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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL

OLD SERIES, VOL. XV.—No. 6.
NEW SERIES, VOL. VII.—No. 8.

AUGUST, 1897

PRICE 10 CENTS
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CANADIAN

ELECTRICAL NEWS

AND

STEAM ENGINEERING JOURNAL.

VOL. VII. AUGUST, 1897 No. 8.

MR. SAMUEL J. T. BROWN.

MEMBERS of the Canadian Electrical Association and persons connected with the electrical interests in Western Ontario will have no difficulty in recognizing in the accompanying portrait the smiling features of Mr. S. J. T. Brown, local manager of the Bell Telephone Co. at London, Ont. Mr. Brown was born in Hertford County, England, on October 3, 1852. In 1869 he came to Canada and settled in Hamilton, where he became engaged in the building business. In 1873 he entered the employ of the Bell Telephone Company under Mr. Hugh C. Baker. In 1883 he was appointed travelling agent to organize exchanges and put in plants in the district west of Kingston. He met with so much success that the company promoted him to the position of manager of the London branch, October, 1891. The numerous improvements in the telephone service in the city since that date are an evidence of the thorough appreciation which he has of his business. Mr. Brown has always taken an active interest in the welfare of the city, and is highly respected by all who know him.

MR. SAMUEL J. T. BROWN.

ECONOMY OF ELECTRICAL PRODUCTIONS.

MANY of the commercial chemicals now in general use are made at much cheaper rates than formerly, says an exchange, because of the economy of electrical production. A large percentage of the metals can now be reduced from their ores by electrolytic methods. The production, refining, purifying, etc., of many products not essentially chemical, such, for example, as sugar, molasses, beer, starch, beet-root juice, etc., is now accomplished electrolytically. Cotton is picked and bleached, leather is tanned, white lead is made, meat is preserved, ozone is generated, acetylene gas is produced, safes are broken into, car wheels are tested, graphite is formed, and diamonds are manufactured by either the direct or indirect action of the current; gold, silver, iron, zinc, lead, copper, tin, aluminum, nickel, bismuth, antimony, are all either mined, refined or separated from their ores, and in some cases actually produced by the magical properties of the electric current. Power is transmitted, farms are worked, boats and land carriages are propelled, oil wells are made to increase their flow, the stage is made more spectacular, watercourses are disinfected, and hitherto impenetrable substances are rendered transparent, all by means of electrical development. The list is not carried beyond the achievements of a year or two past, nor is it meant to include such apparatus as the telephone, telegraph, phonograph, or other widely-spread factors of electrical development.

EDISON'S VIEW OF HORSELESS CARRIAGES.

A REPORTER of a daily paper interviewed Edison recently upon the subject of horseless carriages. His opinion is that the problem rests on the construction of cheaper and lighter motors. Over 2,000 men, he says, are at work in this country alone trying to invent better motors for horseless vehicles. Hundreds of others in Europe are also engaged in the same task. The automobile is bound to be in general use before long. Take the bicycle, for instance The high grade wheels which cost $100 each to-day will in a few years at best drop to $50, and machines that can now be bought for from $50 to $75 apiece will cost only $15 or $20. The same thing will be the outcome of the experiment with horseless carriages. The motors now cost from $250 to $350 each. The motors will also be made smaller and can be more easily manipulated. Then tricycles and light road vehicles can be put on the market at a cost of $100 to $125 each; a serviceable light vehicle to carry two, or even four, people can be made after the principle of the tricycle at a cost of from $100 to $125. In the construction of the motor there are three different kinds of power to consider—gas, petroleum and electricity. Electricity should be the best and cheapest. The most successful automobiles made thus far are those in which electric motors are used. They can go twenty-five miles or more without being re-charged at the rate of ten miles an hour. Delivery waggons, express waggons, broughams and all of the heavier class of vehicles can be driven as easily by a storage battery as any other kind if the battery is improved sufficiently, and that will unquestionably be done.

Mr. G. Sage, engineer, Clinton, states on renewing his subscription to the ELECTRICAL NEWS, that no up-to-date engineer can afford to be without it.

The Jenckes Machine Co., of Sherbrooke, recently shipped to the Asbestos & Asbestic Co., of Danville, one of their 20-drill air compressors, together with three high-speed crushing rolls and two picking tables, being a plant required by the Asbestos Co. in connection with the extension of their operations.

TORONTO TECHNICAL SCHOOL EXAMINATIONS.

By the kindness of Mr. James Milne, the instructor in this depart ent, we are enabled to print the answers to the problems given the students in Applied Mechanics at the recent examinations of the above school. The questions were published in the July issue of the ELECTRICAL NEWS, and the answers are as follows:

APPLIED MECHANICS.

ELEMENTARY.

ANSWERS:

1. 32⅔".
2. 14062.5 ft. pds.
3. 39063 lbs.
4. .718 or 71.8% efficiency.
5. Top 1,000 lbs., bottom, 5,000 lbs., sides 3,000 lbs.
6. B. W. 4740¼ lbs. very nearly.
7. 12" and 48" diam. 30 and 120 teeth respectively.
8. 22 cwts. 28 cwts. 11.2 feet from support having 22 cwts. reaction.
9. 15.13 lbs.
10. 200 lbs. 7½ lbs.
11. 55.8 lbs. 896 lbs.
12. 64. 160.

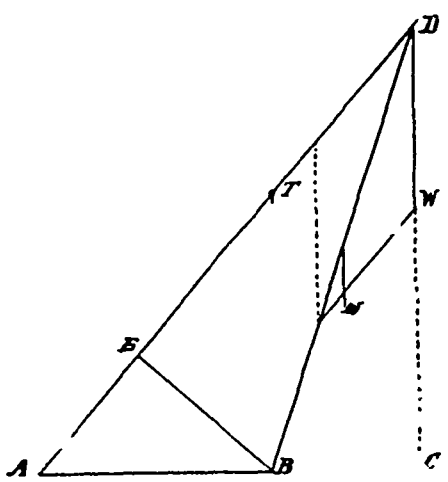
ADVANCED.

13. Let R = Radius of large sheave.
r = radius of small sheave.
P = Pull in lbs.
W = Weight to be lifted.

$$W = \frac{2\,P\,R}{R-r} = 1{,}200 \text{ lbs.}$$

Efficiency = useful work done. Total work expended.

14.



$$\text{Tension} \times E\,B - W.\,B\,C + w.\frac{B\,C}{2} = 31\,B\,C.$$

Find E B and B C.

Area of Triangle A B D = 95 sq. ft.

$$\therefore \frac{A\,D \cdot E\,B}{2} = 95 \text{ sq. ft.}$$

E B = 7.6 feet.

$$\text{Again } \frac{A\,B \cdot C\,D}{2} = 95 \text{ or } C\,D = 19'$$

$$\text{But } B\,C = \sqrt{20^2 - 19^2} = 6\tfrac{1}{4}' \text{ nearly}$$

Tension × E B = 31 B C.

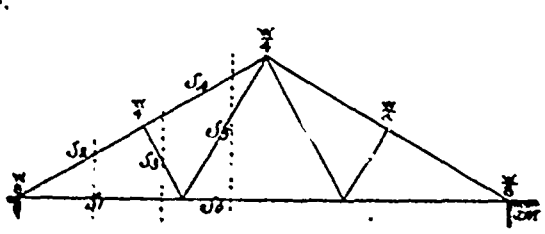
Tension = 25.5 cwts.

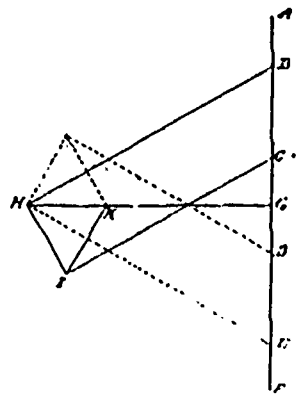
By parallogram of forces the thrust on the gib as measured on diagram is 52.5 cwts.

15. 9,000 lbs.

16. When on the point of lowering the weight is 2380 lbs., and when on the point of raising the weight is 220 lbs.

17.





Let B_1, B_2, B_3, etc., be the angles, made by
S_1, S_2, S_3, etc., with the vertical

$$\text{Sin } B_2 = \sin B_4 = \cos B_3 = \cos B_5$$
$$\text{Sin } B_3 = \sin B_5 = \cos B_2 = \cos B_4$$

and by the method of resolution of forces we get for the section cutting S_1 and S_2 the equations

$$S_1 + S_2 \sin B_2 = 0$$
$$\frac{W}{2} - \frac{W}{8} + S_2 \cos B_2 = 0$$

From which we get $S_1 = 2{,}600$ and $S_2 = -3{,}000$ lbs.

If we take a section cutting S_1, S_3, S_4 we get

$$S_1 + S_3 \sin B_3 + S_4 \sin B_4 = 0$$
$$\frac{W}{2} - \frac{W}{8} - \frac{W}{4} - S_3 \cos B_3 + S_4 \cos B_4 = 0$$
$$S_3 = -866 \text{ lbs.}$$
$$S_4 = -2{,}500 \text{ lbs.}$$

S_5 and S_6 are found in the same manner, viz:

$$S_6 + S_5 \sin B_5 + S_4 \sin B_4 = 0$$
$$\frac{W}{2} - \frac{W}{8} - \frac{W}{4} + S_5 \cos B_5 + \sin \cos B_4 = 0$$
$$S_5 = 866 \text{ lbs.}$$
$$S_6 = 1732 \text{ lbs.}$$

By construction as shown in the figure we get exactly the same results as measured to scale.

S_1 = H G = 2,600 lbs. tension.
S_2 = H B = 3,000 lbs. compression.
S_3 = H I = 866 lbs. "
S_4 = I C = 2,500 lbs. "
R_5 = I K = 866 lbs. tension.
S_6 = K G = 1,732 lbs. "

18. 360 h. p. nearly.

19. 251 h. p. or 109 h. p. less.

20.

Drives No. 1 = 14"		Follower No. 1 = 11.2"	
" " 2 = 11.92"		" " 2 = 13.28"	
" " 3 = 9.8"		" " 3 = 15.4"	
" " 4 = 8.7"		" " 4 = 17.5"	

21. Tension 12. 3 cwts. nearly.
Reaction 8 cwts. fully.
To find the direction of the reaction
Let R h = horizontal component acting from B to A
R v = vertical component acting upwards.
By taking moments about A we have

$$\text{Reaction} \times r = W \times 2 + W \times 6$$
$$r = 4\tfrac{3}{4} \text{ feet.}$$

∴ with A as centre and 4¾ feet radius describe an arc and draw from B a line tangent to this arc. This line represents the direction of the reaction.

22. (a) What 30 teeth makes 7 revolutions.
" 40 " " 3.5 "
(b) " 30 " " 3 " in same direction.
" 80 " " .5 " in opposite direction.

23. 14.5 tons.

24. 821,200 lbs. nearly. 660 lbs. nearly.

25. 454 revs.

The Kaslo Electric Light Company, of Kaslo, B.C., is about to change its motive power from steam to water power, and has secured a site for a power house about a mile from the town.

The Jenckes Machine Co. have just completed for the Sultana Mine at Rat Portage one 30-stamp mill, with six vanners, one 150 h.p. Corliss engine, with complete equipment of boilers, compressor and hoisting plant. This is the largest and most complete plant of this kind in the Lake of the Woods district.

WESTERN ONTARIO LIGHTING PLANTS.

Our travelling representative has furnished the following descriptions of lighting plants in Western Ontario, as an adjunct to those which appeared in our July issue:

FERGUS ELECTRIC LIGHT AND POWER COMPANY.

The Fergus electric light and power plant is owned by Dr. Groves, of Fergus, and was installed in 1891, the power house being situated in Dr. Groves' mills. Besides supplying light to Fergus, the company in 1893 extended their line to Elora, and have since supplied that town with street and residential lighting. They also supply power for motors.

The company have at present 24 miles of wire, 800 incandescent lamps and 40 arc street lights. The plant consists of Reliance dynamo of 2080 volts, and Thomson-Houston alternator, all switch-board apparatus being from Reliance works. One of the special features of this plant is the exciting of alternator direct from arc circuit without the use of a separate exciter. There is a well equipped machine shop in connection with the plant furnished with Bertram drill lathe and full complement of tools, in which all repairs are made and arc light winding done. Power is furnished by a Brown tandem-compound, 9 x 14, 24" stroke, and Porter & Allen 10¼ x 20 high speed engines, controlled by Porter governor, steam being supplied by two boilers, one 52 in. x 14 ft. and one 48 in. x 14 ft. The engine room is equipped with Northey fire pump and fire hose and an indicator outfit. This plant has had in use a jet condensor, but owing to the hardness of the water they are now putting in a new surface condensor.

Mr. Gibson Groves, the manager of the plant, was born near Fergus on the 20th of June, 1857. After

MR. GIBSON GROVES.

leaving public school he resided for several years in Manitoba, engaging in different lines of business. He always took an active interest in engineering and electrical matters, and in 1893 took charge of the above plant, which, under his progressive and energetic management, has reached a high state of efficiency.

SEAFORTH ELECTRIC LIGHT, HEAT AND POWER COMPANY.

The plant of the Seaforth Electric Light, Heat & Power Company has been in operation since 1894, and is at present supplying 1,160 incandescent lights, forty-four 1,000 candle power arc and twenty 2,000 c. p. street arc lamps.

The power house is a commodious brick building, with excellent ventilation, the offices and store-rooms being in the front. The floor of the dynamo room is covered with oil cloth, and the boiler room is built adjoining, with concrete floor. The basement contains toilet and bath room, large water tank and oil filter. Power is generated by a United Electric Improvement Co.'s alternator and Ball arc dynamo. The switch-board is fitted with instruments of same make, with exception of a Carpenter's enamelled rheostat. Two 85 h. p. high speed Robb engines and two 70 h. p. Robb boilers, Austin water heater and Northey pump complete the power apparatus.

Mr. A. H. Ingram, manager for the company, whose portrait we present, has had charge of the plant since

MR. A. H. INGRAM.

its installation. Mr. Ingram is a native Canadian, now 35 years of age, and was born in the county of Huron. After leaving the public schools, and having a liking for mechanical pursuits, he followed engineering, and with the advent of electricity into commercial use, obtained a position with the Brush Company, of Detroit, with which firm he was engaged for over two years, severing his connection with them to take his present position. He operated the plant for about four years for the corporation, and returned to the position when the present company took over the business. He is a progressive and energetic manager. Mr. Ingram now enjoys more than a local reputation, and any visitor to the plant under his charge will be convinced that the reputation he enjoys is well deserved. He is ably assisted by his engineer, Mr. I. Moddlin, and his assistants, Messrs. Darling, Chesney and Smiley.

Under Mr. Ingram's management this company are branching out into the manufacture of dynamos, having already supplied several small plants with generators.

SOUTHAMPTOM AND PORT ELGIN ELECTRIC LIGHT PLANT.

Messrs. Kilmer, Cowan & Co., of Southampton, Ont., who have secured a franchise for electric lighting the towns of Southampton and Port Elgin, Ont., are now installing their new plant at Denny's Dam, on the Saugeen river, about 2½ miles north of Southampton, from which they will supply both light and power to above towns.

