by diligent atterdance three or four nights a week in a well lighted and well ventilated building, listening to the instruction given in a manner suited to his ability to grasp it, must be regarded as a very valuable privilege, and men who will not take advantage of all this, must be considered drones of their class. But everything in the success of such an institution must depend upon the zeal of the board of management, and the ability of the instructors. The board of management must be composed of men who are to a greater or less degree experts in the branches they represent; they must be men who will throw themselves into the work of the institution with zeal and unflagging interest, who will carefully watch their several departments and see that those who come up for instruction are receiving all that the school is able to give. Under them must be a supervisor or head master, who is responsible for the direct management of the school, and while capable of taking occasional classes himself, must be able to know that all the other classes are well managed, that the teachers are doing a thorough work and are able to impart instruction.

The teaching staff must not only be persons who have passed qualifying examinations and are experts in their particular lines, but they must have the *faculty of teaching*, which is by no means possessed by every one who may be considered an expert in a particular science. Necessarily, of course, they must have a love for teaching, and the ability to guage the minds of those who come to them for instruction, and be readily able to grasp the meaning of the duller students who have difficulty in expressing their needs succinctly. Patience is a gift that must be possessed by all teachers, and then with a love of the subject and a desire to infuse into the students an equal love of the subject, the qualified expert will be a successful instructor.

We have in Toronto a technical school the general working of which is little known to the public. It is in its infancy, and much that such an institution desires to accomplish, is necessarily beyond the means in hand at present. But it speaks well for the school that the attendance has already become too large for the rooms now occupied, and the work done by the students such as is of a character that can be exhibited, is very creditable to the institution.

The Toronto Technical School has a board of management composed of the Mayor of the city, the chairman of the Executive Committee and three aldermen, ex officio members; two experts in technical education; two stationary engineers; two members of the Council of the Ontario Association of Architects; one manufacturer, and five representatives of the Trades and Labor Council. Of the technical staff, the head master, Mr. Duff, and one other, are B. A's. and graduates of the School of Practical Science; one other is a graduate of the same school; one is a B. A., another a B. A. and M. C., while another is a member of the Ontario Association of Architects, and another a lady, is a B. A., and holds the position of Public Analyst.
on the necessity of proper qualification in the instructors of a school such as the one in question. It may be said that something of the same importance must attach to teachers in all schools, but there is even a greater necessity in an institution of this kind because it is not rudimentary work that is here studied, but work that cannot be successfully carried out but by eminently qualified teachers. Mechanics, chemistry, physics, mathematics, descriptive geometry and drawing cover a wide range of

We have given these particulars because of our insistence upon technical study, both theoretical and practical, starting at a point considerably in advance of the highest grade of public school instruction and stretching forward to an indefinite grade of study in science. One of the important points for first consideration therefore must be: what shall be the highest limit of the instruction given in a particular school. This must be decided by two things: first the amount of funds at disposal for the purchase of apparatus and appliances, and secondly by the requirements of the majority of the students likely to attend. There must be some limit, or the theorist might carry on his course over several years and a great deal of time would be spent in mere speculation, while in practical matters it would be a mistake to go beyond the recognized requirements of particular trades. It has been found necessary to treat in an elementary manner upon some subjects, such for instance as arithmetic and mensuration. A student would profit little by the most excellent instruction in mathematics unless he had a certain fluency in arithmetic, and as most students coming first to the school, have passed some years since they left the public school their arithmetic, except in very simple matters, must necessarily be "rusty" even if they ever learned enough "at school" to enable them to take up the higher branches. Descriptive

geometry and drawing cover, perhaps, a larger field than any other subjects, from practical geometry, drawings of constructions in all trades, the setting out of carpenter and joiners' work (some of which is necessarily indicated) drawings for pattern makers for machinery, up to free hand, ornament and design, and even architecture. Thus this subject illustrates, in a way, the importance of a thoroughly qualified instructor.

Another very important point to which a Board of Management must be thoroughly alive is, that having satisfied themselves with the *qualifications* of the teaching staff, they ascertain from time to time that the teachers are making progress themselves and keeping abreast of the times. It is very easy for an instructor in any subject to "get into a groove" or even to become careless in the preparation of his lectures; the problems he propounds must be progressive and must carry with them important lessons; and again these problems must be suited to the various stages at which the students have arrived. A problem may be in every respect a very excellent one, but if it goes beyond the instruction given, or does not come up to it, it is valueless, for in the one case the student will work it out with the greatest ease as belonging to a stage he has passed, or in the other, it will be a waste of time for him to puzzle over something about which he has not as yet received full instruction. It has been said that the guarantee against failure, in this respect, on the part of the instructor would be, that the students would themselves complain that they did not obtain that which they found of necessity to them. But it must be remembered that the majority of students, probably, would not have sufficient ability to detect any weakness of this kind in the teacher, and few would like to take upon themselves the responsibility and the great unpleasantness of making a complaint. The consequence would be, that one or two, who felt this, but did not see how to help themselves would leave, while the majority would remain and waste their time under the impression that they were progressing. Examinations of students to ascertain their progress would not mend matters or be a sufficient guarantee in the matter. This work of keeping the instructors up to the mark would, we suppose, devolve upon the two experts in technical education. These two experts are Prof. Galbraith and Dr. R. B. Orr, and we find their names head the list of the "School Management Committee." In these two gentlemen we think the public have a thoroughly satisfactory guarantee in this particular.

One point which concerns the public generally more perhaps than any other, and vitally concerns the institution itself, is the salaries paid to the instructors. The suggestion of reduction of question of salaries is now occupying the attention of the Board of Management. Every institution in its infancy, to be a success, must be carried on on the most economical principles consistent with the objects to be attained. An institution of the kind in question requires a large number of appliances for the execution of its work, as well as competent instructors, and the instructors must necessarily be hampered in their work without a sufficiency of appliances. When the appropriation for the work of the school is limited, it becomes a nice question as to what proportion shall be spent in salaries and what in the purchase of appliances, having first deducted from the appropriation the current expenses, such as rent, fuel, light, etc., etc. It seems to us that the subject has not received the attention it deserves at the hands of the board of management, and that the principle in force in the technical school of Toronto is an easy one of disposing of a difficult question, but that it is open to question as to whether it is very fair to the instructors themselves or altogether judicious in view of the limit of the appropriation. We do not for a moment agree with undervaluing the services of qualified teachers, but the point is one of utilizing the funds to the utmost advantage. Out of an appropriation of $7000, $4000 is divided equally among the eight instructors, no difference being made between one who has to spend a large amount of time in necessary preparation of his lectures and one whose subject being practically book work, does not need much time for preparation—between one whose subject is endlessly progressive, and one whose subject is by very nature, a limited science. In the first place $500 seems a large sum for an instructor who having the whole day for earning his livelihood, puts in say three nights a week for about six months of the year, and has little or no preparation to make for his class work at the school. But it does not seem too much for one who has to put in five nights a week for the same time, and has to spend two or three hours a day besides in preparation, even if he is an expert, and thoroughly posted on his subject.

In this institution the principle is that the work of instruction is to be divided up as equally as possible among the eight instructors, and if one has more than he can do in one subject, he must get the assistance of one whose time is not so fully occupied, so that the time of each shall be equally employed and all receive the same remuneration. But is there not a weakness here? The expert in one science is not likely to be an expert in another. If the instructor in drawing had too much on his hands, he could hardly obtain assistance from the expert in chemistry, or the expert in chemistry from the teacher of mathematics. While we do not advocate the reduction of salaries as an all round principle, nolens volens, we think that there would be a decided gain to the institution if the matter were regulated in a rather more practical manner than at present.

The limited space at command of the institution should make the matter of admission to its benefits, one of some consideration. At present any applicant (unless something serious is known against his character for instance) is admitted. A youth may think it will do him good to attend certain classes and he applies for admission; he attends a few nights and "drops out"; another may find it a pleasant way of spending a few evenings a week, taking up much valuable time of the instructor, and learning nothing, or one may come to learn, for example freehand drawing, not for the purpose of improving himself at his trade, but simply as an accomplishment. Thus, the space being limited, these three would shut out others, worthy seekers after knowledge as a means of improvement in their trades, for whom we conclude the institution is primarily intended. Now that the two dollar deposit, originally demanded from an applicant is not required, there is absolutely no guarantee of serious intention on the part of the applicant. Some kind of enquiry should, we think, be made concerning the applicant before admission is granted, of a fuller scope than is supplied by the simple form of application.

There is one other point upon which we wish to touch, that is examinations. The institution, like all others in their youth, cannot be expected to produce in the short time that it has been at work, very great results, and the public should not be disappointed that experts are not turned out at the close of every term. The work is necessarily progressive, and a certain course must be taken (in some classes of two years duration), before the ground is covered. There are certain disadvantages perhaps in permitting each instructor to examine his own class, but there are many advantages, and on the whole this principle really has proved in the majority of institutions to be more satisfactory than the employment of "outside" examiners. The "outside" examiner is generally or should be necessarily an expert among experts, but he has no intimate knowledge of the students he has to examine. Consequently he looks over the work through which the students have waded in the term, concludes that they have reached a certain standard, and he possesses certain or if we may say so, stock or test questions, which, if every student was of the same mental calibre as his neighbor, would no doubt test their abilities very well. But in all classes, there are some students brighter than others, and some who cannot by any means grasp a subject so easily as others. Moreover every examiner knows that many a student fairly well posted in his subject and who has shown great diligence at his work may fail completely at an examination through nervousness or the inability to comprehend the exact meaning of the questioner; while it may happen and has happened that a student may be acquainted with the peculiarities of a particular examiner and come out with flying colours at an examination who really was not so well grounded as the former example. There is a difficulty here that is not easy to get over in the way of satisfying the public that the results of the work are commensurate with the appropriation. A certain amount of result may in some branches be seen, as for instance in the exhibition of drawings executed by students, but even this is not satisfactory, for if a student exhibits a beautiful drawing of an elaborate machine, the public cannot know from the drawing that the student has an accurate knowledge of the use and working of every portion of the machine. A knowledge of algebra and such sciences cannot be exhibited, nor can the result of a two years course of chemistry be practically demonstrated to the public mind. In this matter the public must trust to its representatives on the board of management. The duty of the public to themselves is to see that the best men for the positions are elected to fill these offices and the public may and should scrutinize carefully the work done and the attention given by each member of the board.