This firm having purchased the water privilege at what was known as Denny's hull, have erected a two-storey power house, 20 x 38 feet, finished in hardwood, and have rebuilt and enlarged the flume, and are put-

ting in a Kennedy 66 in. special water wheel, with Kennedy governor. They have a 10½ foot head of water, and the privilege to raise to 16 feet, giving them 1,500 h. p. For present lighting they have installed a 75 k w. monocyclic Canadian General generator, with other instruments. They have at present about fifteen miles of wire, and expect to transmit to other towns in the vicinity. They are using No. 4 wire on the line to Port Elgin and No. 6 to Southampton, and furnish about 1,200 incandescent lights, but are putting in a number of 50 c. p. incandescent street lights.

Mr. C. E. Kilmer, the manager of the plant, is a native Canadian, and an experienced electrician, having had several years experience with the Canadian General Company at Peterboro.

PAISLEY ELECTRIC LIGHT PLANT.

The plant has been operated by water power for about two years, and is owned and managed by Mr. D. McIntyre, of Paisley. The power house is situated on the north branch of the Saugeen river about two miles from the town, and is equipped with a Leffel 52 in. water wheel and a 750 light Royal generator, with instruments, from the Royal Electric Company. For transmitting Mr. McIntyre has already put in about seven miles of wire, and is supplying about 200 lights. With the capacity of the plant it is needless to remark that the citizens of Paisley are getting an efficient service.

ELECTRICITY APPLIED TO GOLD MINING.

The big power plant at Blue Lakes city, Amador county, Cal., is nearing completion and will shortly be ready to transmit light and power along 32 miles of the mother lode in Amador and Calaveras counties. Large reservoirs have been built in Slabtown, two miles from the site of the power building. Two 2 phase generators will be shipped from Massachusetts, together with the other electrical apparatus, in a few days. It is claimed that this will be 60 per cent. cheaper than the power now used at the mines. The application of electricity to the working of ore is becoming general in all mining regions. Electricity, of New York, says concerning the subject:

"Two important undertakings, which have somewhat recently been before the British investor, have for their object the generation and supply of electrical power for use in gold mining. One of the schemes is for the extensive gold mining districts of Western Australia, particularly the Coolgardie neighborhood, the matter having been gone into very carefully by English experts who have advised the Westralian Electrical Company. It is thought that the growing gold mining industry of Westralia will afford satisfactory instances for the successful application of electric power transmitted over distances.

The other undertaking has been, for some time, in course of carrying out. It is that of the Rand Central Electric Works, which supplies electric power to the gold mines of the Rand district in the South African Republic. The Siemens & Halske Company have been very closely identified with this scheme, but there are a number of English shareholders, Sir Charles Rivers-Wilson being the chairman of the company. The capacity of the plant put down, which is equal to about 2,100 horse power, has been applied for at an average of about £45 per horse-power per annum delivered, including wires and fittings. As this is a cheaper rate than steam power can be obtained it is not very surprising that the demand should have been so ready. The company expects to find it necessary very shortly to extend its plant, and sees its way to good returns on its capital. There are four three-phase generators in position, these being direct-driven by vertical triple-expansion marine-type engines, having a maximum break horse power of 1,200. Each dynamo weighs 30 tons, and is constructed in four pieces. Eight multi-tubular boilers, with 200 tubes each, supply the steam. Each is of 600 horse-power, and has 9,300 square feet of heating surface. Only three sets of the plant will be worked at first, the fourth being held in reserve for a time. Some of the mines supplied are situated over 20 miles from the generating station. Current is generated in the dynamos at 700 volts, is raised by means of step-up transformers to 10,000 volts, and at the mines is reduced by step-down transformers to 120 volts for lighting and 240 to 500 volts for motor work."

H. M. Chance, in a lecture before the Engineers Club of Philadelphia, not long ago, gave a description of the various processes of extracting gold from ores by electricity. He divided them into six classes, each involving a different principle or method of application. The classes are:

1. Electro-magnetic.
2. Electro-solvent.
3. Electro-amalgamating.
4. Electro-precipitating.
5. Electro-inductional.
6. Electro-smelting.

The first class employs electro-magnets to remove magnetic material from the gold with which it is associated. In the second class the current is used to assist in dissolving the gold from ores by means of chemical solvents of gold. In the third class the current is passed through the amalgamated plates or mercury to facilitate amalgamation. The processes of the fourth class are electrolytic, the gold being electrically deposited from its chemical solutions. These processes are extensively used in South Africa and to some extent in this country. The fifth method aims to remove gold particles from other materials by the inductive action of high frequency alternating currents. The sixth method, that of electric smelting, promises well, provided the cost can be reduced to that of ordinary smelting processes.

THE NEW TELEPHONE GIRL.

She was a new girl at the central telephone exchange. Her previous experience in this big and busy world had been behind the counter at Chintz & Chally's. Nevertheless, she was a pleasant-spoken young lady and amiability was written all over her nature. She had adopted as her motto the touching sentence: "We try to please," and she honestly tried to live up to it. There was a ring at the bell. She applied her ear to the instrument and asked, sweetly:

"What number, please?"

"Let me have No. 474."

"I am sorry that No. 474 is busy now," she replied. "You can have No. 473 or No. 475 if you wish."

The individual at the other end of the wire hung up his receiver and used language which plainly showed that all efforts to please do not necessarily succeed. - Harper's Bazaar.

The Electrical Supply Company of Hamilton, Limited, has been incorporated, with a capital of $20,000. The promoters are John Wesley Van Dyke, of Grimsby, manufacturer, and John Sintzel, tailor; Joseph Overholt, dentist; William Gilzean Read, merchant, and George Thompson Simpson, electrician, all of Hamilton.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.

Note.—Secretaries of Associations are requested to forward matter for publication in this department not later than the 25th of each month.

ANNUAL CONVENTION.

THE annual convention of the Canadian Association of Stationary Engineers will be held at Brockville, Ont., on Thursday and Friday, the 19th and 20th instants. The meeting is expected to be especially interesting, as some important questions will be discussed, one being the proposed Dominion license law. A paper on "The Indicator," prepared by Mr. G. B. Risler, of London, will be presented, and it is possible other essays on engineering subjects will be forthcoming.

STRATFORD NO. 3.

The features of the president of the above association, Mr. John Hoy, are herewith portrayed. Mr. Hoy is an active association worker, and puts forth every effort to make the meetings interesting. He was born about ten miles from Stratford, in the township of South East Hope, on September 28th, 1854. At the age of 10 years he learned the trade of machinist, afterwards becoming engineer at the works of Thompson, Williams & Co., remaining in that position for nine years. For a time he was engaged at Weston, Ont., but upon returning to Stratford he accepted the position of engineer for Messrs. Dufton & Sons, which he has occupied for the past thirteen years. He has therefore been in the employ of a steam plant for twenty-three years, and is a thoroughly reliable engineer.

MR. JOHN HOY.

LONDON NO. 5.

The above branch of the C. A. S. E. have made a somewhat new departure in association work. A number of engineering questions have been prepared by the examining committee, a copy of which has been furnished to each member. Three prizes will be awarded to the winners. The questions were prepared by Mr. G. B. Risler, of the Advertiser office, who is also furnishing the prizes. Mr. Potter, chief engineer of the London street railway, will act as judge. The answers are to be received in writing before 8 p. m. of August 19th, and the result is looked forward to with much interest.

BROCKVILLE NO. 15.

Mr. J. Aikens, secretary of Brockville No. 15, writes: At our last meeting the election of officers for the ensuing year was held, with the following result: President, J. Grundy; past president, A. Franklin; vice-president, C. L. Bertrand; 2nd vice-president, F. Andrews; recording secretary, J. Aikens; financial secretary, Wm. Robinson; treasurer, J. McCaw; conductor, W. S. Baverstock; door-keeper, E. Mortimer; trustees, E. Carr, F. Devine, J. McRitchie; delegates to convention, E. Andrews, F. Wilkinson. The programme for the convention is not yet completed.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

THE annual meeting of the Ontario Association of Stationary Engineers was held in Toronto on Monday, May 31st last. President Arthur Ames, of Brantford, called the meeting to order at 11 a. m.

The minutes of the previous meeting were read and approved, on motion of Bros. Mackie and Devlin. *The president delivered the following address:*

GENTLEMEN,—On the occasion of our seventh annual meeting, I feel it my duty to thank the officers and members of this association for having shown the confidence reposed in me by re-electing me for a second term to the honorable position as president of the association. It is with the greatest pleasure that I note the growing interest with which our annual meeting is looked forward to by all. I am sure that I but voice the sentiment of all the members when I express the sincere regret occasioned by the absence, through illness, of our worthy registrar, Mr. A. E. Edkins. I am happy to state, however, that he is now convalescent, and we may look forward to seeing him with us again ere long. In his absence, the duties of his position have fallen to Mr. A. M. Wickens, who has so ably taken up the work with all his old-time vigor, and has managed the business connected with the office in a manner highly creditable to himself and to the society in general, and it must be encouraging to remember how deep an interest the older members still retain in the society.

The business to be brought before you will consist of, as on previous occasions, the election of officers to the board to replace the retiring members whose time have expired. In connection with this matter it is scarcely necessary to impress upon you the importance and desirability of electing, to fill the vacancies, members who have the interests of the association at heart, for, as you will readily understand, its future success as an association depends, to a very great extent, upon the perseverence and intelligence of the officers. In this connection, I may congratulate the officers and members of the outgoing board on the fact that, during the past years, no complaint has reached me respecting any certificate holder, either for neglect of duty, intoxication or other unbecoming conduct, consequently we have not had to revoke any certificates.

I would draw your attention to the fact that the membership of the association has not increased to the extent that it might have during the past year, but it is nevertheless gratifying to note that the best men throughout the province have availed themselves of the privileges offered by the association and procured certificates on their own merits. The importance of this statement is shown by the fact that manufacturers all over the province now require engineers holding Ontario certificates, and every steam plant of any consequence is now managed by a member of this association—a most encouraging sign.

The all important question of legislation is again before us. A short time ago, as you no doubt remember, a joint committee of the Canadian Association and Ontario Association was appointed to draught a bill respecting the inspection of steam boilers and the licensing of engineers in the Dominion. This was done satisfactorily to the committee, and at the meeting in question Messrs. A. M. Wickins, Jas. Devlin and myself were delegated to introduce the bill and explain its purposes. As an association we are deeply indebted to Mr. Jas. Sutherland, M. P. for North Oxford, who so courteously, at our solicitation, consented to introduce the measure in the House, and to draw to the attention of the members of that body the great and increasing importance connected with the proper inspection of steam boilers and the qualifications of the engineers in charge thereof. The bill up to the present time has passed its second reading, which you will be pleased to receive as an assurance that the measure is being duly considered at the hands of the Government. I may say, however, that owing to the great pressure of business at Ottawa connected with the tariff, etc., and owing partially to the introduction of the measure late in the session, the possibilities of securing its passage were lessened, but great hopes are entertained of obtaining the necessary legislation early in the session of 1898.

In conclusion, I wish to once more earnestly and sincerely thank the members of this association for the very great confidence reposed in me and the honor shown me during the time I have held the position of president of this association, and I do this the more earnestly knowing that this is the last opportunity I will have of thanking you individually and collectively for the hearty co-operation and support I have received at your hands in connection with the various duties that have fallen to my position during my term of office. I need hardly say that I will ever have the best interests and welfare of the association at he[illegible], and

should the opportunity ever arise I will be always ready and willing to do all that lies in my power to further its interest to the utmost.

Mr. A. M. Wickins, acting registrar, presented his report. The business of the year was stated to be satisfactory. Regret was expressed that Bro. Edkins was unable to be present. The report also said: The number of new certificates issued for the year of all grades is 76. There have been 17 certificates raised to a higher grade. We have issued 680 certificates, some of which have been cancelled for non-payment of renewals and a few have been blanked by their holders passing to the great beyond, leaving us with 634 certificate holders in good standing. The financial report is as follows:

RECEIPTS.		DISBURSEMENTS.	
New Certificates and Raises	$200 25	To Paid Treasurer	$158 47
Renewals	229 75	" Paid Examination Fees	187 55
Cash from Treasurer	35 00	" Postage, Printing and Legislation	106 69
		" Cash on Hand	12 29
	$465 00		$465 00

The treasuser's report showed that $158.47 had been received from the Registrar, which with the balance on hand May 31, 1896, made an income of $393.31. The expenditure was as follows:

1896.		
June 1—Board Meeting, Galt		$ 88 64
	Caretaker and Hall Rent	3 00
	Paid Treasurer Salary	10 00
	Percentage on Renewals	75
6—Paid Registrar		25 00
Nov. 26—Paid Registrar		35 00
1897.		
Mar. 17—Legislation Committee Expenses		44 00
May	Legislation Committee, Expenses to Ottawa	51 00
May 30—Postage and Expenses		3 75
		$281 14
Balance on Hand		111 17
		$393 31

The standing committees were then appointed as follows: Committee on good of the order—O. P. St. John, F. W. Donaldson, W. G. Blackgrove, Jas. Devlin and John Bain. The legislative committee were re-appointed, and on motion of Bros. Donaldson and Mackie were given power to add to their number. Committee on mileage, Bros. Jas. Devlin, Robt. Mackie and Wm. Sutton.

On motion of Bros. Mackie and Bain, it was resolved that the president be empowered to appoint a member to investigate and report on any boiler explosion that may occur, should he deem it advisable so to do.

It was moved by Bro. Devlin, seconded by T. Elliott, that a petition for a Dominion license law be forwarded to the members in the different towns, with a request to have them circulated, signed and forwarded to Ottawa.

Mr. Mooring moved, seconded by Mr. Wickens, that Bros. Mitchell, Dandie and Bain be appointed a committee on transportation for the next regular meeting at Oshawa.

The treasurer was granted the sum of $10 for his services.

On motion of Bros. Mitchell and Devlin, a uniform price for inspection of a steam plant, was agreed upon, said price to be $4 if the plant is situated in the town where such examiner lives; if not, railway fare and hotel expenses to be added.

ELECTION OF OFFICERS.

For president, Bros. T. W. Mitchell and O. P. St. John were nominated, Bro. Mitchell being elected.

For vice-president, Bros. St. John and Donaldson were nominated, the latter being successful.

Bros. Wickens and Mackie were elected by acclamation to the respective offices of registrar and treasurer.

Hamilton, Brantford and Oshawa were all strongly supported by the members as the next meeting place, with the result that Oshawa was decided upon

On motion of Bros. Devlin and Blackgrove, the regular meeting was fixed for the first Monday after the 24th of May.

ELECTION OF BOARD MEMBERS.

The retiring members of the board were Bros. Mackie, Edkins, Philip and Wickens.

Moved by Bros. Elliott and Donaldson that the retiring members be re-elected by acclamation. Lost.

Nominations were made as follows: Bros. Edkins, St. John, Mackie, Mooring, Philip and Blackgrove.

Upon a vote being taken, Bros. Edkins, Mackie, St. John and Wickens were declared elected.

The standing committee here reported, which was then followed by a report from the committee on mileage, recommending that the sum of $75.19 be paid board members for mileage.

The committee on the good of the order request all certificate holders to use their best endeavors in setting forth the advantages of taking out certificates, and the usefulness of a Dominion license law to engineers and steam users.

PERSONAL.

Mr. Wm. Cross, C.E., was recently appointed to take charge of the waterworks plant at Calgary, Alta.

Mr. John Davis, of the Metropolitan Railway, North Toronto, has recently passed through a severe illness, from which he is now recovering.

Mr. Fred B. Robb, of Amherst, N.S., was drowned while bathing near Wallace. Deceased was secretary-treasurer of the Robb Engineering Company.

Mr. Wm. F. Chapman, chief engineer for the Canada Carriage Company, Brockville, and executive secretary of the Canadian Association of Stationary Engineers, was recently married to Mrs. Alfred.

TRADE NOTES.

The Lucky Jim Gold Mining Co., of Sandon, B.C., have placed an order with the Jenckes Machine Co., of Sherbrooke, through their Rossland branch, for the ironwork for one three-wheel tramway.

The Colonna Gold Mining Co., of Rossland, are putting in an air pipe line to connect their two properties. This has been bought through the Rossland branch of the Jenckes Machine Co. of Sherbrooke, Que.

We have received a copy of the 1897 circular of information of the International Correspondence School of Electricity, of Scranton, Pa. The thorough system of this school is making for it a world-wide reputation, and those contemplating home study should send for full information.

The Sherbrooke Street Railway Co. have closed a contract with the Jenckes Machine Co. for one of their 45-inch Crocker turbines, with tubing and wheel cases complete, horizontal setting, for direct connection to an electric generator, which is being furnished by the General Electric Co.

The firm of Patterson & Corbin, street car builders, St. Catharines, Ont., has failed. Possession of the estate has been taken by the bank under power of mortgage, while the municipality placed a bailiff in charge for taxes. The firm for several years did a successful trade, but for two or three years past have been at a stand-still.

We are in receipt of an invitation to the nineteenth annual Rhode Island Clam Dinner tendered to the electrical fraternity by Mr. Eugene F. Phillips, president of the Eugene F. Phillips Electrical Works. The event takes place at the Pomham Club, Providence, R. I., on August 21st, and will no doubt prove as enjoyable as similar occasions in the past.

CANADIAN ELECTRICAL NEWS AND STEAM ENGINEERING JOURNAL

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TORONTO BRANCH NO. 1.—Meets 1st and 3rd Wednesday each month in Engineers Hall, 61 Victoria street. G. C. Mooring, President; T. Eversfield, Vice-President; J. W. Marr, Recording Secretary.

MONTREAL BRANCH NO. 1.—Meets 1st and 3rd Thursday each month, in Engineers Hall, Craig street. President, Wm. Smyth; 1st Vice-President, Wm. Bowles; 2nd Vice-President, P. McNaughton; Recording Secretary, J. O'Rourke; Treasurer, G. Jones.

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BRANDON, MAN., BRANCH NO. 1.—Meets 1st and 3rd Friday each month in City Hall. A. R. Crawford, President; Arthur Fleming, Secretary.

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LONDON BRANCH NO. 5.—Meets on the first and third Thursday in each month in Sherwood Hall. D. G. Campbell, President; B. Bright, Vice-President; W. Blythe, Secretary.

GUELPH BRANCH NO. 6.—Meets 1st and 3rd Wednesday each month at 7.30 p. m. H. Geary, President; Thos. Anderson, Vice-President; H. Flewelling, Rec.-Secretary; P. Ryan, Fin.-Secretary; Treasurer, C. F. Jordan.

OTTAWA BRANCH NO. 7.—Meet every second and fourth Saturday in each month, in Borbridge's hall, Rideau street; Frank Robert, President; T. G. Johnson, Secretary.

DRESDEN BRANCH NO. 8.—Meets 1st and Thursday in each month. Thos. Steeper, Secretary.

BERLIN BRANCH NO. 9.—Meets 2nd and 4th Saturday each month at 8 p.m. J. R. Utley, President; G. Steinmetz, Vice-President; Secretary and Treasurer, W. J. Rhodes, Berlin, Ont.

KINGSTON BRANCH NO. 10.—Meets 1st and 3rd Thursday in each month in Fraser Hall, King street, at 8 p.m. President, F. Simmons; Vice-President, C. Asselstine; Secretary, J. L. Orr.

WINNIPEG BRANCH NO. 11.—President, G. M. Hazlett; Rec.-Secretary, J. Sutherland; Financial Secretary, A. B. Jones.

KINCARDINE BRANCH NO 12.—Meets every Tuesday at 8 o'clock, in McKibbon's block. President, Daniel Bennett; Vice-President, Joseph Lighthall; Secretary, Percy C. Walker, Waterworks.

PETERBOROUGH BRANCH NO. 14.—Meets 2nd and 4th Wednesday in each month. W. L. Outhwaite, President; W. Forster, Vice-President; A. E. McCallum, Secretary.

BROCKVILLE BRANCH NO. 15.—Meets every Monday and Friday evening, in Richards' Block, King St. President, John Grundy; Vice-President, C. L. Bertrand; Recording Secretary, James Aikins.

CARLETON PLACE BRANCH NO. 16.—Meets every Saturday evening. President, Jos. McKay; Secretary, J. D. Armstrong.

ONTARIO ASSOCIATION OF STATIONARY ENGINEERS.

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LONDON—F. Mitchell.
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Information regarding examinations will be furnished on application to any member of the Board.

Proposed Russian Electrical Exhibition.

THE Russian Electro-Technical Society is said to be arranging for an electrical exhibition in St. Petersburg in 1899, at which every kind of electrical device will be granted admission. The expenses are to be borne by the government, the city authorities and the above-named society. This exhibition should be taken advantage of to make known in Russia the merits of Canadian manufactured electrical goods.

Engineering Education.

THE fifth annual meeting of the Society for the Promotion of Engineering Education will be held in the School of Practical Science, Toronto, on the 16th, 17th and 18th of the present month. Special rates have been granted by the railways to delegates to this convention, and a number of pleasure excursions have also been arranged. Mr. Frank Callen, the secretary, may be found at the Arlington Hotel during the convention.

Developments in Telegraphy.

PERSONS connected with the electric lighting and power and telephone interests have shown a disposition to regard the telegraph system as somewhat of a back number. The remark has frequently been heard that the telegraph has reached the limits of its development, and consequently attracts but little notice. Recent developments go to prove, however, that telegraphy is likely to keep fully abreast, if not in advance of improvements in other departments of the electrical field. Reference was recently made in these columns to experiments carried out under the direction of the British post office authorities for telegraphing through space without the aid of wires. Since then the celebrated electrical inventor, Nikola Tesla, of New York, has been devoting his attention to the subject, and claims to have developed apparatus which enables him to telegraph successfully a distance of twenty miles through

the earth. Mr. Tesla has demonstrated to his entire satisfaction by means of the rudimentary apparatus at present at command that communication can be carried on with any part of the globe, and he is about to begin the construction of improved appliances for the accomplishment of this object. The character of these appliances has not been disclosed.

Illumination of Niagara Falls.

THE delegates to the recent convention of the Canadian Electrical Association at Niagara Falls heard from the old residents of that locality descriptions of the beautiful effects which resulted from the illumination of the cataract by means of electricity nearly twenty years ago. Many were the regrets expressed that when the lands surrounding the falls came under the control of the government these artificial effects ceased. Our readers will be interested in knowing that the Acetylene Light, Heat and Power Co. have now in operation a system of illumination by means of acetylene gas. Half inch pipe connects three Naphey generators with fifteen large locomotive headlights placed in various positions. It is said that the light does not penetrate very far, and that no attempt is made to light up the Horse Shoe falls, but only the river close to the American shore.

The Canadian Electrical Association.

THE late convention of the Canadian Electrical Association at Niagara was both interesting and instructive, in that the several papers presented gave rise to especially valuable discussions, and it is gratifying to note that, in these discussions, members associated purely with the operating branch of electricity took part almost as actively as those representing the several manufacturing companies. This evinces a growing interest in the C. E. A. as the representative electrical association of Canada that augurs well for the future of the association, not only as affording yearly a pleasant re-union, but also as an aid in raising the standard of electrical operating by the exchange of experiences and opinions. Such an association should be recognized as an absolute necessity, where, as in the business of electrical lighting and power distribution, the most efficient and economical means of generating and the most remunerative system of operating and managing generally, is not a matter of exact science, but is largely empirical, and varies under different local conditions. Thus it is only by obtaining the views, founded on experience of observers operating under all kinds of varied conditions, that any comprehensive idea can be formed of the most favorable ways of operating.

The Gorge Road.

WE were much impressed on the occasion of the recent electrical conventions at Niagara Falls with the advantages which the Niagara Falls Park and River Railway has over its American rival, known as the "Gorge Road." As most of our readers know, the Canadian road runs close to the edge of the bank of the gorge, and affords a panoramic view of the river and surrounding scenery which is positively delightful. The American road winds along the face of the cliff near its base, the object being to bring sight-seers within as close range as possible of the rapids. The Canadian road enjoys the advantage of being safer for the sight-seer and less costly to maintain in operation. The face of the cliff out of which a road bed has been cut for the Gorge road has been rendered almost as rotten as pumice stone by being constantly percolated with water. As a result, pieces of rock are continually becoming detached from the upper face of the cliff and falling upon the road-bed of the railway below. To prevent as far as possible accidents from this cause, a staff of fifty workmen is constantly employed in keeping the road-bed in repair. The greatest difficulty is experienced in the spring, at which time the services of several hundred men have sometimes been required. The great expense thus imposed upon the management, coupled with the fact that the period of operation is only about four months each year, makes it extremely doubtful if the enterprise can be made to pay expenses. There is also the possibility, if not probability, that an accident, frightful to contemplate, may some day occur in spite of all the precautions which are or can be taken.

[Since the above was written a collision has occurred on the Gorge road in which nearly twenty persons were injured, some seriously. To allow of repairs being made to one of the tracks both up and down cars were said to be using the inside track.]

Central Station Management.

MR. Armstrong's paper, read at the recent convention of the Canadian Electrical Association, on "Why Some Lighting Plants Do Not Pay," was but the introductory note to a subject on which volumes might well be written, and which we are glad to see is claiming the attention of energetic central station owners. Mr. Armstrong gives, in very unmistakeable language, one of the principal reasons for absence of profits, when he says: "There is no industry representing an equivalent money investment and possibility of public service which is so generally managed by men who know little or nothing about it." In an electric lighting plant we have a factory that contains two perfectly different kinds of machinery, the object of which is to generate an invisible, imponderable force out of so simple a material as coal. Both the steam engine and the electric dynamo are lightly developed scientific machines, and the economical generation of steam in a boiler is thought a fit problem for the attention of highly educated engineers. And yet in the large majority of cases a mechanic, whose education has not included any scientific instruction, and whose experience is limited to repairing broken parts, is placed in the responsible position of manager or electrician. It is not fair to such a man to put him in a position requiring much higher order of technical knowledge and business ability than it is in the least degree possible for him to possess, and the wonder is that central station owners are so blind to their own interests as to follow such a course.

Apparent Inconsistency

WITHIN the last very few weeks there was a proposition made to appoint an "electrical engineer" on the staff of the city engineer, Hamilton. This proposition was defeated on the ground that such a person was not required, as any mechanic could do the necessary work. Now, the work may, or may not, have been such as to call for the exercise of great technical skill, but the decision seems to indicate the estimation in which engineers are held in Canada. When will the public learn to know the difference between a mechanic and an engineer? They send their sons to McGill or the School of

Practical Science to become electrical engineers, because, as they say, "Electricity is the thing of the future," and they evince their confidence in the advantage of a thoroughly technical and scientific education by preferring the service of a mechanic whose school was the bench and whose technical qualification is the willingness to work for $40 a month, to those of the certificated graduate whom they themselves have caused to be filled with apparently utterly useless knowledge at considerable expense. Is there really nothing in electrical engineering that is not instinctively known by an uneducated mechanic? Why support such schools as we have in Toronto, Montreal and elsewhere if what they teach is of no value? Why waste time, brains and money in teaching one young man at college what another young man is paid for absorbing unconsciously at a bench? But, on the other hand, if a technical education does specially fit a man for a particular profession, in the name of common sense why not recognize and profit by the probability that he knows more about his work than another man who has made no study of it?

MR. GEORGE BLACK,

SUPERINTENDENT GREAT NORTHWESTERN TELEGRAPH COMPANY, HAMILTON.

THE subject of this sketch was born of Scotch parents in the City of Montreal on June 19th, 1838, in which city he received his education. His ambition was to be an engine builder, but owing to his delicate health his friends deterred him from following that vocation. After spending three years in commercial life he entered the service of the Montreal Telegraph Company as entry clerk, in November, 1854. He was given the option of remaining at the head office or taking an agency, and, choosing the latter, was placed in charge of the St. Hyacinthe, Que., office, working for the G. T. R. and M. T. companies until April, 1855, and in September of the same year was promoted to the Brockville agency, the business of which doubled in the course of a few months. Mr. Black yet speaks of his surprise when one morning the general superintendent called him up and conveyed to him the thanks of the board of directors for the manner in which he had conducted the business of the office, and informed him that an increase in his salary had been decided upon.

MR. GEORGE BLACK.

On October 1st, 1858, Mr. Black was promoted to the management of the Hamilton office, where he remained till the company was merged in the Great Northwestern Company, and since that time he has continued as manager for the new company. So attached was he to his old company that he refused an offer to go into opposition in 1869 at nearly three times the salary he then received. A couple of offers since to leave the service were also declined.

Mr. Black has taken a lively interest in all improvements in telegraphy, and has watched with deep interest the development of electrical inventions and their application to the use of the public. In 1874 he and a friend invented and applied for an American patent on a method of signalling automatically to and from trains in motion, to prevent accidents, or signal defects in tracks, bridges, etc. This application was killed in the patent office by a mere technicality, no interference being raised which could not be overcome, and though proceedings could have been started over again, the inventors feared that other obstructions would be raised and abandoned the case. This patent anticipated the trolley wire, and when railway collisions are reported Mr. Black always feels that they might have been avoided by the use of his system.

When the Bell telephone came before the public Mr. Black accepted the agency for Hamilton and vicinity, and helped to popularize the new invention by public exhibitions, etc. While experimenting with the telephone he discovered a method of using the telegraph and telephone on the same wire simultaneously. He, in conjunction with Dr. Rosebrugh, of Toronto, patented this method, which was issued in 1878. This was the first method of simultaneous telegraphic telephony invented, and when subsequently improved worked perfectly between Toronto and Hamilton and at other places for a lengthened period. Prof. Ryssel-berge, of Belgium, got credit and praise for this invention, but his method, which is somewhat similar, was not announced till some years later.

Mr. Black has been a member of the Canadian Electrical Association since its inception, and has been most of the time on its executive committee. He is the local electrical inspector for the Canadian Fire Underwriters.

QUESTIONS AND ANSWERS.

"SUBSCRIBER," Toronto Junction, writes: Would like some information as to where I might obtain a book treating on the design and construction of water turbines; also what kind of machine is used to produce Farradic currents, such as are used for electrical treatment by doctors. Is there any book published on the design of such a machine?