A visit to the institution satisfies us that so far as it is able to go, the lines upon which its work is based are very excellent. It is a school worthy of a much larger appropriation, but the foregoing suggestions with reference to improvement in management present themselves, and are worthy we think of investigation.

Our thanks are due to the very courteous reception we met with at the hands of Mr. Duff, and the pains he took to give us the fullest information concerning this valuable institution.

THE MAGNOLIA METAL COMPANY'S ENORMOUS SALES.

The business of the Magnolia Metal Co. in its sales of Magnolia Metal, has increased 12% from January 1893 to January 1894, over the sales of the previous year, notwithstanding one of the greatest panics that the world has ever seen, passed over the country during that time.

The factory of this company has never closed down for one day on account of the panic, and a part of the time it had to run all night in order to keep up the company's orders for Magnolia Metal.

The outlook for the coming year of 1894 is very bright, and the Magnolia Metal Company anticipates an increase of at least 50% over the year 1893.

Meetings of property holders and others interested in the construction of an electric railway from Montreal to Lachine have recently been held, and a general committee appointed to preface a plan of the route, and report at a future meeting.

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

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Information regarding examinations will be furnished on application to any member of the Board.

A LARGE number of the citizens of Toronto petitioned the Ontario Legislature to define the intervals at which a vote on the subject of Sunday street cars should be taken, and to provide such safeguards as would insure the taking of an honest vote. The Legislature by a vote of 17 to 18 decided that a vote may be taken every four years, the first vote not sooner than 1896. It also decided that when such vote shall be taken, manhood suffrage shall prevail.

THE New York State Department of Public Works is reported to have granted an electric company a fifty years' franchise for the construction of an electric plant with which to propel canal boats. A condition of the franchise is said to be that the company shall not charge boat men more than $20 per electrical horse power for each season of navigation. This price it is said is 50 per cent. less than the cost of animal power. We have already referred to the fact that successful tests have been witnessed by the officials of the Department of Railways and Canals at Ottawa, of apparatus designed to operate electrically lock gates on the canals, and no doubt the experiment of operating also the boats by electricity will be tried at an early date.

THE Hamilton, Grimsby and Beamsville Electric Railway Company, who recently petitioned the Department of Customs at Ottawa to allow the steel rails for their new road to be admitted into Canada from Scotland duty free, have been notified that the Government have granted their request. The duty would have amounted to $10,125. As was pointed out recently, the wording of the tariff with regard to the duty on steel rails is ambiguous, but the action of the Government in the present instance would seem to show that rails for electric railway purposes are not considered to be dutiable. It would be desirable in the interest of all parties concerned that the question should be submitted to the courts for decision at as early a date as possible.

RUMORS have been circulating for some time past to the effect that an electric road is projected between the cities of Toronto and Hamilton. There is a very heavy traffic, both of passengers and freight, between these points, and without having considered the matter in detail, it would appear on the surface as though a profitable business might be done along this route. It is now certain that the extension of electric lines throughout the country in the future, will be much greater than was anticipated even five years ago. These electric roads will to a considerable extent take the place of horses and vehicles on country roads in the vicinity of large towns and cities and will also prove formidable competitors to the steam railroads for passenger and freight traffic. The "Good Roads Association" recently formed in Ontario should not lose sight of the possibilities and probabilities in this direction while seeking to determine the character of the construction of roads.

MR. D. ASWORTH closes a paper on Boiler Firing and Management, read before the Engineers' Society of Western Pennsylvania in the following words: It would be proper to ask what degree of intelligence or knowledge would qualify one to fire boilers properly. (1). That the fires should be maintained with uniformity, and that no openings, in the form of bare places, show upon the bars to permit the cold air to pass through. (2). The judgment that will enable him, by a glance at the ash-pit, to know at once, to a great extent, the condition of the fires. (3). He should know something of the various fittings of the boilers and the details of the furnaces. (4). An ambition to grasp the details, so as to qualify him for a still higher plane, which would certainly follow, provided there was judgment enough in his superior to note such details.

A CORRESPONDENT writes us expressing his opinions in a very decided way in opposition to the granting by the Legislature of Ontario of the petition of the Ontario Association of Engineers for legislation to make it compulsory on all engineers operating engines of 15 h. p. and upwards, to present themselves for examination and obtain certificates of competency as may now voluntarily be done under the Engineers' Act. Our correspondent asserts the opinion that if engineers are to be compelled to undergo examination and obtain certificates, the examinations should be conducted by the Government and not by a body of engineers. He argues that a man who does not belong to the Engineers' Association, and who may not have the time or the disposition to become a member of that organization, would be likely to stand prejudiced in the eyes of the members of the examining board, as at present constituted, if he should be compelled to present himself to them for examination, and that it is quite unlikely that such a man would be granted the required certificate. The point of his contention is that the members of the present examining board are competitors for positions with those who go up for examination, and therefore might be supposed to be interested in withholding certificates from them.

MEETINGS OF THE MONTREAL ELECTRIC CLUB.

Feb. 12—Several of the members submitted draughts of wiring specifications for the use of architects in calling for tenders. After a lively discussion, the matter was left over till the next meeting for final consideration.

Feb. 26—Mr. J. A. Anderson read an interesting paper on "The Telephone" for which he was given a vote of thanks. The wiring specifications were then brought up for consideration and after careful discussion a particular form was adopted.

MONTREAL JUNIOR ELECTRIC CLUB.

The above Club have held weekly meetings at No 6 Richmond avenue, at which papers were read as follows:

Feb. 25th—Paper on "Incandescent Lamps," by S. W. Smith.

March 4th—Paper on "Arc Lamps," by R. H. Street.

March 11th—Paper on "Edison Three Wire Meter and Westinghouse Meter," by E. W. Sayer.

March 18th—Paper on "Induction and Induction Coils," by Wm. T. Sutton.

The address of the Secretary of the Club, Mr. O. H. Overton, is 19 Brunswick street, not Burnside street, as given in our last issue.

QUESTIONS AND ANSWERS.

SHERBROOKE, P. Q., March 9th, 1894.

Editor ELECTRICAL NEWS.

Sir,—There is a discussion going on amongst the men in our electric station in connection with our arc light circuit and dynamos. We have a circuit with 65 arc lamps from two Ball dynamos, 35 lights each. We find that by connecting the two dynamos, we get a steadier current on our lines. Each lamp takes say 50 volts, and for 65 lamps makes 3250 volts. The discussion is: are there 3250 volts pressure on each dynamo, or simply each dynamo exerts an E. M. F. only equal to its own capacity, whatever it may be built for, or whatever number of lamps up to its capacity may be in use. I trust you will understand what I wish to get at.

Yours very truly,

A. SANGSTER,

Supt. Sherbrooke Gas and Water Co.

ANSWER.—The tension in each dynamo is that due to the electromotive force it is generating itself; the total electromotive force in the circuit is that due to the sum of the combined machines.—[ED. NEWS.

The annual meeting of the shareholders of the Victoria Electric Tramway and Lighting Company of Victoria, B. C., was held a few days ago, at which the annual report and financial statement was presented. The report showed the company to be in a prosperous condition. Mr. T. S. Gore was elected a member of the Board of Directors to fill the vacancy caused by the resignation of Hon. D. W. Higgans. The other members of the Board were re-elected. At a subsequent meeting of the directors, the following officers were elected: President, C. T. Dupont; Vice-president, Dr. T. J. Jones; Secretary, T. S. Gore; Auditors, Messrs. Raymur and Berridge.

ABOUT PACKING.

If the rod is in first-class condition almost any kind of packing will answer the purpose, but where it is scored or worn tapering, or is out of line, we must use a packing that will follow up the inequalities in its travel, and to do this without excessive friction the packing must be very elastic. The following plan is a very good one, says the American Machinist.

Suppose that the stuffing box is 4 inches in diameter and the rod is 2.5 inches, leaving a space three-quarters of an inch wide to be filled with packing, and assume that the stuffing box is 3¼ inches deep. Take a piece of pure gum rubber sheet packing, without cloth insertion, which is one-quarter of an inch thick, and cut a piece from it 3 inches wide, and of such a length that when it is rolled up into the form of a circle, it will form a bushing for the stuffing box, reducing the space around the rod to ¼ inch in width. Care must be taken to cut this so that the ends will meet squarely, leaving no space between them, for this bushing of rubber must be a perfect fit in order to be effective. Next take a piece of firmly made packing, which is ¼ inch square, and cut rings enough to pack the rod out flush with the rubber bushing, which we made 3 inches deep, thus taking six rings. These rings should be of such a length that when they are in place there will be at least ¼ inch between the ends. They must never be cut so as to make a tight fit, although it makes a neater looking job in that way, for, unless there is room for the rings to expand, the heat will cause excessive friction, sometimes to the extent of burning out the packing and scoring the rod.

We have left a space ¼ inch deep, which is sufficient for the gland to enter, but the nuts which hold it in place should not be screwed up with a wrench, but with the fingers only. If there is a leak of steam when the engine is started, it will do no harm for an hour or two, but if the expansion does not take it up then, the nuts may be screwed up until the joint is tight, but no further, for obvious reasons. If packing put in according to these directions does not abolish the disagreeable hiss of steam at each revolution of the engine, I do not believe that any other kind of fibrous packing will do it, and the rod should be turned true and put into line.

So far as flange joints are concerned, it is a very good plan to have them ground so that no packing will be required, but as many of them are not built that way, it remains to select the packing which will render the best service. If the steam is not saturated with oil, we may select any elastic grade that is most convenient, but the flanges of the throttle valve, and any other that may be beyond the lubricator, must be packed with something that will not be dissolved by the oil. A corrugated copper gasket for each of such joints will answer a very good purpose, unless the faces are very rough. If we are to use soft packing, it is well to take a small piece of it, and put it in a cup of oil, and let it remain for about a week. There are several kinds in the market that will not stand this test, for when taken out there will be but little left of them, as they will be either partially or wholly dissolved, but others will be just as good as new after the test, and these should be used exclusively.