ANSWER.—(1) There are several books treating on turbines, which can be seen in the Public Library, one of the best being Professor Rankin's. (2) Electricity in Electro Therapeutics, by Houston & Kennelly, price about $1.50, would probably answer your requirements.

BUSINESS MAXIMS FOR ELECTRICAL COMPANIES.

An electrical company in Buffalo has compiled these "Electrical Don'ts." Some good advice is tersely expressed.

Don't try to revolutionize the electrical business by cutting prices. You can't.

Don't expect to get all the jobs you figure on, and get mad if you don't.

Don't expect to make a living on a 10 per cent. margin of profit. You can't.

Don't abuse your competitor because he underbid you. He may lose money and yet do as good work as you.

Don't bid low, do poor work and employ boys to even up. You can't.

Don't educate the embryo electrician and then try to kill him off as soon as he is able to work.

Don't give your work away. What is worth doing is worth getting paid for; and, above all, employ good workmen.

THE NATIONAL ELECTRICAL CODE.

After many months of labor and careful consideration, an electrical code has finally been adopted by the National Board of Fire Underwriters of the United States. The code is identical with that which received the unaminous approval of the Code Committee of the National Conference on Standard Electrical Rules, and is the result of the united efforts of the various electrical, insurance, architectural and allied associations, which have recommended its adoption. These rules received the approval of the National Electric Light Association at its meeting at Niagara Falls in June last, and now, for the first time, a National Electrical Code is issued, stamped with the approval of the insurance as well as the electrical and allied interests. The matter has, we believe, sufficient interest for our readers to warrant the publication of the code:

The following associations have unanimously voted to recommend the code to their respective associations for approval and adoption. American Institute of Architects, American Institute of Electrical Engineers, American Society of Mechanical Engineers, American Street Railway Association, Factory Mutual Fire Insurance Companies, National Association of Fire Engineers, National Board of Fire Underwriters, National Electric Light Association, Underwriters' National Electric Association.

GENERAL PLAN GOVERNING THE ARRANGEMENT OF RULES.

Class A.—Central Stations, Dynamo, Motor and Storage Battery Rooms, Transformer Sub-Stations, etc. Rules 1 to 11.

Class B.—Outside Work, all systems and voltages. Rules 12 and 13.

Class C. Inside work. Rules 14 to 39. Sub-divided as follows:

General Rules, applying to all systems and voltages. Rules 14 to 17.

Constant-Current Systems. Rules 18 to 20.

Constant-Potential Systems. All voltages: Rules 21 to 23. Voltage not over 300: Rules 24 to 31. Voltage between 300 and 3,000: Rules 32 to 37. Voltage over 3,000: Rules 38 to 39.

Class D. Specifications for Wires and Fittings. Rules 40 to 55.

Class E. Miscellaneous. Rules 56 to 59.

Class F. Marine Wiring. Rules 60 to 72.

GENERAL SUGGESTIONS.

In all electric work, conductors, however well insulated, should always be treated as bare, to the end that under no conditions, existing or likely to exist, can a grounding or short circuit occur, and so that all leakage from conductor to conductor, or between conductor and ground, may be reduced to the minimum.

In all wiring special attention must be paid to the mechanical execution of the work. Careful and neat running, connecting, soldering, tapping of conductors and securing and attaching of fittings, are specially conducive to security and efficiency, and will be strongly insisted on.

In laying out an installation, except for constant-current systems, the work should, if possible, be started from a centre of distribution, and the switches and cut-outs, controlling and connected with the several branches, be grouped together in a safe and easily accessible place, where they can be readily got at for attention or repairs. The load should be divided as evenly as possible among the branches, and all complicated and unnecessary wiring avoided.

The use of wire-ways for rendering concealed wiring permanently accessible is most heartily endorsed and recommended; and this method of accessible concealed construction is advised for general use.

Architects are urged, when drawing plans and specifications, to make provision for the channeling and pocketing of buildings for electric light or power wires, and in specifications for electric gas lighting to require a two-wire circuit, whether the building is to be wired for electric lighting or not, so that no part of the gas fixtures or gas piping be allowed to be used for the gas lighting circuit.

CLASS A.—STATIONS AND DYNAMO ROOMS.

Includes Central Stations, Dynamo, Motor and Storage Battery Rooms, Transformer Sub-Stations, Etc.

1. GENERATORS—

a. Must be located in a dry place.

b. Must never be placed in a room where any hazardous process is carried on, nor in places where they would be exposed to inflammable gases or flyings of combustible materials.

c. Must be insulated on floors or base frames, which must be kept filled to prevent absorption of moisture, and also kept clean and dry. Where frame insulation is impracticable, the Inspection Department having jurisdiction may, in writing, permit its omission, in which case the frame must be permanently and effectively grounded.

A high-potential machine which, on account of great weight or for other reasons, cannot have its frame insulated from the ground, should be surrounded with an insulated platform. This may be made of wood, mounted on insulating supports, and so arranged that a man must always stand upon it in order to touch any part of the machine.

In case of a machine having an insulated frame, if there is trouble from static electricity due to belt friction, it should be overcome by placing near the belt a metallic comb connected with the earth, or by grounding the frame through a very high resistance of not less than 200 ohms per volt generated by the machine.

d. Every constant-potential generator must be protected from excessive current by a safety fuse, or equivalent device, of approved design in each lead wire.

These devices should be placed on the machine or as near it as possible.

Where the needs of the service make these devices impracticable, the Inspection Department having jurisdiction may, in writing, modify the requirements.

e. Must each be provided with a waterproof cover.

f. Must each be provided with a name-plate, giving the maker's name, the capacity in volts and amperes, and normal speed in revolutions per minute.

2. CONDUCTORS—

From generators to switch-boards, rheostats or other instruments, and thence to outside lines.

a. Must be in plain sight or readily accessible.

b. Must have an approved insulating covering as called for by rules in Class "C" for similar work, except that in central stations, on exposed circuits, the wire which is used must have a heavy braided non-combustible outer covering.

Bus bars may be made of bare metal.

c. Must be kept so rigidly in place that they cannot come in contact.

d. Must in all other respects be installed under the same precautions as required by rules in Class "C" for wires carrying a current of the same volume and potential.

3. SWITCHBOARDS—

a. Must be so placed as to reduce to a minimum the danger of communicating fire to adjacent combustible material.

Special attention is called to the fact that switchboards should not be built down to the floor, nor up to the ceiling, but a space of at least ten or twelve inches should be left between the floor and the board, and from eighteen to twenty-four inches between the ceiling and the board, in order to prevent fire from communicating from the switchboard to the floor or ceiling, and also to prevent the forming of a partially concealed space very liable to be used for storage of rubbish and oily waste.

b. Must be made of non-combustible material or of hardwood in skeleton form, filled to prevent absorption or moisture.

c. Must be accessible from all sides when the connections are on the back, but may be placed against a brick or stone wall when the wiring is entirely on the face.

d. Must be kept free from moisture.

e. Bus bars must be equipped in accordance with rules for placing conductors.

4. RESISTANCE BOXES AND EQUALIZERS—(For construction rules see No. 52.)

a. Must be placed on a switchboard, or, if not thereon, at a distance of a foot from combustible material, or separated therefrom by a non-inflammable, non-absorptive insulating material.

5. LIGHTNING ARRESTERS—(For construction rules see No. 55.)

a. Must be attached to each side of every overhead circuit connected with the station.

It is recommended to all electric light and power companies that arresters be connected at intervals over systems in such numbers and so located as to prevent ordinary discharges entering (over the wires) buildings connected to the lines.

b. Must be located in readily accessible places away from combustible materials, and as near as practicable to the point where the wires enter the building.

Station arresters should generally be placed in plain sight on the switchboard.

In all cases, kinks, coils and sharp bends in the wires between

the arresters and the out-door lines must be avoided as far as possible.

c. Must be connected with a thoroughly good and permanent ground connection by metallic strips or wires having a conductivity not less than that of a No. 6 B. & S. copper wire, which must be run as nearly in a straight line as possible from the arresters to the earth connection.

Ground wires for lightning arresters must not be attached to gas pipes within the buildings.

It is often desirable to introduce a choke coil in circuit between the arresters and the dynamo. In no case should the ground wire from a lightning arrester be put into iron pipes, as these would tend to impede the discharge.

6. Care and Attendance—

a. A competent man must be kept on duty where generators are operating.

b. Oily waste must be kept in approved metal cans and removed daily.

Approved waste cans shall be made of metal, with legs raising can three inches from the floor, and with self-closing covers.

7. Testing of Insulation Resistance—

a. All circuits must be provided with reliable ground detectors. Detectors which indicate continuously, and give an instant and permanent indication of a ground, are preferable. Ground wires from detectors must not be attached to gas-pipes within the building.

b. Where continuously indicating detectors are not feasible, the circuits should be tested at least once per day, and preferably oftener.

c. Data obtained from all tests must be preserved for examination by the Inspection Department having jurisdiction.

These rules on testing to be applied at such places as may be designated by the Inspection Department having jurisdiction.

8. Motors

a. Must be insulated on floors or base frames, which must be kept filled to prevent absorption of moisture; and must be kept clean and dry. Where frame insulation is impracticable the Inspection Department having jurisdiction may, in writing, permit its omission, in which case the frame must be permanently and effectively grounded.

A high potential machine which, on account of great weights or for other reasons, cannot have its frame insulated, should be surrounded with an insulated platform. This may be made of wood, mounted on insulating supports, and so arranged that a man must stand upon it in order to touch any part of the machine.

In case of a machine having an insulated frame, if there is trouble from static electricity due to belt friction, it should be overcome by placing near the belt a metallic comb connected to the earth, or by grounding the frame through a very high resistance of not less than 200 ohms per volt generated by the machine.

b. Must be wired under the same precautions as required by rules in Class "C", for wires carrying a current of the same volume and potential.

The leads or branch circuits should be designed to carry a current at least fifty per cent. greater than that required by the rated capacity of the motor to provide for the inevitable over-loading of the motor at times without over-fusing the wires.

c. The motor and resistance box must be protected by a cut-out and controlled by a switch (see No. 17a) said switch plainly indicating whether "on" or "off". Where one-quarter horse-power or less is used on low tension circuits a single pole switch will be accepted. The switch and rheostat must be located within sight of the motor, except in such cases where special permission to locate them elsewhere is given, in writing, by the Inspection Department having jurisdiction.

d. Must have their rheostats or starting boxes located so as to conform to the requirements of Rule 4.

In connection with motors the use of circuit breakers, automatic starting boxes and automatic under-load switches is recommended, and they must be used when required.

e. Must not be run in series-multiple or multiple-series.

f. Must be covered with a water-proof cover when not in use, and if deemed necessary by the Inspection Department having jurisdiction, must be enclosed in an approved case.

From the nature of the question the decision as to what is an approved case must be left to the Inspection Department having jurisdiction to determine in each instance.

g. Must, when combined with ceiling fans, be hung from insulated hooks, or else there must be an insulator interposed between the motor and its support.

h. Must each be provided with a name-plate, giving the maker's name, the capacity in volts and amperes and the normal speed in revolutions per minute.

9. Railway Power Plants—

a. Must be equipped in each feed wire before they leave the station with an approved automatic circuit breaker (see No. 44) or other device, which will immediately cut off the current in case of a ground. This device must be mounted on a fireproof base, and in full view and reach of the attendant.

10. Storage or Primary Batteries

a. When current for light and power is taken from primary or secondary batteries, the same general regulations must be observed as applied to similar apparatus fed from dynamo generators developing the same difference of potential.

b. Storage battery rooms must be thoroughly ventilated.

c. Special attention is directed to the rules for rooms where acid fumes exist. (See No. 24, j and k.)

d. All secondary batteries must be mounted on non-absorptive, non-combustible insulators, such as glass or thoroughly vitrified and glazed porcelain.

e. The use of any metal liable to corrosion must be avoided in connections of secondary batteries.

11. Transformers (*For construction rules see No. 54.*)

a. In central or sub-stations the transformers must be so placed that smoke from the burning out of the coils or the boiling over of the oil (where oil filled cases are used) could do no harm.

Class B.—Outside Work

All Systems and Voltages.

12. Wires—

a. Service wires must have an approved rubber insulating covering. (See No. 40a.) Line wires, other than services, must have an approved weather-proof, or rubber insulating covering. (See No. 40 a and b.) All tie wires must have an insulation equal to that of the conductors they confine.

b. Must be so placed that moisture can not form a cross connection between them not less than a foot apart, and not in contact with any substance other than their insulating supports. Service blocks must be covered over their entire surface with at least two coats of waterproof paint.

c. Must be at least seven feet above the highest point of flat roofs, and at least one foot above the ridge of pitched roofs over which they passed or to which they are attached.

d. Must be protected by dead insulated guard iron or wires from possibility of contact with other conducting wires or substances to which current may leak. Special precautions of this kind must be taken where sharp angles occur, or where any wires might possibly come in contact with electric light or power wires.

e. Must be provided with petticoat insulators of glass or porcelain. Porcelain knobs or cleats and rubber hooks will not be approved.

f. Must be so spliced or joined as to be both mechanically and electrically secure without solder. The joints must then be soldered, to insure preservation, and covered with an insulation equal to that on the conductors.

All joints must be soldered, even if made with some form of patent splicing device. This ruling applies to joints and splices in all classes of wiring covered by these rules.

g. Must, where they enter buildings, have drip loops outside, and the holes through which the conductors pass must be bushed with non-combustible, non-absorptive insulating tubes slanting upward toward the inside.

h. Telegraph, telephone and similar wires must not be placed on the same cross-arm with electric light or power wires.

i. The metallic sheathes to cables must be permanently and effectively connected to "earth".

TROLLEY WIRES.

j. Must not be smaller than No. 0 B. & S. copper or No. 4 B. & S. silicon bronze, and must readily stand the strain put upon them when in use.

k. Must have a double insulation from the ground. In wooden pole construction, the pole will be considered as one insulation.

l. Must be capable of being disconnected at the power plant, or of being divided into sections, so that, in case of fire on the railway route, the current may be shut off from the particular section and not interfere with the work of the firemen. This rule also applies to feeders.

m. Must be safely protected against accidental contact where crossed by other conductors.

Guard wires should be insulated from the ground and should be electrically disconnected in sections of not more than 300 feet in length.

GROUND RETURN WIRES.

n. For the diminution of electrolytic corrosion of underground metal work, ground return wires must be so arranged that the difference of potential between the grounded dynamo terminal and any point on the return circuit will not exceed twenty-five volts.

It is suggested that the positive pole of the dynamo be connected to the trolley line, and that whenever pipes or other underground metal work are found to be electrically positive to the rails or surrounding earth, that they be connected by conductors arranged so as to prevent as far as possible current flow from the pipes into the ground.

13. TRANSFORMERS—(For construction rules see No. 54.)

a. Must not be placed inside of any building, excepting central stations, unless by special permission of the Inspection Department having jurisdiction.

b. Must not be attached to the outside walls of buildings, unless separated therefrom by substantial supports.

CLASS C. INSIDE WORK.

All Systems and Voltages.

GENERAL RULES. ALL SYSTEMS AND VOLTAGES.

14. WIRES—(For special rules see Nos. 18, 24, 32, 38 and 39.)

a. Must not be of smaller size than No. 14 B. & S., except as allowed under rules 24u and 40c.

b. Tie wires must have an insulation equal to that of the conductors they confine.

c. Must be so spliced or joined as to be both mechanically and electrically secure without solder; they must then be soldered to insure preservation, and the joint covered with an insulation equal to that on the conductors.

Stranded wires must be soldered before being fastened under clamps or binding screws, and when they have a conductivity greater than No. 10 B. & S. copper wire, they must be soldered into lugs.

All joints must be soldered, even if made with some form of patent splicing device. This ruling applies to joints and splices in all classes of wiring covered by these rules.

d. Must be separated from contact with walls, floors, timbers or partitions through which they may pass by non-combustible, non-absorptive insulating tubes, such as glass or porcelain.

Bushings must be long enough to bush the entire length of the hole in one continuous piece, or else the hole must first be bushed by a continuous water-proof tube, which may be a conductor, such as iron pipe; the tube then is to have a non-conducting bushing pushed in at each end so as to keep the wire absolutely out of contact with the conducting pipe.

e. Must be kept free from contact with gas, water of other metallic piping, or any other conductors or conducting material which they may cross, by some continuous and firmly fixed non-conductor, creating a separation of at least one inch. Deviations from this rule may sometimes be allowed by special permission.

f. Must be so placed in wet places that an air space will be left between conductors and pipes in crossing, and the former must be run in such a way that they cannot come in contact with the pipe accidentally. Wires should be run over, rather than under, pipes upon which moisture is likely to gather or which, by leaking, might cause trouble on a circuit.

15. UNDERGROUND CONDUCTORS—

a. Must be protected, when brought into a building, against moisture and mechanical injury, and all combustible material must be kept removed from the immediate vicinity.

b. Must not be so arranged as to shunt the current through a building around any catch-box.

16. TABLE OF CARRYING CAPACITY OF WIRES—

Below is a table showing the allowable carrying capacity of wires containing ninety-eight per cent. pure copper, which must be followed in placing interior conductors:

	TABLE A. Rubber Covered Wires. See No. 4 a.	TABLE B. Weatherproof Wires. See No. 40b
B. & S. G.	Amperes	Amperes.
18	3	5
16	6	8
14	12	16
12	17	23
10	24	32
8	33	46
6	46	65
5	54	77
4	65	92
3	76	110
2	90	131
1	107	156
0	127	185
00	150	220
000	177	262
0000	210	312

Circular Mills.	Amperes.	Amperes.
200,000	200	300
300,000	270	400
400,000	330	500
500,000	390	590
600,000	450	680
700,000	500	760
800,000	550	840
900,000	600	920
1,000,000	650	1,000
1,100,000	690	1,080
1,200,000	730	1,150
1,300,000	770	1,220
1,400,000	810	1,290
1,500,000	850	1,360
1,600,000	890	1,430
1,700,000	930	1,490
1,800,000	970	1,550
1,900,000	1,010	1,610
2,000,000	1,050	1,670

The lower limit is specified for rubber-covered wires to prevent gradual deterioration of the high insulations by the heat of the wires, but not from fear of igniting the insulation. The question of drop is not taken into consideration in the above tables.

The carrying capacity of sixteen and eighteen wire is given, but no smaller than fourteen is to be used, except as allowed under Rules 24u and 40c.

17. SWITCHES, CUT-OUTS, CIRCUIT BREAKERS, ETC.—(For construction rules, see Nos. 43, 44 and 45.)

a. Must, whenever called for, unless otherwise provided (for exceptions, see No. 8c and No. 22c), be so arranged that the cut-outs will protect, and the opening of the switch or circuit breaker will disconnect, all of the wires; that is, in a two-wire system the two wires, and in a three-wire system the three wires, must be protected by the cut-out and disconnected by the operation of the switch or circuit breaker.

b. Must not be placed in the immediate vicinity of easily ignitible stuff or where exposed to inflammable gases or dust or to flyings of combustible material.

c. Must, when exposed to dampness, either be inclosed in a waterproof box or mounted on porcelain knobs.

CONSTANT CURRENT SYSTEMS.

Principally Series Arc Lighting.

18. WIRES—(See also No. 14, 15 and 16.)

a. Must have an approved rubber insulating covering. (See No. 40a.)

b. Must be arranged to enter and leave the building through an approved double-contact service switch (see No. 43,) mounted in a non-combustible case, kept free from moisture, and easy of access to police or firemen. So-called "snap switches" must not be used on high potential circuits.

c. Must always be in plain sight, and never incased, except when required by the Inspection Department having jurisdiction.

d. Must be supported on glass or porcelain insulators, which separate the wire at least one inch from the surface wired over, and must be kept rigidly at least eight inches from each other, except within the structure of lamps, on hanger-boards, in cut-out boxes, or like places, where a less distance is necessary.

e. Must, on side walls, be protected from mechanical injury by a substantial boxing, retaining an air space of once inch around the conductors, closed at the top (the wires passing through bushed holes), and extending not less than seven feet from the floor. When crossing floor-timbers in cellars or in rooms, where they might be exposed to injury, wires must be attached by their insulating supports to the under side of a wooden strip not less than one-half an inch in thickness.

19. ARC LAMPS—(For construction rules, see No. 49.)

a. Must be carefully isolated from inflammable material.

b. Must be provided at all times with a glass globe surrounding the arc, securely fastened upon a close base. No broken or cracked globes are to be used.

c. Must be provided with a wire netting (having a mesh not exceeding one and one-quarter inches) around the globe, and an approved spark arrester (see No. 50), when readily inflammable material is in the vicinity of the lamps, to prevent escape of sparks, melted copper or carbon. It is recommended that plain carbons, not copper-plated, be used for lamps in such places.

Arc lamps, when used in places where they are exposed to flyings of easily inflammable material, should have the carbons inclosed completely in a globe in such manner as to avoid the necessity for spark arresters.

For the present, globes and spark arresters will not be required on so-called "inverted arc" lamps, but this type of lamp must not be used where exposed to flyings of easily inflammable materials.

d. Where hanger-boards (see No. 48) are not used, lamps must be hung from insulating supports other than their conductors.

20. Incandescent Lamps in Series Circuits—

a. Must have the conductors installed as provided in Rule No. 18, and each lamp must be provided with an automatic cut-out.

b. Must have each lamp suspended from a hanger-board by means of rigid tube.

c. No electro-magnetic device for switches and no system of multiple-series or series-multiple lighting will be approved.

d. Under no circumstances can they be attached to gas fixtures.

Contsant-Potential Systems.

General Rules—All Voltages.

21. Automatic Cut-outs (Fuses and Circuit Breakers.) (See No. 17, and for construction, Nos. 44 and 45.)

a. Must be placed on all service wires, either overhead or underground, as near as possible to the point where they enter the building and inside the walls, and arranged to cut off the entire current from the building.

Where the switch required by Rule No. 22 is inside the building, the cut-out required by this section must be placed so as to protect it.

b. Must be placed at every point where a change is made in the size of wire [unless the cut-out in the larger wire will protect the smaller. (See No. 16)].

c. Must be in plain sight, or enclosed in an approved box (see No. 46), and readily accessible. They must not be placed in the canopies or shells of fixtures.

d. Must be so placed that no set of incandescent lamps, whether grouped or one fixture or several fixtures or pendants, requiring a current of more than six amperes, shall be dependent upon one cut-out. Special permission may be given in writing by the Inspection Department having jurisdiction for departure from this rule in cases of large chandeliers.

e. Must be provided with fuses, the rated capacity of which does not exceed the allowable carrying capacity of the wire, and when circuit breakers are used, they must not be set more than about thirty per cent. above the allowable carrying capacity of the wire, unless a fusible cut-out is also installed in the circuit (see No. 16).

22. Switches—(See No. 17, and for construction, No. 43.)

a. Must be placed on all service wires, either overhead or underground, in a readily accessible place, as near as possible to the point where the wires enter the building, and arranged to cut off the entire current.

b. Must always be placed in dry, accessible places, and be grouped as far as possible. Knife switches must be so placed that gravity will tend to open rather than close the switch.

c. Must not be single-pole, except when the circuits which they control supply not more than six sixteen candle-power lamps or their equivalent.

d. Where gangs of flush switches are used, whether with conduit systems or not, the switches must be inclosed in boxes constructed of or lined with fire resisting material. Where two or more switches are placed under one plate, the box must have a separate compartment for each switch. No push buttons for bells, gas lighting circuits or the like shall be placed in the same wall plate with switches controlling electric light or power wiring.

23. Electric Heaters—

a. Must, if stationary, be placed in a safe situation, isolated from inflammable materials and be treated as sources of heat.

b. Must each have a cut-out and indicating switch (see No. 17a).

c. Must have the attachments of feed wires to the heaters in plain sight, easily accessible and protected from interference, accidental or otherwise.

d. The flexible conductors for portable apparatus, such as irons, etc., must have an approved insulating covering (see No. 40c, 3).

e. Must each be provided with name-plate, giving the maker's name and the normal capacity in volts and amperes.

Low Potential Systems.—300 Volts or Less.

Any circuit attached to any machine, or combination of machines, which develops a difference of potential between any two wires of over ten volts and less that 300 volts, shall be considered as a low potential circuit, and as coming under the class, unless an approved transforming device is used, which cuts the difference of potential down to ten volts or less. The primary circuit not to exceed a potential of 3,000 volts.

24. Wires—General Rules. (See also Nos. 14, 15 and 16.)

a. Must not be laid in plaster, cement or similar finish.

b. Must never be fastened with staples.

c. Must not be fished for any great distance, and only in places where the inspector can satisfy himself that the rules have been complied with.

d. Twin wires must never be used, except in conduits, or where flexible conductors are necessary.

e. Must be protected on side walls from mechanical injury. When crossing floor timbers in cellars or in rooms, where they might be exposed to injury, wires must be attached by their insulating supports to the under side of a wooden strip, not less than one-half inch in thickness, and not less than three inches in width.

Suitable protection on side walls may be secured by a substantial boxing, retaining an air space of one inch around the conductor, closed at the top (the wires passing through bushed holes), and extending not less than five feet from the floor; or by an iron-armored or metal-sheathed insulating conduit sufficiently strong to withstand the strain it will be subjected to; or plain metal pipe, lined with insulating tubing which must extend one-half inch beyond the end of the metal tube.

The pipe must extend not less than five feet above the floor, and may extend through the floor in place of a floor bushing.

If iron pipes are used with alternating currents, the two or more wires of a circuit must be placed in the same conduit. In this case the insulation of each wire must be reinforced by a tough conduit tubing projecting beyond the ends of the iron pipe at least two inches.

f. When run immediately under roofs, or in proximity to water tanks or pipes, will be considered as exposed to moisture.

Special Rules.

For open work, in dry places:

g. Must have an approved rubber or weather-proof insulation. (See No. 40a and b.)

h. Must be rigidly supported on non-combustible, non-absorptive insulators, which separate the wire at least one-half inch from the surface wired over, and they must be kept apart at least two and one-half inches.

Rigid supporting requires under ordinary conditions, where wiring along flat surfaces, supports at least every four and one-half feet. If the wires are liable to be disturbed, the distance between supports should be shortened. In buildings of mill construction, mains of No. 8 B. & S. wire or over, where not liable to be disturbed, may be separated about four inches, and run from timber to timber, not breaking around, and may be supported at each timber only.

This rule will not be interpreted to forbid the placing of the neutral of a three-wire system in the centre of a three-wire cleat, provided the outside wires are separated two and one-half inches.

In damp places, such as breweries, packing houses, stables, dye houses, paper or pulp mills, or buildings specially liable to moisture or acid or other fumes liable to injure the wires or their insulation, except where used for pendants:

i. Must have an approved rubber insulating covering (see No. 40a).

j. Must be rigidly supported on non-combustible, non-absorptive insulators, which separate the wire at least one inch from the surface wired over, and they must be kept apart at least two and one-half inches.

Rigid supporting requires under ordinary conditions, where wiring over flat surfaces, supports at least every four and one-half feet. If the wires are liable to be disturbed, the distance between supports should be shortened. In buildings of mill construction, mains of No. 8 B. & S. wire or over, where not liable to be disturbed, may be separated about four inches and run from timber to timber, not breaking around, and may be supported at each timber only.

k. Must have no joints or splices.

For moulding work:

l. Must have approved rubber insulating covering (see No 40a).

m. Must never be placed in moulding in concealed or damp places.

For conduit work:

n. Must have an approved rubber insulating covering (see No. 40c).

The use of concentric wire (see No. 40c) is recommended in preference to twin conductors.

o. Must not be drawn in until all mechanical work on the building has been, as far as possible, completed.

p. Must not have wires of different circuits drawn in the same conduit.

q. Must, for alternating systems, have the two or more wires of a circuit drawn in the same conduit.

It is advised that this be done for direct-current system also, so that they may be changed to alternating systems at any time, induction troubles preventing such a change unless this construction is followed.

For so-called concealed work:

r. Must have an approved rubber insulating covering (see No. 40a).

s. Must be rigidly supported on non combustible, non-absorptive insulators which separate the wire at least one inch from the surface wired over, and must be kept at least ten inches apart, and, when possible, should be run singly on separate timbers or studding.

Rigid supporting requires under ordinary conditions, where wiring along flat surfaces, supports at least every four and one-half feet. If the wires are liable to be disturbed, the distance between supports should be shortened.

t. When from the nature of the case it is impossible to place concealed wiring on non combustible insulating supports of glass or porcelain, the wires, if not exposed to moisture, may be fished on the loop system if encased throughout in approved continuous flexible tubing or conduit.

For fixture work:

u. Must have an approved rubber insulating covering (see No. 40d), and shall not be less in size than No. 18 B. & S.

v. Supply conductors, and especially the splices to fixture wires, must be kept clear of the grounded part of gas pipes, and, where shells are used, the latter must be constructed in a manner affording sufficient area to allow this requirement.

w. Must, when fixtures are wired outside, be so secured as not to be cut or abraded by the pressure of the fastenings or motion of the fixture.

25. Interior Conduits (See also Nos. 24n to q, and 41).

The object of a tube or conduit is to facilitate the insertion or extraction of the conductors to protect them from mechanical injury and, as far as possible, from moisture. Tubes or conduits are to be considered merely as raceways, and are not to be relied upon for insulation between wire and wire, or between the wire and the ground.

a. Must be continuous from one junction box to another or to fixtures, and the conduit tube must properly enter all fittings.

b. Must be first installed as a complete conduit system, without the conductors.

c. Conduits must extend at least one-half inch beyond the finished surface of walls or ceilings, except that, if the end is threaded and a coupling screwed on, the conduit may be left flush with the surface, and the coupling may be removed when work on building is completed.

d. Must, after conductors are introduced, have all outlets plugged with special wood or fibrous plugs, made in parts, and the outlet then sealed with approved compound. Joints must be made air-tight and moisture-proof.

e. Must have the metal of the conduit permanently and effectually grounded.