Flange joints, when newly packed, should not be suddenly subjected to a heavy pressure, but should be warmed up gradually, and while still under a very light pressure, the nuts should be carefully screwed up until all of the lost motion caused by the relaxation of the packing is taken up. Under no circumstances is it proper to screw up these nuts under a heavy pressure, for if one of them should fail, the additional strain thrown on the others might cause them to break, and a serious accident would be the result.

In making up these joints do not begin on one side and screw up the nuts in rotation, as that will cause the flanges to be brought together on one side, and thrown open on the other, and then when this side is tightened up also, if it does not break the flange, it will cause a very heavy strain to be brought to bear on the bolts, much of which is entirely unnecessary.

In using old bolts for this purpose, they should be put in a vise, well oiled, and the nuts run down on them, until it is known that they are an easy fit a little farther down than they will ever be needed when in place. If this precaution is not taken, it is quite possible for the bolts to be twisted off before the flange is together properly.

In packing a cylinder head it is not necessary to have a large rubber gasket, as some asbestos wicking will answer every purpose at a very low cost. In packing a large valve stem, which is worn down, or has been turned down until it no longer fills the hole in the bonnet, a washer or gasket cut from thick pieces of cloth-insertion sheet rubber packing will answer a very good purpose, if put in first, or if the gland is a loose fit it may be put in last, to prevent the wicking from working into the space around the stem.

The Mayor of Bracebridge, Ont., has been requested by the Council to correspond with electric light companies regarding an electric light scheme.

The City Council of Victoria, B. C., has passed a by-law authorizing the issue of debentures to the amount of $50,000 for the purchase of an electric light plant and the erection of a building for the same. The by-law is to be submitted to the ratepayers.

The claim of the City of Toronto against the old Street Railway Company for the sum of $146,000, being the cost of certain local improvements for which the company is alleged to be liable, is at present occupying the attention of the Supreme Court at Ottawa.

PRACTICAL HINTS TO ENGINEERS ON THE MANIPULATION OF DYNAMOS AND ELECTRICAL PLANTS.*

BY JAMES MILNE.

MR CHAIRMAN AND GENTLEMEN.—I don't propose to go elaborately into the technical or mechanical construction of dynamos and electrical plants in general but for those who may not be sufficiently informed as to the manipulation of dynamos or plants under their charge, I simply wish to assist them as far as is possible to do for the short time I am here.

Engineers as a rule wish to get to the bottom of things, and like to know how this is done how this is arrived at who invented this and that and the other thing and I think they are perfectly justified in finding out everything pertaining to the machinery they are in charge of, whether electrical or mechanical. A man is certainly a very poor tool indeed if he is in charge of any machinery and does not know thoroughly both the practical and theoretical workings of same, and he is certainly a great deal worse, knowing where he is deficient, if he does not strive to get the requisite information.

I am sorry to state, in quite a large number of stations and plants I have had the pleasure of visiting, that the lamentable ignorance displayed by those in charge of dynamos or running same, is about the first thing that attracts one's attention, in fact, you would wonder sometimes how they pulled through. If the question is asked, "How is the current generated?" &c., &c., you get an answer, but what sort of an answer is it? It is one of these that you feel sorry for the party endeavoring to disentangle himself from the labyrinth he has worked himself into. If he had said that his knowledge on that point was limited, there would have been some excuse, but it would not do under any consideration whatever to let a visitor to his plant think that he did not thoroughly understand the workings of same.

A man should be able to think for himself, and if he depends on some one else doing the thinking for him all the time, he will never make much headway in the world. I don't mean by this that one should be above asking a question or seeing how things should be done, but see that you thoroughly understand why or how it is done—this way or that way, as the case may be—and try and avoid if possible doing it this way because you saw some other party doing it unless you comprehend just why it was done in that manner.

Let us now come to the more interesting part of our paper. Faraday about 1831 discovered that electric currents were generated in conductors by moving them in a magnetic field. Let us see what that means. When a conductor is moved in a field of magnetic force in any way so as to cut the lines of force, there is an electromotive force produced in the conductor in a direction at right angles to the direction of motion and at right angles also to the lines of force as received from the point from which the motion originates. By examining Fig. 1 it represents the case very clearly. The conductor is marked C, the direction of the current is indicated by the fore finger, the direction of motion or rotation is as shown by the middle finger, and the direction of magnetic force is indicated by the thumb.

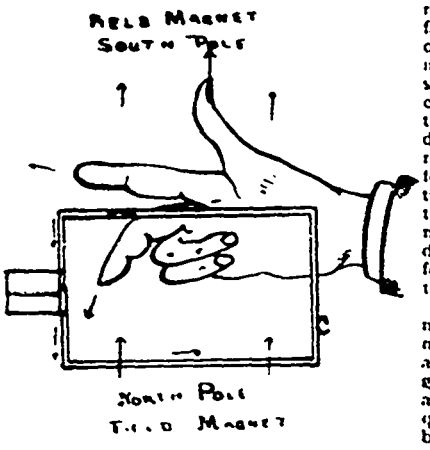


FIG 1

A dynamo can be made to run as a motor just as efficiently as when running as a generator. The only alteration that is required is to cross the brush leads in series and compound wound dynamos. The shunt wires in the latter have also got to be crossed. In shunt wound motors no alteration is made on the brush leads.

It is quite possible in running electric light plants, when quite a number of generators are in parallel, to run a dynamo as a motor and scarce y know it. This does not mean, however that the brush leads have go. to be altered, for a dynamo in a station will run as a motor without any alteration with wiring whatever. Suppose one dynamo is running say at 110 volts, and it is found necessary to couple on another one with it—just the same as if we had one boiler at 110 lbs. and the load getting too heavy for same, and we wish to cut in a second one. If the pressure on the second boiler is only 80 lbs. no benefit will be derived from same, in fact the reverse is the case, as in a probability, primings, &c., will be caused. It is much about the same with the dynamo if we cut the second one in at say 80 volts instead of 110. It means a difference of 30 volts and this difference runs the dynamo and engine instead of same assisting generator No 1. The effect on the first machine is simply that it overloads it the lights probably go down in brilliancy, and if it is a big overload and the attendant slow in rectifying the matter, the armature on dynamo No. 1 may be burned out. The ammeters will register the same as if the machine was generating current instead of simply absorbing the power generated by the other machine to the extent of the motor load, as it really does. The direction of rotation remains the same the brush leads have not been altered in any way. The current is going round the fields in the same direction as it did when running as a dynamo. I will draw a figure to illustrate this. Fig 2 shows the direction of the current from the machine and through field coils when running as a generator and Fig. 3 shows the direction of the currents in the same machine when running as a motor. You will observe the current goes through the field coils in the same direction in each although the current through the armature is going in the opposite direction. Fig. 4 shows the current through the armature apparently going in the same direction as in Fig. 2, but as same is a motor, and what is + on the one is really − on the other, although the arrows point in the same direction. You will observe that the shunt wires are crossed. By reversing the direction of rotation the polarity of the wires is also reversed, but the polarity of the field remains the same owing to the simple fact that the current is going through the coils in the same direction by the crossing of the shunt.

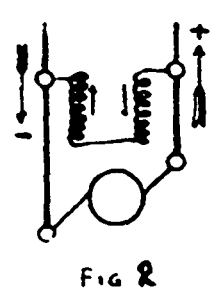


FIG 2

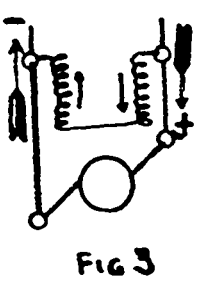


FIG 3

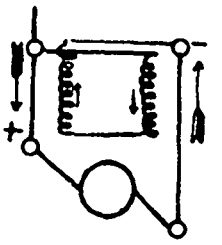


FIG 4

The electromotive force is proportional to the number of lines of force cut per second, and is therefore proportional to the intensity of the magnetic field and to the length and velocity of the moving conductor. The more powerful the magnetic field, the stronger will be the current generated. Looking at it from another standpoint—say a steam engineer's—the more steam admitted into the cylinder the more power derived from the engine, the faster the engine runs, still more the power. In all or nearly all generators the strength of the current can be altered at pleasure—some by altering the speed of the engine, others by moving the pole pieces to and from the armature, but I dare say the most common method is by changing the resistance of the field circuit and allowing a greater or a less amount of current to flow through the coils; to produce a greater current the resistance being cut out, and the opposite is done for a less current. By referring to Fig. 5 the arrangement is seen very clearly. When the current to the fields is going through all the coils marked 1-7, part of it is lost in overcoming the resistance, and by gradually cutting out any or all of the coils any combination can be obtained to the extent of rheostat.

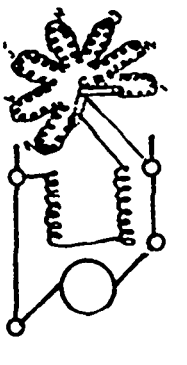


FIG 5.

When the contact piece is as shown by the full line, the current is going through all the coils, and if same were turned to the position as indicated by the dotted line, none of the current would pass through the resistance coils at all; there would be no obstruction, as it were, offered to the flow of current through the field coils except the resistance of the coils themselves. The dynamo at this point is doing all the work it can do provided same is running at the proper speed. If, however, more current than this is required, well, the only alternative is to increase the speed of your machine. This can be done in many ways and I presume all engineers here to-night are conversant with them.

The rheostat or resistance box could be compared to a steam or water valve. If we wished to send a small quantity of steam or water through a set of coils, we introduce a resistance, or obstruction, as it were; this obstruction is in the form of a valve. By regulating the valve any combination of quantities can be obtained, from wide open to almost shut. If, however, we want to get more steam or water through than we can with valve wide open, in ordinary running, we have simply to increase the pressure or head, as the case may be.

When the flow of current is steady, it is immaterial what kind of magnets are used to procure the requisite magnetic field—whether permanent steel or electro magnets, self-excited or otherwise. The current as generated by the machine may be utilized to excite the magnetism of the fields by being caused wholly or partially to flow around the field coils. Let us look for a moment at the most common methods of exciting same—

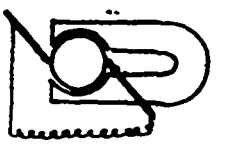


FIG 6

1st. With permanent steel magnets, as the ordinary magnet machine used in telephone work, fig 6.

2nd. Separately excited machine, i e., machines with fields excited from some external source otherwise than from the machine itself. Fig. 7.

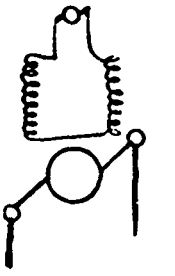


FIG 7.

3rd. Separate coil machines. The armature in this case is wound with two distinct windings—one for the external circuit and the other for exciting the fields. It is practically a double machine.

4th. Shunt wound. This is one of the most common forms of dynamos. The fields are excited by a small portion of the whole current generated being let through the coils. Fig. 2 represents a shunt wound machine.

5th. Series machine. All the current generated by the armature is used to excite the fields. Ordinary arc machines are series wound and would be shown diagramatically, as Fig. 8.

6th. Compound wound. This is another very common form of machine. Compound wound means, of course, two windings, same as a compound engine means an engine with two cylinders.

Let us now consider the three latter, viz., shunt, series, and compound wound dynamos.

For incandescent lighting, continuous currents, the shunt and compound wound machines are generally used. There are, however, several series wound machines in use for the same purpose, generally street lighting, but we will not consider them here to-night. In a shunt wound machine the E. M. F diminishes when the resistance of the external circuit is reduced, that is to say, supposing the engine, etc., to be running at precisely the same speed and more light turned on, the pressure at the dynamo terminals, and consequently at the mains, is reduced. To rectify this, and bring same to its normal pressure, we have got to supply more current to charge the fields, this is simply done by cutting out the resistance as shown in our preceding diagram, fig. 5. As we said before, the pressure diminishes as the resistance of the external circuit is reduced. It may occur to some that turning on more lights increases the resistance; such is not the case, however, as the more lamps turned on the greater is the number of paths for the current to go through. If the resistance of one lamp is 200 ohms, the resistance of a number of lamps in multiple is therefore 200÷ the number of lamps. If a curve were drawn showing the fall in pressure as the resistance diminished, it would be something like Fig 9, until same (the E. M. F.) is increased by the extra current going through field coils.

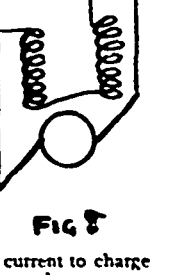
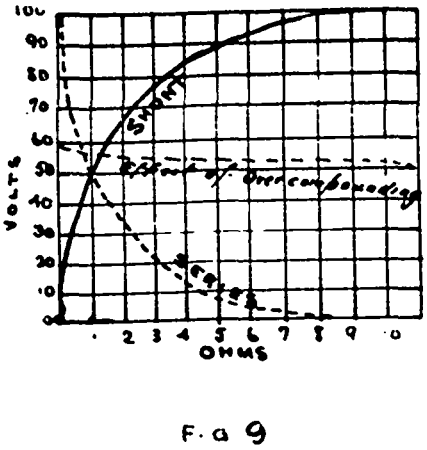


FIG 8

In a series wound machine the pressure increases when the resistance of

* Paper read before the Canadian Marine Engineers' Association

the external circuit is decreased—just the opposite effect of the shunts. If same were drawn or plotted out, it would be something like the dotted line shown on Fig. 9. On examining the two curves you will no doubt observe that one is almost directly opposite of the other, and it may occur to some of you that by combining the two windings a different result would be obtained. This is exactly what is done in compound wound machines. The aim in compound winding is to have a constant potential at the lamps or brushes, as the case may be, regardless of the load. Suppose we have a cubic foot of steam at say 100 lbs., and another at 50 lbs., and we mix same together—we get two cubic feet at about 75 lbs. pressure. Now, by looking at these curves you will observe that one starts from 100 and descends to 0, the other starts from 0 and ascends to 100, so by combining the two an average of 50 volts is obtained. Many machines, however, are overcompensated, that is to say, they are wound with a little extra series winding so that the pressure rises slightly as the load increases. This is a very desirable thing in many cases, as it compensates for any losses that may exist in the wiring.



F. a 9

You will observe sometimes stamped on machine, "Wound for 10% loss." What does that mean? It means simply that if we had 100 volt lamps on our system, and running this dynamo to full load, the pressure at the terminals would be about 111 volts. This increase is done automatically by the effect of the extra series winding. Should only half the number of lights be burning, the loss would only be the half of 10%=5, consequently our machine would be running at about 105 volts, although the pressure at the lamps themselves is only 100 volts. If we had a steam plant arranged *in this manner, it would be something like this. We have, say, 10 engines,* and the initial pressure at same to give the correct power must be 100 lbs. There is a loss of 10 lbs. between the boiler and the engines owing to the piping being too small, not properly covered, etc., when running at full load, and about 5 lbs. when running five engines. It therefore stands to reason that the pressure at the boiler has to be 111 and 105 lbs. respectively, so that the required initial pressure may be had at the engines. The raising of the steam pressure is done, of course, by the fireman, who answers the same purpose to the steam plant as the extra series winding does to the dynamo. This, I think, explains very clearly the compound winding and the extra compounding for certain percentages of losses in the external circuit.

We will now come to the second part of our lecture. In it we shall treat upon the practical working of the dynamos, and see their behavior, the troubles that arise, and how to get over them.

The troubles that generally affect the running of a dynamo may be briefly summarized as follows. Sparking at brushes; ring of fire around commutator; *burning out of armature coils, grounded armature and fields, short*-circuiting of external circuit.

Sparking at the brushes may be caused in a multitude of ways, viz., brushes not set diametrically opposite, not set at the neutral point, not bearing properly on commutator, not having sufficient pressure, brushes filled with dirt and oil, commutator dirty, high or low bars in commutator, poor connection between the armature coils and commutator bars, section short-circuited either in armature coils or in commutator, commutator worn in ridges, out of truth, dynamos overloaded and armature damp—will all cause sparking at the brushes. Too much care can never be bestowed on the filing and proper adjusting of the brushes. One can almost tell at a glance what sort of a man is in charge of a dynamo by seeing the condition of the brushes and commutator. If he is a careful attendant everything will be kept in the best possible condition. Brushes should be set with the least possible pressure; not, however, too loose, so that they will spring off. Should a high or a low bar make itself manifest during a run, the tension on the brushes has to be increased until such time as the defect is remedied. *To rectify a high bar*, one method is to drive same down flush with the rest of the commutator and screw up the collar; the other is to file same down flush. If the bar is low, screw up the collar firmly and turn the rest of the commutator down to suit.

A loose connection, or a poor joint between armature coil and commutator, will make itself apparent at every revolution. It will show at the particular bar having the loose connection. A "flat" will be caused thereby on the commutator and it would appear that this segment was made of softer material than the rest. The whole trouble originates, however, from the bad connection. This should be rectified with as little delay as possible, for time does not improve matters any. The remedy for this is to unsolder the joint and scrape the wires thoroughly clean and see that same are properly tinned and soldered up in good style. This appears to some to be a very easy job, but if great care is not taken the matter will be made worse instead of better. Some think that if the joint looks all right from the outside then everything is all right, but sometimes you will run across a joint where to all appearances everything is perfect, and it sometimes seems a pity to disturb same, but when you unsolder it a different state of affairs is seen. The wires are not even cleaned; solder has never been near them. Have all wires thoroughly cleaned before you attempt to solder them. This fault, viz., poor connection, scarcely shows up until after a machine has run a short time.

When a section is short-circuited or burnt out, unless the attendant is thoroughly familiar with the winding, it will perhaps be better for him not to attempt to repair same. One way out of the difficulty, if a spare armature is not at hand and the lights must be kept going, is simply to cut out the injured coil altogether. Disconnect same from the commutator and the two adjacent bars to which the coil was connected and join same together with a piece of wire not smaller than the rest of the winding. You are now running the armature minus that coil or coils. It will run this way for a long time and give excellent satisfaction. It should be repaired, however, the very first opportunity.

If the armature is damp the dynamo should not be started up until same is rectified. It is very seldom that an armature becomes damp if it is used every now and again. It is more likely to be this way when starting up the machine for the first time, owing probably to same being not sufficiently packed up or taken care of in transit. The remedy is simply to bake same above the boilers or beside a stove.

Sometimes a ring of fire is seen around the commutator. This is not a very serious matter and can easily be got rid of. It is caused by particles of copper getting in between the commutator bars, thereby making a local short circuit from bar to bar across the insulation. This is most likely to occur when the commutator has been filed or turned up, and to remedy this examine each segment carefully and remove all particles of copper connecting any of the bars together.

Burning out of fields very seldom occurs, and we need not lose much time on this. It is an easy matter to test which *field is burned out by an ordi*nary magneto bell.

Armature grounded. This is quite a common trouble, and one liable to give serious results if not attended to. If only one coil is grounded no great harm can result, but should another one get grounded it is simply a question of a few seconds before same is useless. Again, suppose one coil is grounded and the machine not properly insulated from "earth," a short circuit is formed through the armature to ground and the armature is burned out as before. It is a very easy matter to test for a grounded armature or a grounded machine, and no excuse should be taken for this state of affairs, especially the machine being grounded.

Reversal of polarity is a trouble that no one will experience with generators running in multiple. It is only when run in series that this occurs. I need not therefore take up your time with this, but should anyone desire to know the easiest and quickest method of recharging the fields I will be happy to inform him at the close of the paper.

"Short circuit" is a word I think familiar to every one. The *technical meaning, however, may not be so familiar. It is "a shunt of low* resistance introduced into a circuit either accidentally or otherwise." This is without doubt the most frequent trouble in running dynamos. They range from what is called a short-circuited lamp, taking 1/4th of a H. P. to burn out, to the "ground," taking several thousand H. P. to get rid.