26. Fixtures—(See also No. 24u to w.)

a. Must, when supported from the gas piping of a building, be insulated from the gas-pipe system by means of approved insulating joints (see No. 51) placed as close as possible to the ceiling.

It is recommended that the gas outlet pipe be protected above the insulating joint by a non-combustible, non-absorptive insulating tube, having a flange at the lower end where it comes in contact with the insulating joint; and that, where outlet tubes are used, they be of sufficient length to extend below the insulating joint, and that they be so secured that they will not be pushed back when the canopy is put in place. Where iron ceilings are used, care must be taken to see that the canopy is thoroughly and permanently insulated from the ceiling.

b. Must have all burs, or fins, removed before the conductors are drawn into the fixture.

c. The tendency to condensation within the pipes should be guarded against by sealing the upper end of the fixture.

d. No combination fixture in which the conductors are concealed in a space less than one-fourth inch between the inside pipe and the outside casing will be approved.

e. Must be tested for "contacts" between conductors and fixtures, for "short circuits" and for ground connections before it is connected to its supply conductors.

f. Ceiling blocks of fixtures should be made of insulating material; if not, the wires in passing through the plate must be surrounded with non-combustible, non absorptive, insulating material, such as glass or porcelain.

27. Sockets—(For construction rules, see No. 47.)

a. In rooms where inflammable gases may exist the incandescent lamp and socket must be enclosed in a vapor-tight globe, and supported on a pipe-hanger, wired with approved rubber-covered wire (see No. 40a) soldered directly to the circuit.

b. In damp or wet places, or over specially inflammable stuff, water-proof sockets must be used.

When waterproof sockets are used, they should be hung by separate stranded rubber-covered wires, not smaller than No. 14 B. & S., which should preferably be twisted together when the drop is over three feet. These wires should be soldered direct to the circuit wires, but supported independently of them.

28. Flexible Cord—

a. Must have an approved insulation and covering (see No. 40c.)

b. Must not be used as a support for clusters.

c. Must not be used except for pendants, wiring of fixtures and portable lamps or motors.

d. Must not be used in show windows.

e. Must be protected by insulating bushings where the cord enters the socket.

f. Must be so suspended that the entire weight of the socket and lamp will be borne by knots under the bushing in the socket, and above the point where the cord comes through the ceiling block or rosette, in order that the strain may be taken from the joints and binding screws.

29. Arc Lights on Low-Potential Circuits—

a. Must have a cut-out (see No. 17a) for each lamp or each series of lamps.

The branch conductors should have a carrying capacity about fifty per cent. in excess of the normal current required by the lamp to provide for heavy current required when lamp is started or when carbons become stuck without over-fusing the wires.

b. Must only be furnished with such resistances or regulators as are inclosed in non-combustible material, such resistances being treated as sources of heat. Incandescent lamps must not be used for resistance devices.

c. Must be supplied with globes and protected by spark arrestors and wire netting around globe, as in the case of arc lights on high potential circuits. (See Nos. 19 and 50.)

30. Economy Coils—

a. Economy and compensator coils for arc lamps must be mounted on non-combustible, non absorptive insulating supports, such as glass or porcelain, allowing an air space of at least one inch between frame and support, and in general to be treated like sources of heat.

31. Decorative Series Lamps—

a. Incandescent lamps run in series shall not be used for decorative purpose inside of buildings, except by special permission in writing from the Inspection Department having jurisdiction.

High-Potential Systems.

300 to 3,000 Volts.

Any circuit attached to any machine, or combination of machine, which develops a difference of potential, between any two wires, of over 300 volts and less than 3,000 volts, shall be considered as a high-potential circuit, and as coming under that class, unless an approved transforming device is used, which cuts the difference of potential down to 300 volts or less.

32. Wires—(See also Nos. 14, 15 and 16.)

a. Must have an approved rubber insulating covering. (See No. 40a.)

b. Must be always in plain sight and never incased, except where required by the Inspection Department having jurisdiction.

c. Must be rigidly supported on glass or porcelain insulators, which raise the wire at least one inch from the surface wired over, and must be kept apart at least four inches for voltages up to 750 and at least eight inches for voltages over 750.

Rigid supporting requires under ordinary conditions, where wiring along flat surfaces, supports at least about every four and one-half feet. If the wires are unusually liable to be disturbed, the distance between supports should be shortened.

In buildings of mill construction, mains of No. 8 B. & S. wire or over, where not liable to be disturbed, may be separated about six inches for voltages up to 750 and about ten inches for voltages above 750; and run from timber to timber, not breaking around, and may be supported at each timber only.

d. Must be protected on side walls from mechanical injury by a substantial boxing retaining an air space of one inch around the conductors, closed at the top (the wires passing through bushed holes) and extending not less than seven feet from the floor. When crossing floor timbers, in cellars or in rooms, where they might be exposed to injury, wires must be attached by their insulating supports to the under side of a wooden strip not less than one-half an inch in thickness.

33. Transformers (When permitted inside buildings, see No. 13)—(For construction rules, see No. 54.)

a. Must be located at a point as near as possible to that at which the primary wires enter the building.

b. Must be placed in an inclosure constructed of or lined with fire-resisting material; the inclosure to be used only for this purpose, and to be kept securely locked and access to the same allowed only to responsible persons.

c. Must be effectually insulated from the ground and the inclosure in which they are placed must be practically air-tight, except that it shall be thoroughly ventilated to the outdoor air, if possible, through a chimney or flue. There should be at least six inches air space on all sides of the transformer.

34. Car Wiring—

a. Must be always run out of reach of the passengers, and must have an approved rubber insulating covering. (See No. 40a.)

35. Car Houses—

a. Must have the trolley wires securely supported on insulating hangers.

b. Must have the trolley hangers placed at such a distance apart that, in case of a break in the trolley wire, contact can not be made with the floor.

c. Must have cut-out switch located at a proper place outside of the building, so that all trolley circuits in the building can be cut out at one point, and line circuit breakers must be installed, so that when this cut-out switch is open the trolley wire will be dead at all points within 100 feet of the building. The current must be cut out of the building whenever the same is not in use or the road not in operation.

d. Must have all lamps and stationary motors installed in such a way that one main switch can control the whole of each installation—lighting or power independently of main feeder-switch. No portable incandescent lamps or twin wire allowed, except that portable incandescent lamps may be used in the pits, connections to be made by two approved rubber-covered flexible wires (see No. 40a), properly protected against mechanical injury; the circuit to be controlled by a switch placed outside of the pit.

e. Must have all wiring and apparatus installed in accordance with rules under Class "C" for constant potential systems.

f. Must not have any system of feeder distribution centering in the building.

g. Must have the rails bonded at each point with not less than No. 2 B. & S. annealed copper wire; also a supplementary wire to be run for each track.

h. Must not have cars left with trolley in electrical connection with the trolley wire.

36. Lighting and Power from Railway Wires—

a. Must not be permitted, under any pretense, in the same circuit with trolley wires with a ground return, except in electric railway cars, electric car houses, and their power stations, nor shall the same dynamo be used for both purposes.

37. Series Lamps—

a. No system of multiple-series or series-multiple for light or power will be approved.

b. Under no circumstances can lamps be attached to gas fixtures.

Extra High-Potential Systems.

Over 3,000 Volts.

Any circuit attached to any machine or combination of machines, which develops a difference of potential, between any two wires, of over 3,000 volts, shall be considered as an extra high potential circuit, and as coming under that class, unless an approved transforming device is used, which cuts the difference of potential down to 3,000 volts or less.

38. Primary Wires—

Must not be brought into or over buildings, except power and sub-stations.

39. Secondary Wires—

a. Must be installed under rules for high-potential systems, when their immediate primary wires carry a current at a potential of over 3,000 volts.

The high line insulation required for extra high-potential current tends to make the insulation resistance between primary and secondary coils of transformers a comparatively weak point, and lightning discharges would be apt to take this path to the earth. With the present means of protection against transformer break-downs and the consequent liability of secondary wiring being subjected to the strain of the primary current, it is not deemed advisable to permit a primary current with a potential of over 3,000 volts without an intermediate step-down transformer. The presence of wires carrying a current at a potential of over 3,000 volts in the streets of cities and towns is also considered as increasing the fire hazard.

(To be Continued.)

The New York and New Haven Railway Company recently adopted what is known as the third rail system on a branch line of railway thirteen miles long. The electric power for the motors is carried along the track by a special rail laid between the two, on which the cars run. The "electrified" rail weighs 100 pounds to the yard, and is shaped like a wedge, with a flat top. This affords a large conducive body, with plenty of surface for the "shoes" which convey the current to the motors to act upon. Insulation is provided by simple blocks of wood, which, to the surprise of the experts, have been found to answer perfectly well, the loss of current being practically insignificant. At crossings, switches and stations the current is conducted underground, while an ingenius automatic arrangement, operated by electricity, provides compressed air to operate a whistle for signalling.

SPARKS.

Mr. E. B. Tree, of Woodstock, Ont., has invented a rotary engine.

William Davidson is supplying two 50-horse power boilers for the Exhibition Association of Halifax, N.S.

The Exeter Electric Light and Power Company has been organized at Exeter, Ont., with a capital of $10,000. The provisional board is composed of C. Lutz, president; R. C. C. Tremaine, B. A. Sc., manager; B. S. O'Neill, E. J. Spackman and Frank Woods.

The Gas and Water Company, of Sherbrooke, Que., have reduced the price of electric lighting from $1 per 100 amperes to 75 cents, with a further reduction of 15 cents on payment within 15 days. This is practically 60 cents for a 16-candle power lamp burning 100 hours.

The New York post office is laying underground postal tubes this summer for distribution of letters. The tubes will be eight inches in diameter, and carriers capable of containing 500 letters each will be forced through them by power furnished by an electric plant in the General Postoffice.

The Canadian Locomotive and Engine Company, of Kingston, Ont., are now making steel pipes under patents held by Mr. F. A. Williams, of Wolverton, England. Tests of the pipes were recently made in the presence of a number of experts, and are said to have been entirely satisfactory.

The Dominica Electric Heating and Supply Company, of Ottawa, have elected the following officers: President, Andrew Holland; vice-president, Thomas Askwith; secretary-treasurer, J. I. McCracken; directors, Chas. A. Carriere, A. Tradeau, P. MacGregor, Geo. Low and B. H. Bell.

A syndicate of capitalists are said to be negotiating for the purchase of the Chemong and Lakefield lines of the Grand Trunk Railway, with a view of converting them into electric systems. For the present the scheme is kept somewhat in the dark, but definite information is looked for at an early date.

The Lachine Rapids Hydraulic and Land Company, of Montreal, have made a reduction of 33⅓ per cent. in the rate charged for electric power. This brings the price to one-half cent per 16 candle-power lamp per hour, and is claimed to be the cheapest rates charged in any city the size of Montreal in the world. The company have lately issued $500,000 of six per cent. debentures, redeemable in ten years. These were issued among the stockholders only, each of whom were allowed to take debentures to the amount of 50 per cent. of the stock held.

The Dominion Government has completed forty miles more of the telegraph line on the north shore of the St. Lawrence, from the former terminus at Pointe Esquimax, and an office has been opened at Plastre Bay. It is intended to extend the line forty-four miles more this summer, to Natashguan, where an office will be opened this fall. The north shore line will still be about 250 miles from Belle Isle, its objective point, and it is the intention to complete this section as rapidly as possible, so that the entrance to the Straits of Belle Isle will be in direct telegraphic communication with Quebec and Montreal.

A car "fender," the design of the manager, Mr. J. W. Moyes, has been adopted by the Metropolitan Street Railway. The fender, which is 5 feet 8 inches by 2 feet 6 inches, and lies without rocking about three inches above the rails, hangs on two perpendicular strings, instead of horizontal ones, and its braces are attached to the main body of the car. There is consequently no recoil, and whatever the fender picks up it holds, as was demonstrated when the car ran at a considerable speed into a flock of sheep, coming in the opposite direction. A point in its favor is that it can be folded up while on the car, to the saving of much valuable room in a motor shed.

A sextuplex telegraph wire was successfully operated in a telegraph office in Boston a few days ago. The circuit was to New Haven and return, a distance of 300 miles. Three different messages were sent over the wire simultaneously, and were easily and accurately received on the receiving side. The inventor of the new scheme is Mr. Thomas B. Dixon, of Kentucky, son of the late former Senator Archibald Dixon, of that state. He is a practical telegrapher, and has been trying to solve the problem of the sextuplex since 1891. The telegraphic world has long been familiar with a duplex wire, which will transmit one message each way at the same time, and latter with the quadruplex, with which it is possible to send two messages each way at the same time. The new sextuplex will transmit three messages each way at once.

WATER HAMMER.

A DESCRIPTION of some experiments upon the causes of steam pipe explosions, made to an engineering society, shows under what conditions water hammer may be expected in steam pipes and under what conditions it becomes dangerous. The tests were made upon steam pipes 6" in diameter and .197" thick. The ends were closed by flanges and provided with drain cocks and air relief-cocks, and suitable pressure gauges that would record to 2133 pounds, one on the end flange and one on the top of the pipe. The pipe was inclined upward, and entering the bottom flange was a steam pipe with a valve, so that if any water was in the pipe the entering steam must pass through it.

The second experiment was conducted upon 12" pipe, ¼" thick, with four pressure gauges, steam being supplied at the bottom through a 3" pipe. The position of this pipe was afterwards considerably changed. The tests made were as follows :

1. Pipe without water, air cock closed and the drain cock open.

2. Pipe without water, air cock open and the drain cock closed.

3 .Pipe without water, air and drain cocks open.

4. Pipe without water, air and drain cocks closed.

5. Vacuum in pipe and some condensed water formed by creating vacuum, air and drain cocks closed.

6. Vacuum in pipe, and the latter filled with water to about one-third of its cubic capacity, so that the point where the steam entered was under water in the first pipe, it being made to incline toward that point. In the second pipe the water filled the bottom of the pipe. Air and drain cocks were closed to one-third of their capacity at one end, and running into nothing at the other end.

7. Pipe without vacuum filled with water as under 6, air and drain cocks closed.

8. Pipe without vacuum filled with water the same as under 6, air and drain cocks open.

In the experiments with the first pipe, steam was admitted from a boiler under 70 pounds pressure, by rapidly opening the stop valve on the main steam pipe, the influx of steam having been regulated beforehand by adjusting the valve close to the experimental pipe. Beginning with one-fifth of the area of this valve the opening was increased one-fifth in each of the succeeding tests, the whole tests being frequently repeated to check results. In carrying out tests 1 to 4 no motion was observed, whether the filling of the pipe with steam was retarded or accelerated. The pipe became heated slowly or quickly, according to the rapidity with which it filled with steam, until it became thoroughly warmed, and the pressure guages on the pipes showed same as boiler. As soon as vacuum formed and a small amount of condensed water was present in the pipe (test No. 5), light hammering was present in the pipe when steam was admitted. This was not, however, indicated on the guages, but caused a slight movement of the pipes. This hammering and backward and forward movement of the pipe became more intense the greater the quantity of water present (tests 6 and 7), manifesting itself in distinct blows at short intervals, and causing the gauges to show between 126 to 242 pounds. Whether the vacuum in the pipe (test 6) had any influence on the action of the steam when admitted, could not be determined by any of the trials.