How does a short circuit affect a dynamo or dynamos in the manner they do? Suppose we have got a small engine, say 50 H. P., and a 500 light dynamo with the full complement of lamps installed. The current required for 500 lamps is about 220 amperes. You can arrive at this result in the following manner. The resistance of one lamp is 220 ohms; R. of 500 lamps = 220 ÷ 500 = say .5 ohms. The current required according to Ohm's law, which is $C = \frac{E}{R}$ would therefore be $C = \frac{110 \text{ volts}}{.5 \text{ ohms}} = 220$ amperes. $\frac{220 \times 110}{746} = 33$ E. H. P. + 20% for losses in armature and field coils, and 20% for friction, etc., making an indicated H. P. of about 45. We will not *take into consideration the resistance of the wiring, as same is supposed to* be very little, but the extra allowance on the resistance of the lamps will make up for this. It is accurate as far as our needs are at present. A piece of wire or anything metallic having little resistance comes in contact with the two conductors. We will say the resistance of same is .25 ohms. This shunt or wire will carry, if same has good contact, twice as much current as we have already on our machine, viz., 440 amperes, for by applying the same rule as before, viz., $\frac{110}{.25} = 440 =$ about 70 H. P. This amount of current would flow if the engine and dynamos were capable of transmitting same, and the safety appliances at that time were, as usual, out of order. We said our engine was 50 H. P., and we were running same up to 45 H. P.; another load of 70 H. P. has come suddenly on, or an overload on dynamo and engine of about 130%. What is the result? Is it to be wondered at that armatures give out or engines are disabled?

There are or should be in every installation safety devices for breaking *the circuit when* a load of more than the safe carrying capacity of the wires comes on. They should be carefully adjusted to the requirements of the system, so as to come into play when the load reaches a certain percentage above the normal. Sometimes one of these safety devices, or cut-outs, persists in burning out, showing clearly that something is wrong. Instead of tracing out the trouble, the attendant having too much to do, or "hasn't time"—that never failing excuse—puts in a larger fuse, or piece of copper wire, so that same *will not* burn out. This is something similar to tying down a safety valve on a boiler so that same will not blow off when the correct pressure is reached. The results we are all familiar with, especially when they bring the factor of safety to a minus quantity. Having now put in a bigger fuse, one larger than the carrying capacity of the conductors, and as we have indicated, there is a short circuit on the line by the safety fuses giving out, the switch is now closed. What is the result?—a fine display of fireworks, and in all probability an armature gone!

In central stations where there are thousands of horse power at command, it is common practice to burn out grounds or short circuits. A ground is without doubt the worst kind of a short circuit, the earth in the case being the shunt, and is the worst trouble that can come over an electric light plant. Grounds always develop when running at a light load. When one does come on no time has to be lost in getting rid of same. It is simply a case of cutting in engine after engine, dynamo after dynamo, until you have got sufficient power to burn it out.

It is only when trouble arises in an electric plant that the necessary qualifications of those in charge are made manifest. One must be able to grasp the situation at a glance, know exactly what the trouble is and rectify same with the least possible delay. Presence of mind, calm and correct judgment, quick action, all combined, are all necessary in cases of emergency.

Short circuits will scarcely burn out a shunt wound dynamo, for as we saw in the former part of the paper, when the resistance of the external circuit is diminished the E. M. F. goes down. Now, when a short circuit or ground comes on it is neither more nor less than a big load, and if the machine is not strong enough to burn out same, the E. M. F. will gradually diminish until there is no pressure whatever to do any harm. With series and compound wound machines the results are different. We also saw before that the E. M. F. increased when the resistance of the circuit diminished, that is, when the load is increased. In the compound wound, the shunt winding simply becomes inoperative, and the series winding increases the pressure, etc., to such an extent that the dynamo simply burns itself up in the attempt to meet the demands made upon it. As nearly all dynamos in steam boats, street railway power houses, and all central stations, excepting probably Edison, are compound wound, it is not to be wondered at the large number of accidents which occur to engines and dynamos when subjected to such enormous overloads.

We will suppose that we have got in our possession a street railway power plant of say five 500 H. P. engines, and generators, etc., to suit. Devices known as circuit breakers are put in each circuit leading from the generators to the feeders. These circuit breakers answer the same purpose to the street railway plant as the safety fuses do to the lighting plants. It is very often these safety appliances do not operate when they are required to, or they are so arranged that they will *not* operate—generally the latter—and in many cases do serious damage. A heavy ground comes on our

plant the circuit breakers respond almost immediately to the overload on four of the generators, but the fifth one fails to act. What is the result? This engine and dynamo has not only got the 'ground' to contend with, but has also got the load of the other four generators, making probably a load of about 3000 H. P. on this engine and dynamo, if same were capable of transmitting same. Surely quite enough to wreck any 500 H. P. engine and generator?

Before finishing up, I wish to draw your attention to one other item, viz., cleanliness. *We are told in the good book that cleanliness is next to godliness.* I think this applies more directly to electrical apparatus than any other machinery in existence. I have not come across in the aforesaid book that my electrical plants were in existence when the above phrase was written but I think there must have been. Keep everything in order, keep everything in the cleanest possible state, have all contacts bright and switches in good order. All switches should carry their rated load with little or no heating up. Where there is heat in conductors or switches there is a loss. Overcome all these losses. If everything is kept scrupulously clean there will be very little trouble experienced in running isolated plants. Some machines on examination would reveal the fact that same were for making copper dust instead of generating current, have no copper dust lying around dynamos, as this is one of the first causes of trouble.

In conclusion, I wish to thank you for the very patient manner in which you have all listened to me, and I hope that some will be benefitted thereby.

ON LIGHT AND OTHER HIGH FREQUENCY PHENOMENA.

BY NIKOLA TESLA.

(Concluded.)

In regard to the incandescence of a refractory button (or filament in an exhausted receiver, which has been one of the subjects of this investigation, the chief experiences, which may serve as a guide in constructing such bulbs, may be summed up as follows: 1. The button should be as small as possible, spherical, of a smooth or polished surface and of refractory material, which withstands evaporation best. 2. The support of the button should be very thin and screened by an aluminum and mica sheet, as I have described on another occasion. 3. The exhaustion of the bulb should be as high as possible. 4. The frequency of the currents should be as high as practicable. 5. The currents should be of a harmonic rise and fall, without sudden interruptions. 6. The heat should be confined to the button by enclosing the same in a small bulb or otherwise. 7. The space between the walls of the small bulb and the outer globe should be highly exhausted.

Most of the considerations which apply to the incandescence of a solid just considered may likewise be applied to phosphorescence. Indeed, in an exhausted vessel the phosphorescence is, as a rule, primarily excited by the powerful beating of the electrode stream of atoms against the phosphorescent body. Even in many cases, where there is no evidence of such a bombardment, I think that phosphorescence is excited by violent impacts of atoms, which are not necessarily thrown off from the electrode, but are acted upon from the same inductively through the medium or through chains of other atoms. That mechanical shocks play an important part in exciting phosphorescence in a bulb may be seen from the following experiment. If a bulb, constructed as that illustrated in Fig. 10, be taken and exhausted with the greatest care so that the discharge cannot pass, the filament f acts by electrostatic induction upon the tube t, and the latter is set in vibration. If the tube o be rather wide, about an inch or so, the filament may be so powerfully vibrated that whenever it hits the glass tube it excites phosphorescence. But the phosphorescence ceases when the filament comes to rest. The vibration can be arrested and again started by varying the frequency of the currents. Namely, the filament has its own period of vibration, and if the frequency of the currents is such that there is resonance, it is set easily vibrating, though the potential of the currents be small. I have often observed that the filament in the bulb is destroyed by such mechanical resonance. The filament vibrates as a rule so rapidly that it cannot be seen, and the experimenter may at first be mystified. When such an experiment as the one described is carefully performed, the potential of the currents need be extremely small, and for this reason I infer that the phosphorescence is then due to the mechanical shock of the filament against the glass, just as it is produced by striking a loaf of sugar with a knife. *The mechanical shock produced by the projected atoms is easily* noted when a bulb containing a button is grasped in the hand and the current turned on suddenly. I believe that a bulb could be shattered by observing the conditions of resonance.

In the experiment before cited it is, of course, open to say that the glass tube upon coming in contact with the filament retains a charge of a certain sign upon the point of contact. If now the filament again touches the glass at the same point while it is oppositely charged, the charges equalize under evolution of light. But nothing of importance would be gained by such an explanation. It is unquestionable that the initial charges given to the atoms or to the glass play some part in exciting phosphorescence. So, for instance, if a phosphorescent bulb be first excited by a high frequency coil by connecting it to one of the terminals of the latter and the degree of luminosity noted, and then the bulb be highly charged from a Holtz machine by attaching it preferably to the positive terminal of the machine, it is found that when the bulb is again connected to the terminal of the high frequency coil, the phosphorescence is far more intense. On another occasion I have considered the possibility of some phosphorescent phenomena in bulbs being produced by the incandescence of an infinitesimal layer on the surface of the phosphorescent body. Certainly, the impacts of the atoms are powerful enough to produce intense incandescence by the collisions, since they bring quickly to a high temperature a body of considerable bulk. If any such effect exists, then the best appliance for producing phosphorescence in a bulb, which we know so far, is a disruptive discharge coil giving an enormous potential with but few fundamental discharges, say 25-30 per second, just enough, to produce a continuous impression upon the eye. It is a fact that such a coil excites phosphorescence under most any condition and at all degrees of exhaustion, and I have observed effects which appear to be due to phosphorescence even at ordinary pressures of the atmosphere, when the potentials are extremely high. But if phosphorescent light is produced by the equalization of charges of electrified atoms (whatever this may mean ultimately), then the higher the frequency of the impulses or alternate electrifications, the more economical will be the light production. It is a long known and noteworthy fact that all the phosphorescent bodies are poor conductors of electricity and heat, and that all bodies cease to emit phosphorescent light when they are brought to a certain temperature. Conductors on the contrary do not possess this quality. There are but few exceptions to the rule. Carbon is one of them. Becquerel noted that carbon phosphorescences at a certain elevated temperature preceding the dark red. This phenomenon may be easily observed in bulbs provided with a rather large carbon electrode (says a sphere of six millimetres diameter). If the current is turned on after a few seconds, a snow white film covers the electrode, just before it gets dark red. Similar effects are noted with other conducting bodies, but many scientific men will probably not attribute them to true phosphorescence. Whether *true incandescence has anything to do with phosphorescence* excited by atomic impact or mechanical shocks still remains to be decided, but it is a fact that all conditions, which tend to localize and increase the heating effect at the point of impact, are almost invariably the most favorable for the production of phosphorescence. So, if the electrode be very small, which is equivalent to saying in general, that the electric density is great, if the potential be high, and if the gas be highly rarefied, all of which things imply high speed of the projected atoms, or matter, and consequently violent impacts—the phosphorescence is very intense. If a bulb provided with a large and small electrode be attached to the terminal of an induction coil, the small electrode excites phosphorescence while the large one may not do so, because of the smaller electric density and hence smaller speed of the atoms. A bulb provided with a large electrode may be grasped with the hand while the electrode is connected to the terminal of the coil and it may not phosphoresce; but if instead of grasping the bulb with the hand, the same be touched with a pointed wire, the phosphorescence at once spreads through the bulb, because of the great density at the point of contact. With low frequencies it seems that the gases of great atomic weight excite more intense phosphorescence than those of smaller weight, as for instance, hydrogen. With high frequencies the observations are not sufficiently reliable to draw a conclusion. Oxygen, as is well known, produces exceptionally strong effects, which may be in part due to chemical action. A bulb with hydrogen residue seems to be most easily excited. Electrodes which are most easily deteriorated produce more intense phosphorescence in bulbs, but the condition is not permanent because of the impairing of the vacuum and the deposition of the electrode matter upon the phosphorescent surfaces. Some liquids as oils, for instance, produce magnificent effects of phosphorescence (or fluorescence?), but they last only a few seconds. So if a bulb have a trace of oil on the walls and the current is turned on, the phosphorescence only persists for a few moments until the oil is carried away. Of all bodies so far tried, sulphide of zinc seems to be the most suspectible to phosphorescence. Some samples obtained through the kindness of Prof. Henry in Paris, were employed in many of these bulbs. One of the defects of this sulphide is, that it loses its quality of emitting light when brought to a temperature which is by no means high. It can therefore, be used only for feeble intensities. An observation which might deserve notice is, that when violently bombarded from an aluminium electrode it assumes a black color, but singularly enough, it returns to the original condition when it cools down.

The most important fact arrived at in pursuing investigations in this direction is, that in all cases it is necessary, in order to excite phosphorescence with a minimum amount of energy, to observe certain conditions. Namely, there is always no matter what the frequency of the currents, degree of exhaustion and character of the bodies in the bulb, a certain potential (assuming the bulb excited from one terminal) or potential difference (assuming the bulb to be excited with both terminals) which produces the most economical result. If the potential be increased, considerable energy may be wasted without producing any more light, and if it be diminished, then again the light production is not as economical. The exact condition under which the best result is obtained seems to depend on many things of a different nature, and it is to be yet investigated by other experimenters, but it will certainly have to be observed when such phosphorescent bulbs are operated, if the best results are to be attained.

Coming now to the most interesting of these phenomena, the incandescence or phosphorescence of gases, at low pressures or at the ordinary pressure of the atmosphere, we must seek the explanation of these phenomena in the same primary causes,

that is, in shocks or impacts of the atoms. Just as molecules or atoms beating upon a solid body excite phosphorescence in the same or render it incandescent, so when colliding among themselves they produce similar phenomena. But that is very insufficient explanation and concerns only the crude mechanism. Light is produced by vibrations which go on at a rate almost inconceivable. If we compute, from the energy contained in the form of known radiations in a definite space the force which is necessary to set up such rapid vibrations, we find, that though the density of the ether be incomparably smaller than that of any body we know, even hydrogen, the force is something surpassing comprehension. What is this force, which in mechanical measure may amount to thousands of tons per square inch? It is electrostatic force in light of modern views. It is impossible to conceive how a body of measurable dimensions could be charged to so high a potential that the force would be sufficient to produce these vibrations. Long before any such charge could be imparted to the body it would be shattered into atoms. The sun emits light and heat, and so does an ordinary flame or incandescent filament, but in either of these can the force be accounted for if it be assumed that it is associated with the body as a whole. Only in one way may we account for it, namely, by identifying it with the atom. An atom is so small, that if it be charged by coming in contact with an electrified body and the charge be assumed to follow the same law as in the case of bodies of measureable dimensions, it must retain a quantity of electricity which is fully capable of accounting for these forces and tremendous rates of vibration. But the atom behaves singularly in this respect, it always takes the same "charge."

It is very likely that reasonant vibration plays a most important part in all manifestations of energy in nature. Throughout space all matter is vibrating, and all rates of vibration are represented, from the lowest musical note to the highest pitch of the chemical rays, hence an atom, or complex of atoms, no matter what its period, must find a vibration with which it is in resonance. When we consider the enormous rapidity of light vibrations, we realize the impossibility of producing such vibrations directly with any apparatus of measurable dimensions, and are driven to the only possible means of attaining the object of setting up waves of light by electrical means and economically, that is, to effect the molecules or atoms of a gas, to cause them to collide and vibrate. We then must ask ourselves—How can free molecules or atoms be affected?

It is a fact that they can be affected by electrostatic force, as is apparent in many of these experiments. By varying the electrostatic force we can agitate the atoms, and cause them to collide under evolution of heat and light. It is not demonstrated beyond doubt that we can affect them otherwise. If a luminous discharge is produced in a closed exhausted tube, do the atoms arrange themselves in obedience to any other but to electrostatic force acting in straight lines from atom to atom? Only recently I investigated the mutual action between two circuits with extreme rates of vibration. When a battery of a few jars (c c c c, Fig. 32) is discharged through a primary P of low resistance (the connections being as illustrated in Figs, 19a. 19b and 19c), and the frequency of vibration be many million there are great differences of potential between points on the primary not more than a few inches apart. These differences may be 10,000 volts per inch, if not more, taking the maximum value of the E. M. F. The secondary s is therefore acted upon by electrostatic induction, which is in such extreme cases of much greater importance than the electrodynamic. To such sudden impulses the primary as well as the secondary are poor conductors, and therefore great differences of potential may be produced by electrostatic induction between adjacent points on the secondary. Then sparks may jump between the wires and streamers become visible in the dark if the light of the discharge through the spark gap d d be carefully excluded. If now we substitute a closed vacuum tube for the metallic secondary s, the differences of potential produced in the tube by electrostatic induction from the primary are fully sufficient to excite portions of it; but as the points of certain differences of potential on the primary are not fixed, but are generally constantly changing in position, a luminous band is produced in the tube, apparently not touching the glass, as it should, if the points of maximum and minimum differences of potential were fixed on the primary. I do not exclude the possibility of such a tube being excited only by electrodynamic induction, for very able physicists hold this view; but in my opinion, there is as yet no positive proof given that atoms of a gas in a closed tube may arrange themselves in chains under the action of an electromotive impulse produced by electro-dynamic induction in the tube. I have been unable so far to produce striae in a tube, however long, and at whatever degree of exhaustion, that is striae at right angles to the supposed direction of the discharge or the axis of the tube, but I have distinctly observed in a large bulb, in which a wide luminous band was produced by passing a discharge of a battery through a wire surrounding the bulb, a circle of feeble luminosity between two luminous bands, one of which was more intense than the other. Furthermore, with my present experience I do not think that such a gas discharge in a closed tube can vibrate, that is vibrate as a whole. I am convinced that no discharge through a gas can vibrate. The atoms of a gas behave very curiously in respect to sudden electric impulses. The gas does not seem to possess any appreciable inertia to such impulses, for it is a fact, that the higher the frequency of the impulses, with the greater freedom does the discharge pass through the gas. If the gas possesses no inertia then it cannot vibrate, for some inertia is necessary for the free vibration. I conclude from this that if a lightning discharge occurs between two clouds, there can be no oscillation, such as would be expected, considering the capacity of the clouds. But if the lightning discharge strike the earth, there is always vibration—in the earth, but not in the cloud. In a gas discharge each atom vibrates at its own rate, but there is no vibration of the conducting gaseous mass as a whole. This is an important consideration in the great problem of producing light economically, for it teaches us that to reach this result we must use impulses of very high frequency and necessarily also of high potential. It is a fact that oxygen produces a more intense light in a tube. Is it because oxygen atoms possess some inertia and the vibration does not die out instantly? But then nitrogen should be as good, and chlorine and vapors of many other bodies much better than oxygen, unless the magnetic properties of the latter enter prominently into play. Or, is the process in the tube of an electrolytic nature? Many observations certainly speak for it, the most important being, that matter is always carried away from the electrodes and the vacuum in a bulb cannot be permanently maintained. If such process takes places in reality, then again must we take refuge to high frequencies, for with such, electrolytic action should be reduced to a minimum, if not rendered entirely impossible. It is an undeniable fact that with very high frequencies, provided the impulses be of a harmonic nature, like those obtained from an alternator, there is less deterioration and the vacua are more permanent. With disruptive discharge coils there are sudden rises of potential and the vacua are more quickly impaired, for the electrodes are deteriorated in a very short time. It was observed in some large tubes, which were provided with heavy carbon blocks B B¹, connected to platinum wires w w¹ (as illustrated in Fig. 23), and which were employed in experiments with the disruptive discharge instead of the ordinary air gap, that the carbon particles under the action of the powerful magnetic field in which the tube was placed, were deposited in regular fine lines in the middle of the tube as illustrated. These lines were attributed to the deflection or distortion of the discharge by the magnetic field, but why the deposit occurred principally where the field was most intense did not appear quite clear. A fact of interest, likewise noted, was that the presence of a strong magnetic field increases the deterioration of the electrodes, probably by reason of the rapid interruptions it produces, whereby there is actually a higher E. M. F. maintained between the electrodes.