The heaviest hammering, as well as the greatest movement of the pipe—which also continued for some length of time—were observed when the pipe was about one-third full of water, and both the air and drain cocks kept open (test No. 8) and for all five openings of the valve. During these tests there was a uniform discharge of water from the drain cock and of air from the air cock, for a longer or shorter time, depending on the opening of the stop valve in the pipe. For instance, with one-fifth opening of the stop valve the first hammering was noticeable after four minutes ; at three-fifths opening, after 30 seconds ; and 15 seconds after the valve was wide open, powerful hammering and violent motion of the pipe set in, in each case accompanied by an impulsive discharge of water and air and later by steam from the air and drain cocks. These phenomena are due to the fact that the steam is condensed by the water present, and only when the water has attained the temperature of steam does the impulsive action of the latter set in. The pressures observed on the gauges at the end of each trial (test No. 8) fluctuated between 284 and 1066 pounds. At one time the greatest pressure would be observed on the gauge tapped in the flange at end of pipe, and then on the gauge on side of pipe.

The second experimental pipe was changed somewhat from time to time, but showed no radical change in results.

As a result of these tests it is shown that destruction of a completely drained, though entirely cool, pipe cannot occur, whether the stop valve near the boiler under steam is opened gradually or in a sudden, careless manner, because hammering, which alone can cause an explosion, does not follow. But it is to be observed that a rapid filling of the pipes with steam may prove disastrous, for the sudden heating up of the various parts may cause rupture, due to unequal stresses on and resistance of the material.

When, however, a large quantity of water is contained in the pipes and the steam is forced to find its way through it and to carry it along, an explosion may occur, even if the stop valve is opened in the slowest and most careful manner. If there is so little water in the pipe that steam need not force its way through it, no disastrous hammering will occur, nor will the water present be carried along by the steam when the stop valve is opened, as was demonstrated by the amount of water left in the pipe after the end of all tests. The results of the tests with the first arrangement of the second experimental pipe lead to the conclusion that where water has accumulated in U bends of pipes, if the stop valve is opened gradually, the entering steam will distribute itself at once uniformly over the surface of the water, and by virtue of its pressure, in spite of the original condensation, it is not only maintained but steadily increased, and will prevent any agitation of the water, and, consequently, hammering. If, however, a sudden change of pressure and a rapid influx of steam occur, then the water will be agitated and, once in motion, it will cause violent and dangerous hammering in the pipe. Therefore, steam pipes with pockets are to be avoided. The variations of the pressures indicated in the gauges after all the tests leads to the conclusion that the water is thrown backwards and forwards, wave-motion like, caused by the influx of steam, and that the pressure is greater or less, depending on the intensity with which the moving mass of water strikes the opening to which the gauge is attached.

ELECTRIC RAILWAY DEPARTMENT.

MR. CLYDE K. GREEN.

It was our pleasure about three years ago to present to readers of the ELECTRICAL NEWS a portrait of Mr. Clyde K. Green, who at that time was electrician for the Hamilton, Grimsby and Beamsville Railway. Mr. Green having since received a promotion in the electric railway field, we again reproduce his portrait, with some particulars of his life.

Mr. Green was born across the border, in the state of Michigan, and after leaving school, engaged in the hardware business at Waterford, Ont., leaving there to accept a position with the Edison Company, of Peterboro', in their electrical works, where he obtained a practical knowledge of electrical manufacturing and was promoted to the position of assistant foreman. On the conversion of the Toronto Street Railway to an electrical system, Mr. Green was offered and accepted the position of foreman of the armature department of that road. His success in this direction having attracted

MR. CLYDE K. GREEN.

the attention of the management of the Hamilton, Grimsby and Beamsville Electric Railway, he was offered the position of electrician, fulfilling the duties in an eminently satisfactory manner.

In February of this year he accepted the management of the Hamilton Radial Electric Railway Company.

It might not be amiss to mention a few particulars in regard to this road. The tracks at present cover a distance of eleven miles, extending from Hamilton to Burlington, by way of Burlington Beach. The rolling stock consists of four very handsomely fitted motor cars, each equipped with four G.E. 1000 motors, two at each end of the car, with double trucks, and guaranteed to make 38 miles an hour. The cars are fitted with regular railroad seats with rattan covering, and have a smoking compartment at rear end. The company have, besides the above motors, baggage cars and trailers for use of excursions and pic-nics. One of the special features of this road is the swing bridge over the canal at Burlington Beach, which is operated by an electric motor and which has worked very satisfactorily.

The International Radial Railway Company, of Hamilton, are reported to have sold $30,000 worth of stock, and to be waiting until they can dispose of as much more, before commencing the construction of the road.

TORONTO STREET RAILWAY ASSESSMENT CASE.

A DECISION of interest to street railway companies has been given by Judge McDougall.

Last summer a board of county judges decided against the assessment of the Toronto Street Railway Company's rails, poles and wires, and the Court of Revision refused, on the strength of this judgment, to confirm the assessment of the plant of the company in the first, fifth nnd sixth wards. The City Law Department decided to make a test case and appealed in the name of Controller Lamb and of the Assessment Commissioner against the decision of the Court of Revision in regard to the assessment of $103,500 in the sixth ward. Mr. Fullerton and Mr. Drayton prosecuted the appeal for the city, and Mr. Laidlaw, for the company, urged lack of jurisdiction.

Judge McDougall delivered a judgment last week, the logical sequence of which will be the assessment by municipal officers all over Ontario of all the rails, poles, wires, mains, etc., which have in many cases up to the present time been exempt.

TROLLEYS GAINING IN ENGLAND.

THE prejudice against overhead wires is fast melting away in Great Britain, as evidenced by the following from a London daily :

"The long controversy as to the best form of mechanical traction for tramways in our large cities seems to be gradually deciding itself in favor of the overhead electric trolley system. This method has already been adopted in several towns, and the corporation of Glasgow has now resolved to give it a trial, after a year or two of deliberation, since it acquired the local tramways. The Tramways Committee has been authorized to spend about twenty thousand pounds on the establishment of the system on an experimental route, that is, on an isolated section of the lines, about two and one-half miles in length."

There are still some old fossils who are afraid of shadows, as witness the following extract from an open letter in another London paper of about the same date :

"Among the many objections against the introduction of the overhead system is one that I particularly noticed in the working of the said system in the city of Toronto, viz., that as the cars pass along the roads the connecting rod from the top of the car where it joins the overhead wire is continually giving off bright sparks, sufficient to frighten nervous people with the fear of possible danger, and also to startle nervous horses."

Blinders on the "connecting rod," or a pair of blue goggles for the "nervous" writer, might solve the difficulty.

Mr. C. C. Kramp, Woodstock, Ont., in remitting his subscription to the NEWS, writes: "Am well pleased with the paper. It is welcome every month."

Mr. B. B. Osler, president of the Hamilton and Dundas Railway, states that the conversion of the road to electricity is being delayed by the failure to obtain running privileges over the Hamilton Street Railway Company's tracks within the city limits.

EDUCATIONAL DEPARTMENT

INTRODUCTORY

After mature deliberation the publisher of this journal has decided to devote a certain amount of space each month to what may be termed an Educational Department, wherein both mechanical and electrical formula and mathematical problems will be discussed, illustrated, and as far as possible rule and example given. At the request of the editor, I have with pleasure undertaken to contribute to this department regularly each month, and before discussing actual mathematical problems, wish to briefly introduce the subject at issue.

The primary object of this department is chiefly to increase the value of an already valuable paper, by placing in the hands of every engineer who has any knowledge of the rudimentary principles of mathematics, such matter as will enable him by a little study to master the most intricate mechanical and electrical formula. Many of our most valuable engineering works and publications from time to time contain formula that is in many cases but vaguely understood, and very often entirely misunderstood, thus rendering an otherwise valuable work practically valueless to the reader.

Just at what particular point our calculations should commence became a matter of serious thought, and past experience had to be carefully considered, bearing in mind the fact that there are many really good engineers whose early education has, through force of circumstances, been deficient, and many others who, through lack of opportunity, have not been able to review their early education for years. Knowing by observation and experience the great necessity of having a thorough elementary education before attempting to digest and calculate problems, and the almost utter impossibility of the student arriving at a satisfactory conclusion of his studies without a thorough knowledge of the principle of mathematics involved, I have decided to commence at a point and carry out the programme outlined in this journal—commencing at the foundation and advancing by easy stages until the principles underlying the most obtuse and difficult formula can be readily explained and easily understood. The advantages to be derived from an education of this kind, coupled with practical mechanical ability, is too well understood to require comment.

The programme which has been outlined for the succeeding nine months will embrace:

DECIMAL FRACTIONS—Definitions and explanation of principles of, and method of reduction to common fractions, and vice versa.
SQUARE AND CIRCULAR MEASURE—Definition and explanation and practical demonstrations of.
CUBICAL AND CYLINDRICAL MEASUREMENTS—Definitions and explanations of, with practical hints.
SQUARE AND CUBE ROOT—Definitions and explanations of.
SAFETY VALVE CALCULATIONS—(Spring and Lever Types)—Principles of, with practical demonstrations.
BOILER CONSTRUCTION—Stays, rivets, joints and seams, iron and steel plate—strength of, with formula and practical demonstrations.

It is not the intention to fill these columns with a mass of figures hastily compiled without reference to any particular object; on the contrary, every problem will be carefully thought out, and only such information given as will be of use to you, and an effort will be made, based on experience and a knowledge of the requirements, to make this series of tests complete in every particular.

WM. THOMSON.

[ARTICLE IV.]

EVOLUTION.

EVOLUTION is the process of finding the root of any number, and is of frequent occurrence in engineers' calculations.

The most important and only cases which I shall refer to is the process of finding the square or cube root of any number.

Example (1): Find the square root of 1521. In formula this is written $\sqrt{1521}$.

```
      15.21(39
       9
 69. | 621
     | 621
       ...
```

Beginning at the right hand figure 1, count two figures to the left and mark the second as shown in the example, take the figures to the left of this mark 15 and find what number multiplied by itself will give fifteen; there is no number that will do this, since $3 \times 3 = 9$ is too small and $4 \times 4 = 16$ is too large; we therefore take the one that is too small, viz., 3, and place it in the quotient, placing its square 9 under the 15 marked off in the number and subtract, and bring down the next two figures 21, making new dividend 621. To get the new divisor multiply the quotient 3 by $2 = 6$, and place as a trial divisor at the left of the dividend 621; find how many times this is contained in the dividend, discarding the last figure on the right; 6 is then contained in 62 nine times. Since we cannot pass this point, we place 9 in the quotient and also in the divisor; then we multiply the whole divisor 69 by this number (9) and place the product under the dividend and subtract. Having no remainder, root is now complete and found to be 39. If we require proof of this we simply square the number, thus.

$$39 \times 39 = 1521$$
$$\text{then } 39^2 = 1521$$
$$\text{and } \sqrt{1521} = 39$$

Example (2): Find the square root of 366.

```
        3.66(19.131126
        1
 29       | 266
          | 261
 381      | 5.00
          | 3 81
 3823     | 1 1900
          | 1 1469
 38261    | 43100
          | 38261
 382621   | 483900
          | 382621
 3826222  | 10127900
          | 7652444
 38262246 | 247445600
          | 229573476
             17872124
```

In this example we proceed to mark off as before and get as our quotient the whole number 19, but since there is still a remainder our root cannot be complete; we proceed as before, but since there remains no more figures in the dividend we annex to new dividend two ciphers and place a decimal point in the quotient to the right of the nineteen. Then proceeding as before we get our trial divisor by doubling present quotient $19 \times 2 = 38$ and place to the left of the dividend 500. 38 is contained in 50 once; we therefore place a 1 in the quotient to the right of the decimal point and annex to the new divisor, multiplying as before and subtracting, we proceed in an exactly similar manner until we have no remainder or until decimal begins to repeat itself or is extended sufficiently to answer our purpose.

Example (3): Find the square root of 15227.56.

```
      1.52.27.56(123.4
      1
 22   | .52
      |  44
 243  | 827
      | 729
 2464 | 9856
      | 9856
        ....
```

In a decimal quantity like the foregoing, the marking off differs from the previous examples. Instead of counting twos from right to left begin at the decimal point and count twos towards the left and towards the right. Note: when the first two figures to the right of the decimal is brought down we must place a decimal point in our quotient before extending it.

Briefly, the process of finding the square root of a whole number may for the guidance of the student be described as follows:

First mark off in twos commencing from the right. Then find the number whose square is next less than the figure or figures on the left of the number as the case may be, place this figure in the quotient and its square under the figure or figures already marked off on the left of the number, subtract and annex to the right the next two figures of the number; this then becomes a new dividend. To secure a new divisor, double the quotient by multiplying by 2 and place on the left of the dividend as a trial divisor; find how many times this is contained in the dividend, discarding the right hand figure, place this result in the quotient and also in the new divisor and multiply by same number, placing product under dividend and subtract as before; continue the operation for a new divisor. Bear in mind, however, you must always place two figures to the right of the new dividend.

It will occasionally occur as in our first two examples that the product of the trial divisor multiplied by the new divisor will exceed the dividend. In this case take the next lowest term and proceed as described.

TO FIND THE CUBE ROOT.

Example (1): Find the cube root of 1331.

```
                1.331(11 Ans.
                1
 31      300 | 331
          31 |
         331 | 331
               ...
```

First mark off three figures from the right towards the left of the number, and we have 1 left. Now, 1 cubed equals one. Place the cube of 1 under the one of the number and subtract. There is no remainder. Bring down the next three figures as a new dividend. Next multiply the one placed in the quotient by 3, and place the product well to the left, as in the example. Next multiply this 3 by the quotient figure 1, and place the result, 3, to the right of where the 3 was placed and to the left of the dividend, and add two ciphers to it, as shown in the example.

This 300 is called the trial divisor. Now see how often it will go into the dividend 331, which we find to be once. Put 1 in the quotient to the right of the one already there, and place 1 also to the right of the number 3 at the extreme left of the example.

Now, multiply this number 31 by the figure last placed in the quotient, and place the result under the trial divisor 300 and add. This now gives us the correct divisor, which we multiply by the last figure placed in the quotient and place result under and subtract from the dividend. There being no remainder, our root is now complete, and we find $\sqrt[3]{1331} = 11$.

Example (2): Find the cube root of 80677568161.

Process:

80,677,568,161(4321 Ans.

		64
123	4800	16677
	369	
	5169	15507
1292	554700	1170568
	2584	
	557284	1114568
12961	55987200	56000161
	12961	
	56000161	56000161

The process to the second figure of the answer is a reproduction of last example.

TO FIND THE THIRD FIGURE OF THE ANSWER.