Much would remain to be said about the luminous effects produced in gases at low or ordinary pressures. With the present experiences before us we cannot say that the essential nature of these charming phenomena is sufficiently known. But investigations in this direction are being pushed with exceptional ardor. Every line of scientific pursuit has its fascinations, but electrical investigation appears to possess a peculiar attraction, for there is no experiment or observation of any kind in the domain of this wonderful science which would not forcibly appeal to us. Yet to me it seems, that of all the many marvelous things we observe, a vacuum tube, excited by an electric impulse from a distant source, bursting forth out of the darkness and illuminating the room with its beautiful light, is as lovely a phenomenon as can greet our eyes. More interesting still it appears when reducing the fundamental discharges across the gap to a very small number and waving the tube about we produce all kinds of designs in luminous lines. So, by way of amusement, I take a straight long tube, or a square one, or a square attached to a straight tube, and by whirling them about in my hand, I imitate the spokes of a wheel, a Gramme winding, a drum winding, an alternate current motor winding, etc. (Fig. 34). Viewed from a distance the effect is weak and much of its beauty is lost, but being near or holding the tube in the hand, one cannot resist its charm.

In presenting these insignificant results I have not attempted to arrange and co-ordinate them, as would be proper in a strictly scientific investigation, in which very succeeding result should be a logical sequence of the preceeding, so that it might be guessed in advance by the careful reader or attentive listener. I have preferred to concentrate my energies chiefly upon advancing novel facts or ideas which might serve as suggestions to others, and this may serve as an excuse for the lack of harmony. The explanations of the phenomena have been given in good faith and in the spirit of a student prepared to find that they admit of a better interpretation. There can be no great harm in a student taking an erroneous view, but when great minds err, the world must dearly pay for their mistakes.

PUALICATIONS.

The February Arena is another mammoth number of the great progressive Review. It contains 164 pages and filled with able papers, covering a wide range of topics of special interest to wide awake thinkers and earnest reformers.

The Ontario Legislature is asked to grant incorporation to the Portlock and Desert Lake Iron Mining and Railway Company, which proposes to build an electric or steam and electric railway from Portlock, in Algoma, northward to a junction with the Northern Pacific Railway. Mr. James Stobie, a well-known miner, is one of the promoters.

ELECTRIC RAILWAY DEPARTMENT.

An increase of $16,959. is shown in the earnings of the Montreal Street Railway Company for the last quarter, as compared with the same period in 1893.

The village Council of Portsmouth, Ont., has granted a franchise for forty years to the Kingston, Portsmouth & Cataraqui Company, for the construction of an electric railway on the streets of the said village.

Toronto Lodge of the International Association of Machinists has adopted a resolution urging the City Council to compel the Toronto Railway Company to comply with the clauses of its agreement with the city which provide that all plant required for the use of the railway shall be as far as possible manufactured in the city of Toronto.

A special committee of the County Council of York has drafted an agreement between the county and the Metropolitan Street Railway Company, defining the conditions under which the railway company may extend its lines to Richmond Hill and Lake Simcoe. The agreement is subject to the ratification of the council at its next meeting in June.

The annual general meeting of the Montreal Park and Island Railway Company was held in Montreal a fortnight ago, at which an outline of the operations of the coming summer was presented. Only one change in the directorate was made, it being the appointment of Mr. J. S. Bousquet in the place of Mr. Morris Perrault, who resigned some three months ago.

The Hamilton, Beamsville and Grimsby Electric Railway Company's new power station at Stoney Creek, the construction of which is about to be commenced will be built of brick and stone and roofed with asphalt. The size of engine and dynamo room will be 40 by 60 feet and of boiler room 40 by 30 feet, with a chimney stack 125 feet high. The plant will include two generators and two boilers.

Information has been received at Winnipeg, that the Privy Council in England has given a verdict in favor of the Electric Railway Company on all points involved in its dispute with the Winnipeg Street Railway, which claimed to have been granted a monopoly of the streets for railway purposes. As the result of this decision, it is said the electric railway company will at once proceed to extend its lines.

At the request of the City Council, the City Engineer of Toronto has handed in a report on the cost of a single track electric railway from Hanlan's to Ward's on Toronto Island. It is estimated that to construct a single track on the west and south shores of the island, and equip the same with four motor cars and four trailers, would cost $50,000, and the cost of operation would be $50 per day.

The Toronto Railway Company has presented a counter petition to the Ontario Legislature asking that the company be not compelled to provide shelter for the motormen as petitioned for by the City of Toronto, on the ground that such provision is not contained in its agreement with the city, and that owing to the use of trailers it would be impracticable to work the cars with safety if vestibules were adopted.

During the past month the Board of Directors of the Galt and Preston Street Railway awarded the contract for the electrical construction of their road to Messrs. Ahearn & Soper, of Ottawa. The contract for supplying the engines and boilers for the power house at Preston has been given to Messrs. Goldie & McCulloch, of Galt. Five cars will be used on the road and will be heated by electricity during the winter months. Tenders for the erection of the power house will be awarded in a few days.

A franchise has been granted to Mr. W. R. Hitchcock to build and operate an electric railway at Cornwall, Ont. The franchise provides for the construction of the road, to carry both passengers and freight, to the canal, and the entire length of Second street, with spur lines to the cotton and paper mills, a total distance of about four miles. It is the intention to utilize the water power at Sheik's Island Dam. Mr. Hitchcock is now in the United States for the purpose of organizing his company, the intention being to commence the construction of the road in the spring. The Westinghouse system will be employed. The town council have agreed to exempt from taxation for a period of ten years, the plant and income of the company.

The annual report of the Niagara Falls Park and River Railway Company has been presented to the Legislature. It sets forth that after the road had gone into operation, the impossibility of handling the traffic with a single track became apparent, and the directors decided to issue $300,000 of additional stock for the purpose of double tracking the line. $200,000 of this stock has been allotted, and all the grading for the second track done, with the exception of four miles. The company have arranged for a first-class steamboat connection between Buffalo and Chippewa, and are anticipating that a large business will come through this Buffalo connection. The receipts of the road from the time of its going into operation, on the first of July last, to the close of the season, was $58,064.08, and the expenses, $39.135 06.

Some time ago, the council of the Township of York passed a by-law granting a bonus of $20,000 to the Toronto and Richmond Hill Street Railway Company, on condition that certain construction work was to be completed by the 7th day of March of the present year. Shortly afterwards some of the property owners along the route took action in the courts to prevent the construction of the road, and the legal proceedings thus taken interfered with the floating of the bonds of the company, and consequently prevented them from completing the amount of construction called for by the bonus by-law. At a recent meeting of the Township Council, the by-law granting the bonus, was revoked on the ground that the railway company had failed to fulfil its part of the agreement. The company thereupon presented a petition to the Legislature, setting forth that the actions which had been taken against it in the courts had made it impossible to proceed with construction and asking that the time for completing the railway be extended for two years, and that the by-laws passed by the Township Council granting the bonus, be declared valid and binding. The Legislature has acceded to the company's petition.

Engineers are often slow in adopting changes in their boiler settings, and with so many plans that are urged to their attention, and often of little value, it is perhaps wise to be cautious, but we have often wondered why they do not take more kindly to removable fire-door arches. When the arch overhead burns out it is a source of danger and considerable expense to replace the arch with a new one or to repair it. There are devices that will not burn out and must pay for themselves in time, not only by the actual saving in the expense of constantly renewing the arches, but in the renewed safety and lengthened life of the boiler.

USEFUL HINTS.

Some recent figuring on the cost of power conveyed by water shows that *the greater the pressure the cheaper in proportion becomes the expense or cost.* For example, water at 100 pounds pressure costs about double what water at 700 pounds pressure will, estimating in both cases by the energy or work the water will perform. This is a curious result, and an interesting problem. The water and the pressure upon it are different elements. The amount consumed for a given duty is inversely as the pressure.—*Power.*

STEEL AND IRON TUBES.—Quite an important discussion took place before the Master Mechanics' Association at its recent Saratoga meeting on the character or merits of steel and iron tubes respectively. It was announced in a report on this subject, that, in the case of a large number of steel tubes, the results, so far as wear is concerned, have been unfavorable. The following definite experiment was cited: An engine was equipped with 114 iron tubes and 113 steel tubes, Dec. 20, 1890. The iron tubes were placed on one side of the centre and the steel tubes on the other side of the centre of the boiler, the tubes being divided by a vertical line through the centre of the flue sheet. At the expiration of fifteen months the flues were all removed, the condition of the tubes being such that seventeen of the iron ones were condemned on account of pitting and corrosion, while sixty-four of the steel tubes were condemned for the same defect, the inferiority of the latter being thus largely in excess of the iron tubes.

When a pound of water is turned into steam it will occupy very much less space as the pressure increases; therefore, one cylinderful of steam at high pressure will weigh a great deal more than a cylinderful at low pressure; the amount of heat required to make a given cylinderful of steam increases with its pressure and consequently its weight; that there is more heat in a radiator full of high pressure steam than low-pressure steam, because of above fact; that the temperature of steam increases with the pressure; that the temperature at which water will boil increases with the pressure and equals the temperature of the steam formed from it; that the latent heat of steam is less as the pressure increases; that when steam leaves a cylinder it has in it an amount of latent heat according as the pressure of the steam is greater or less; that it could not leave as steam unless this latent heat was in it, as this heat must be in it or it would be water; that this latent heat can be obtained outside the engine for heating purposes when the steam is condensed to water; that in being so condensed it occupies a materially smaller space and creates a partial vacuum in the space it had previously occupied; that steam at a certain pressure has a certain sensible temperature, and is then known as saturated steam, but that this temperature can be increased by the addition of heat directly to the steam itself, when it becomes known as superheated steam.

TRADE NOTES.

Messrs. Ahearn & Soper, of Ottawa, report the following recent sales of Westinghouse apparatus: a 650 light alternating plant for Chesley, Ont., two 15 K. W. continuous current, slow speed dynamos to the Richelieu and Ontario Navigation Co., for use on their steamers; a 650 light alternating current plant to Mr. Brosseau, of the St. Hyacinthe Gas Co. A sale has also been made of a 1000 light alternator for Windsor, N. S., including the street lighting system, wire, transformers, panel switchboard and all appurtenances.