Multiply the 43 in the quotient by 3, equals $43 \times 3 = 129$; put this well out to the left as before. In the middle column of figures you will see the figures 369 and 5169; add these together, and to their sum add the square of the last figure in the quotient—that is in the present case 3. Then

$$\begin{array}{r} 369 \\ 5169 \\ 3 \times 3 = \quad 9 \\ \hline 5547 \end{array}$$

This number, with two ciphers added, is our new trial divisor 554700. It goes into the dividend 1170568 twice. Place 2 as the third figure of the quotient, and place 2 to the right of the number 129 on the left. Multiply 1292 by this number 2 and place the result, 2584, under the trial divisor and add. Result, 557284 is now the correct divisor. Multiply this number by 2 and place underneath dividend and subtract. Bring down the next three figures. We now have 56000161 as a new dividend.

TO FIND THE FOURTH FIGURE OF THE ANSWER.

Multiply the quotient 432 by $3 - 432 \times 3 = 1296$, and place this number to the left. Again in the middle column we have the figures 2584 and 557284; add together and add the square of the last figure in the quotient.

$$\begin{array}{r} 2584 \\ 557284 \\ 2 + 2 - \quad + \\ \hline 559872 \end{array}$$

This number, with two ciphers annexed, 55987200, is our new trial divisor, and is contained in the dividend once. Add one to the quotient, also to the number on the left. Multiply and subtract as before. And since we have no remainder our root is now complete, and $\sqrt[3]{80677568161} = 4321$.

There is another method of extracting the cube root which to the student may be simpler and process clearer, since it has the advantage over method just described that when the student has mastered the process of working out the first figure of the quotient he has the rest at his command, as the process is but a repetition, and is the same for four figures as for two.

Find the cube of 1728.

1	1.728(12
	1
	728
$3 \times 10^2 = 300$	
$3 \times 10 \times 2 = 60$	
$2^2 = 4$	
364	728

First we mark off the number into quantities of three figures as in previous examples, and selecting the next lowest cube for the first figure of our quotient in the case 1, which is put down in the quotient and as a divisor. The cube of 1 is placed under the dividend and subtracted and next period 728 brought down as a new dividend. Now take the number in the quotient and add a cipher to it, making it 10, square this and multiply by constant 3; we then get $3 \times (10^2) = 300$ which is our trial divisor; for the next line multiply 10 by the constant 3 and multiply the product 30 by the figure placed in the quotient from the trial divisor $30 \times 2 = 60$; place this 60 below the 300 already obtained and add, to the sum of these numbers add the square of the last figure of the quotient, thus, $300 + 60 + 2^2 = 364$. This is now our correct divisor. Multiply by the last figure of the quotient, place underneath the dividend and subtract; being no remainder our root is complete.

APPLICATION OF FORMER STUDIES TO MECHANICAL AND ELECTRICAL ENGINEERING.

Since both numerical and algabraical formula will now be constantly used, it is absolutely necessary that students should endeavor to obtain facility in reading and solving formula generally.

The following signs must therefore receive particular attention, and be committed to memory.

$+$ is read plus, and means that the number following it is to be added to the number before it; thus, $4 + 3$ is 7.

$-$ is read minus, and means that the number after it is to be subtracted from the number before it; thus, $5 - 2$ is 3.

$\times$ is read multiplied by, and means that the number before it is be multiplied by the number following it; thus, 3×3 are 9.

$\div$ is read divided by, and means that the number before it is to be divided by the number following it; thus, $6 \div 3 = 2$.

$=$ is read equal to, and means that the quantity after it is of same value as quantity before it; thus, $7 \times 3 = 21$.

9^2 is read as 9 squared, and means that the number is to be multiplied by itself; thus, $9^2 = 9 \times 9 = 81$.

9^3 means same number cubed; thus, $9 \times 9 \times 9 = 729$.

$\sim$ is read the difference between any two numbers, and means the less number is to be subtracted from the greater.

( ) are called brackets, and mean that all the quantities within them are to be put together first; thus, $5(4 - 2 + 3 \times 9)$ means that 2 must be subtracted from $4 = 2$, and $3 \times 9 = 27 + 2 = 29$, and then this 29 is to be multiplied by $5 = 29 \times 5 = 145$.

NOTE—When no sign is placed between a quantity and a bracket or a letter, it means that the quantity within the bracket is to be multiplied by the quantity outside. Thus in the foregoing the quantity within the bracket = 29 is to be multiplied by 5, the quantity outside.

SIGNS THAT REPRESENT ROOTS OF NUMBERS.

The sign known as the radical sign is common to all numbers, and is expressed thus, $\surd$ or $\surd\overline{\quad}$. When it is required to express the square root of a number we simply put this sign before it, as $\surd 25$, but if the number for which we desire the square root of is made up of two or more terms then we express the square root by the same sign in front, but with a line as far as the square root extends, as $\surd 15 + 10 = 5$, or $\surd 5(2 + 3) = 5$.

The cube root is expressed in a similar manner, but with a small 3 in the elbow of the sign, as $\sqrt[3]{\quad}$; all other roots in exactly same manner; as $\sqrt[4]{\quad}$ $\sqrt[6]{\quad}$ and so on.

In mechanical text books the power and root are often combined and expressed thus $4^{\frac{3}{2}}$. This is read as the square root of 4 cubed. Therefore, the numerator represents the power and the denominator the root. In this case the square root of $4 = 2$, and 2 cubed equals 8.

The commonest form in which this is met with in engineering calculations is when the cube root of a number is squared, as $27^{\frac{2}{3}}$ which is read cube root of 27 squared. The cube root of 27 is 3 and 3 squared equals 9, which is the value of $27^{\frac{2}{3}}$.

One of the most frequently occurring errors in algabraic calculations is the misunderstanding of the proper use of the multiplication sign in algabraic quantities and formula, and requires special mention here. For instance, we have the quantity $25 - 10 \times 2$. It is a common error to say $25 - 10 = 15$; this multiplied by 2 equals 30. This is entirely wrong, as a moment's reflection will prove to the student, as it clearly reads 25 minus 10×2, and the first step should be to multiply $10 \times 2 = 20$; then, $25 - 20 = 5$, which is correct, and not 30, as at first appears.

The student requires to remember the following rule, which applies in all cases:

Multiplication and division signs CONNECT the numbers together between which they occur; plus and minus signs SEPARATE them.

For simplicity and accuracy, it is a good rule when working with complex formula, to first get rid of bracket signs, and then multiplication signs; the operation of computation of formula then becomes an easy task.

NOTE.—Next issue will contain formula and rules for spring and lever safety valves and electrical formula.

Mr. Wm. Cross, Chief Engineer of Waterworks, Calgary, writes: "I think the NEWS is getting better as it grows older."

The Dardanelles Mining Co., at Kaslo, have just placed an order with the Rossland branch of the Jenckes Machine Co., of Sherbrooke, for a complete mining plant for operating their extensive properties in that district.

SPARKS.

By a recent storm about fifty telephones were burned out at London, Ont.

La Compagnie Electrique de St. Etienne de Malbaie is applying for incorporation.

A dynamo is being installed at the C. P. R. shops, Perth, Ont., for incandescent lighting.

The Hamilton, Grimsby and Beamsville Railway are erecting a new station at Beamsville.

The Cornwall Electric Railway Company is considering the extension of the road to neighboring villages.

The Revelstoke Water, Light and Power Company will sell sufficient shares to put in an electric light and power plant.

The new electric railway at Quebec has been completed and put in successful operation. We hope to publish a description of same in an early issue.

The city of St. Hyacinthe, Que., has just closed a contract with the Jenckes Machine Co., of Sherbrooke, for two pressure filters with a capacity of 750,000 gallons in twenty-four hours.

The Kay Electric Company, of Hamilton, has been dissolved. Job & Lynch continue the business on James street north, and Thomas L. Kay has established the Canada Electric Motor Company on Bay street north.

The smoke form the Terauley street power house of the Toronto Electric Light Company is said to have had a bad effect upon the new municipal buildings, and the company have decided to put in smoke consuming appliances.

Mr. J. H. Still has made a proposition to the City Council of St. Thomas to electrify the street railway. The proposed electric road will be six and a quarter miles long, and will cost about $80,000, exclusive of power house.

The Kootenay Electric Co., of Kaslo, B. C., who have a large water power near the town and purpose using the same for power and lighting, have placed their order with the Royal Electric Co. for a 75 k.w. S.K.C. generator and the necessary transformers and motors.

Word comes from Ottawa of the application for a Dominion charter by a company to manufacture calcium carbide. Its capitalization is $11,000,000, and the Hon. A. G. Blair, Rufus Pope, M.P., and a number of Canadian and American capitalists are among the applicants.

Harry Smith, engineer at the Wortman & Ward Manufacturing Company's factory at London, Ont., was recently badly burned. He was engaged in throwing the refuse oil and varnish into the furnace, when the flames suddenly shot out into Mr. Smith's face, burning his hair and whiskers off.

Mr. A. J. Corriveau, of Montreal, succeeded in getting his railway bill through parliament before the close of the session. He now has the right to construct electric lines between Montreal, St. Johns, St. Hyacinthe, Sherbrooke, Magog, Waterloo, and other points, and hopes to have the road completed within one year from the present time.

Mr. Pamphile Boivin, of the town of Baie St. Paul, Que., has received a franchise from the corporation of that town for electric lighting, and the Royal Electric Co. is now installing for him an electric lighting plant, consisting of a 500-light S. K. C. dynamo, with the necessary transformers and material. It is expected that the plant will be in operation about the 1st of September.

A decision has been rendered in the appeal case of the city of Montreal against the Standard Light and Power Company of that city. The Lachine Rapids Hydraulic and Land Company, which obtained a controlling interest in the Standard Company, made excavations preparatory to laying conduits in the city under the latter's act of incorporation. The city objected and sent a squad of police to prevent the men digging. A legal injunction was secured enjoining the city. The matter has been carried to the Privy Council, and the company succeeds.

MOONLIGHT SCHEDULE FOR AUGUST.

Day of Month.	Light.	Extinguish.	No. of Hours.
	H.M.	H.M.	H.M.
1.....	P. M. 8.00	A. M. 4.10	8.10
2.....	" 8.20	" 4.20	8.00
3.....	" 8.20	" 4.20	8.00
4.....	" 9.30	" 4.20	6.50
5.....	" 10.00	" 4.20	6.20
6.....	" 10.50	" 4.20	5.30
7.....	" 11.40	" 4.20	4.40
8	.....	" 4.20	3.50
9.....	A.M. 12.30	....	
10.....	" 2.00	" 4.20	2.20
11.....	No light.	No light.	....
12.....	No light.	No light.	....
13.....	No light.	No light.	....
14.....	No light.	No light.	....
15.....	P. M. 7.50	P. M. 9.10	1.40
16.....	" 7.30	" 9.30	2.00
17.....	" 7.30	" 9.50	2.20
18.....	" 7.30	" 10.10	2.40
19.....	" 7.30	" 10.30	3.00
20	" 7.30	" 11.00	3.30
21.....	" 7.20	" 12 00	4.40
22.....	" 7.20	A. M. 1.00	5.40
23.....	" 7.20	" 2.10	6.50
24.....	" 7.20	" 3.10	7.50
25	" 7.10	" 4.20	9.10
26.	" 7.10	" 4.30	9.20
27.....	" 7.10	" 4.30	9.20
28.....	" 7.10	" 4.30	9 20
29.....	" 7.10	" 4.30	9.20
30	" 7.20	" 4.40	9.20
31.....	" 7.30	" 4.40	9.10
		Total,	158.50

CANADIAN GENERAL ELECTRIC CO.

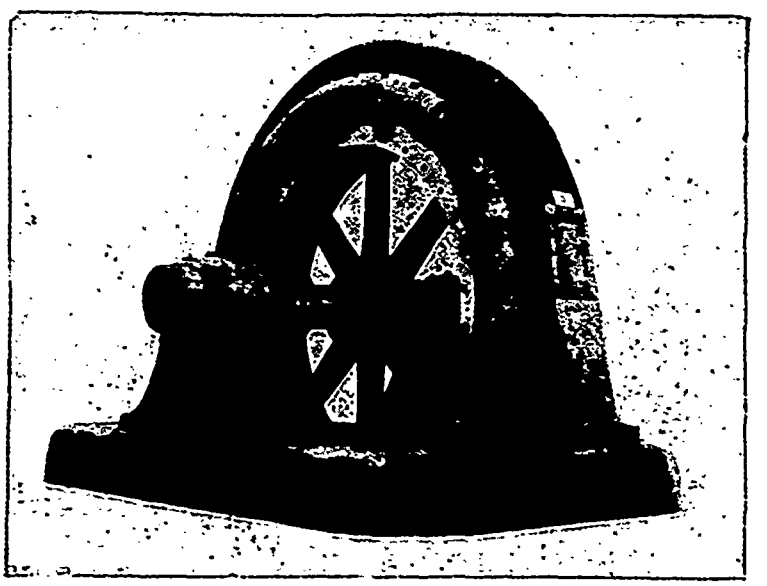
(LIMITED)

HEAD OFFICE: 65 FRONT STREET WEST, TORONTO, ONT.

BRANCH OFFICES AND WARE-ROOMS:

1802 Notre Dame St. -	MONTREAL.	Main Street - -	WINNIPEG.
138 Hollis Street -	HALIFAX.	Granville Street - -	VANOUVER.

NELSON, B. C.



C. G. E. ALTERNATING GENERATOR, REVOLVING FIELD TYPE.

THE WEST KOOTENAY POWER & LIGHT CO., LIMITED,

have just commenced work on the most important power transmission plant so far undertaken in Canada outside of the immediate neighborhood of the city of Montreal. The distance of transmission is thirty miles, the line potential 20,000 volts, and the amount of power to be developed 8,000 horse power. For this important work the three-phase system of the Canadian General Electric Company has been selected and a contract awarded for the initial installation of 2,000 horse-power. The generators will be of the revolving field type, and of 1,000 h.p. capacity each. In type they will be generally similar to the twelve 1,000 h.p. units now being installed for the Lachine Rapids Hydraulic & Land Co.

SPARKS.

Mr. John B. Kelly, manager of the electric light plant, Blyth, Ont., says, "I would not be without the ELECTRICAL NEWS at any price."

The Jenckes Machine Co. have installed at the new works of the Boston Rubber Co. at St. Jerome, one of their 55 in. Crocker turbines, with wheel case and 300 ft. of feeder pipe.

Mr. W. Stewart, who controls the electric light plant of Lucknow, is installing a new plant in place of the one destroyed by the burning of his mills last June. The new plant will consist of a Reliance dynamo and instruments from the works of the Stevens Manufacturing Co., london.

Dr. J. A. McLeay, of Watford, has purchased from the Royal Electric Co. a 500-light alternator and the necessary transformers, and is installing an incandescent plant in the town of Watford. He has about 300 lights wired up, and expects to have the light turned on August 4th.

La Compagnie Electrique, of Chicoutimi, Que., have increased the lighting capacity of their plant by the addition of another 40 k. w. S. K. C. generator, which they have purchased from the Royal Electric Co. This addition has been made necessary owing to the growth of their power transmission work.

Mr. Green, of the Wingham Electric Light Co., having procured the franchise for Brussels, has commenced the erection of a new power house, 40 x 50 feet, two stories, stone and brick, and will have the same in running order by October 1st. The Brussells plant will consist of a Goldie & McCullough high speed Ideal engine, with boiler, and two direct-current dynamos and instruments from Stevens Manufacturing Co., of London.