Readers will notice by our advertising columns that Mr. John Forman has secured the Canadian agency for some of the most reliable manufacturers of electric appliances in England. He intends opening out in the store No. 650 Craig street, Montreal, where he will have one of the best assorted stocks of electrical goods in Canada including the highest class of English fittings and all the latest novelties of English manufacture. His intention is to do a first-class electrical supply business and the names of the firms he represents are a sufficient guarantee that everything in stock will be of the very best quality.

The F. E. Dixon Belting Company, of Toronto, has just issued a valuable handbook of useful information relating to the use of leather belting. The book contains a large amount of valuable data which has been put in convenient form for the use of engineers and others who are called upon to make use of belting under a great variety of conditions and circumstances. This information, Mr. Dixon informs us, has been carefully collected during a period of many years, and its accuracy thoroughly inquired into and proved. In addition, the book contains flattering testimonials from a number of substantial business firms throughout Canada as to the excellent quality of the belting manufactured by this company, some of which is declared to have been in use upwards of twenty years, and is apparently good for several years more service. We notice that the company have recently established a branch house at 13 Lemoine street, Montreal.

The attention of electric lighting companies and others using arc lamps is called to the announcement in our advertising pages of the Exact Arc Lamp Company of Canada, Hamilton, Ont. This company have the exclusive right to manufacture in Canada the Exact arc lamp, the invention of Mr. Irish, the construction of which differs very materially from that of the types of lamps generally in use. These lamps are equipped with a very ingenious thermal regulator. They have no magnets or solonides, regulation being effected by the contracting of a strip of metal. As the arc becomes longer from the burning of the carbon the decreased current heats the metal less, which contracts and permits the carbon to feed down or vice versa. The regulation clutch is constructed on a differential principle, is very simple in construction and enables the lamp to furnish an absolutely steady light. The mechanism is equally applicable to direct or alternating circuits, and greatly reduces the singing when used with the latter. The new lamp is interchangeable from arc to incandescent circuits and vice versa. The Canadian manufacturers will be pleased to furnish all particulars regarding the new lamp.

The Dodge Wood Split Pulley Co., of Toronto, are recently in receipt of the following letter of endorsation from the E. B. Eddy, Co., of Hull, Que., which speaks for itself:

HULL, CANADA, 12th February, 1894.

MESSRS. DODGE WOOD SPLIT PULLEY CO, Toronto, Ont.

DEAR SIRS:—Replying to the request contained in your letter of the 9th inst. as to how we are pleased with the rope drive system put into our mills by you, we would say that some four years ago we put in a small rope drive, about 20 H. P. A year and a half ago we put in three drives, each 500 H. P., whereas last year we put in one 400 H. P., one 300 H. P., and one 200 H. P., all of which are giving us good satisfaction. For main drives or long distances, for transmitting of power, we think there is nothing to equal these drives. We would recommend them to any person requiring similar power.

Yours truly,

(signed) The E. B. EDDY Co.

SPARKS.

Improvements to the Nanaimo, B. C., electric light plant are contemplated

The Carberry, Man., electric light plant has been sold to Mr Wm. McMillan

The Bell Telephone Company have installed an electric fire alarm system at Owen Sound Ont

A deposit of mica of excellent quality is said to have been discovered not far from Rat Portage

The Royal Electric Co., of Montreal will install an incandescent plant for the town of Mitchell, Ont

The Legislature of British Columbia is asked to grant incorporation to the Consolidated Railway and Light Company.

Mr H N Ronson has purchased the electric light plant at Moose Jaw, N W T A number of improvements are in contemplation

We regret to learn that one of our Hamilton subscribers, Mr. W. R Cornish engineer, recently had a very narrow escape from suffocation by coal gas

Mr Geo Black gave an interesting address before the members of the Young Men's Christian Association of Hamilton, recently, on "Electricity at the World's Fair"

Damage to the extent of about $10,000 was caused by an ice jam which carried away part of the dam at Caledonia, Ont., on the 6th of March, and rendered inoperative the electric light plant.

An expert electrician has been employed by the City Council of Victoria, B. C., to examine into and report upon the condition of the city lighting plant, with the object of having it put into a condition of efficiency.

The installation of an electric light plant at Aurora, Ont., is being proceeded with as rapidly as possible. The contract for the electric light station and power house has been awarded to Mr. Walter Machell. The building will be of brick and will be situated on Tyler street.

Messrs E O. Champagne, city boiler inspector, O. E. Granberg and E Manney, of Montreal, W. Laurie, of Maskinonge, and F. Grenden and J Samson, of Quebec, have been appointed a Provincial Board of Boiler Inspectors to examine candidates and grant certificates as boiler inspectors.

A bill is now before the Ontario Legislature to authorize the amalgamation of the various electric lighting companies at Ottawa. Should the bill pass the Legislature, as it is believed it will, the amalgamation will go into effect on the first of June next It is reported that Mr. Berkley Powell, the present manager of the Standard Electric Company, will in all probability become the manager of the new concern. It is also said that a decision has been come to that under the amalgamation, the cost of lighting shall not be increased, but if possible reduced.

SPARKS.

The Brantford Electric Light and Power Company have several times of late suffered damage by reason of floods. On the 6th of March, part of their embankment was carried away, and for a time the total destruction of their plant appeared to be imminent.

Application is being made for incorporation by the T. W. Ness Electric Company, of Montreal. The applicants are Messrs. T. W. Ness, T. H. Davidson, J. L. Rankin, J. E. Adams and M. W. McLaren. The capital stock of the company is to be $150,000.

The shareholders of the Montreal Street Railway Company have resolved to increase the capital stock of the company from $2,000,000 to $4,000,000 and have empowered the directors to issue new bonds for this purpose at such times and in such amounts as they may see fit.

Messrs. A. A. Wright & Company's electric lighting station at Renfrew, Ont., is said to be one of the best arranged and kept in Eastern Ontario, everything about the place being maintained in a condition of perfect cleanliness The credit for this is largely due to Messrs. John Stuart, Wm. Wherry and Howard Wright, who are in charge of the station.

Messrs. Louis Cote, Paul Ryan, Jean Baptiste, Lalime, and Jean, T. Godbout, of St. Hyacinthe, Que., and Antoine M. Morin, of Paris, are applying for incorporation as "La Compagnie des Bouvoirs Hydrauliques de St. Hyacinthe" The object of the company is the production and sale of light, heat and motive power produced by electricity. The capital stock will be $50,000. The gentlemen above named will be the first directors.

A company is being formed to utilize the Falls at Chateau Richer for the purpose of supplying electric light to that town and St. Anne de Beaupre.

A bill has passed the Ontario Legislature, which gives the London Street Railway Company a thirty three years' franchise over the streets of the village of London West.

The Bell Telephone Company will establish a new central station at St. Roch, a suburb of Quebec city, and have had plans prepared by the local manager, Mr. Dauphin, for a new building to be erected at the corner of Caron and Charest streets for the purpose.

At a special meeting of the shareholders of the Merchants' Telephone Company, of Montreal, the directors were authorized to dispose of the balance of the capital stock of the Company, amounting to $20,000 It is stated by the President, Mr. F. X. Monsan, that the company has no intention of selling out to the Bell Company.

The Brockville Gas Light Company is applying to the Ontario Legislature for authority to change the name of the company to "The Brockville Light and Power Company, Limited," to increase the capital stock to $250,000, and to make the charter of incorporation, which expires in nine years, perpetual.

Application will be made to the Dominion Parliament for an act to incorporate "The Dominion Gas and Electric Company," with headquarters at Winnipeg. The capital stock of the company will be $1,000,000. This is said to be the first step toward the consolidation of the Winnipeg Street Railway and the Manitoba Gas and Electric Light Company.

MOONLIGHT SCHEDULE FOR APRIL.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	9.40
1	P. M. 6.50	A. M. 4.30	9.40
2	" 6.50	" 4.30	9.30
3	" 7.00	" 4.30	9.30
4	" 7.00	" 4.30	9.30
5	" 7.00	" 4.30	9.30
6	" 7.00	" 4.30	9.30
7	" 7.00	" 4.30	9.40
8	" 7.00	" 4.40	9.00
9	" 7.50	" 4.50	6.30
10	" 10.20	" 4.50	5.40
11	" 11.10	" 4.50	5.10
12	" 11.40	" 4.50	
13	....	" 4.50	
14	A. M. 12.30	....	4.20
15	" 1.30	" 4.50	3.20
16	" 2.30	" 4.50	2.20
17	" 2.50	" 5.00	2.10
18	No light.	No light.	....
19	No light.	No light.	....
20	No light.	No light.	...
21	P. M. 7.20	P. M. 9.40	2.20
22	" 7.20	" 10.10	2.50
23	" 7.20	" 11.00	3.40
24	" 7.20	" 11.50	4.30
25	" 7.20	A. M. 12.40	5.20
26	" 7.30	" 1.20	5.50
27	" 7.30	" 1.50	6.20
28	" 7.30	" 2.30	7.00
29	" 7.30	" 3.10	7.40
30	" 7.30	" 4.00	8.30
		Total,	169.00

The Council of Nanaimo, B. C., is considering the purchase of an electric light plant.

PERSONAL.

At the recent annual convention of the National Electric Light Association of the United States, held at Washington, Mr. Frederic Nicholls, manager of the Canadian General Electric Company, was elected to the office of second vice-president. We congratulate Mr. Nicholls upon this recognition of his ability, and the National Association upon the wisdom of its choice.

We learn that W. A. Johnson, for ten years General Manager of the Ball Electric Light Co., Ltd., of Canada, and who has since the sale of the Ball factory to the Canadian General Electric Co. acted as general agent for the latter, has terminated his engagement with said company, and will enter into business again on his own account and engage in electric contracting, engineering and installation work.

The citizens of Belleville, Ont., are agitating for an electric railway. The Mayor estimates the cost of construction at $24,000.

We have received from Mr. C. W. Chadwick, of Rat Portage, Ont., samples of white mice of excellent quality from deposits recently discovered in that locality.