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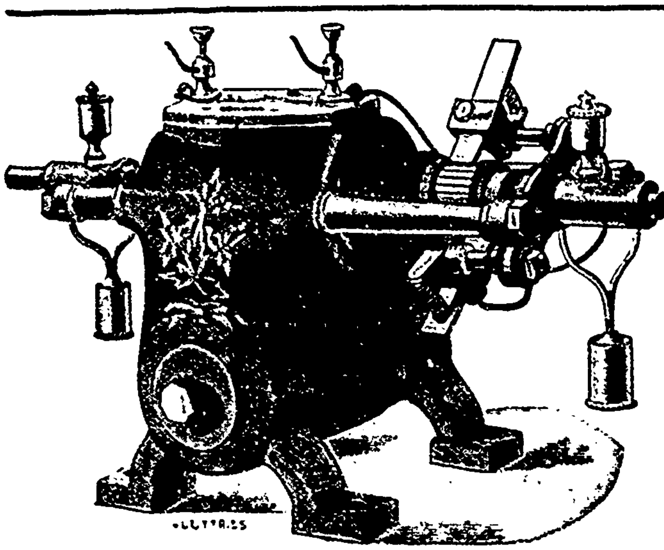

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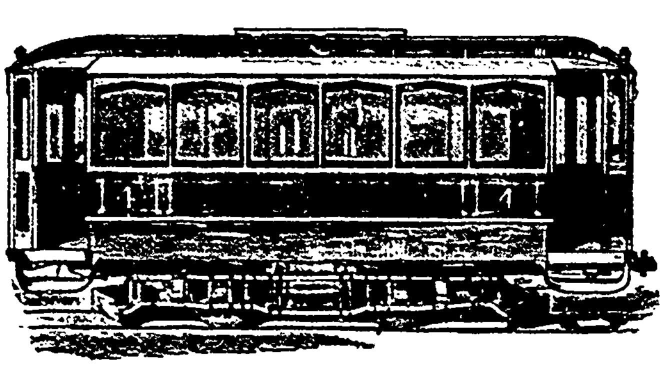

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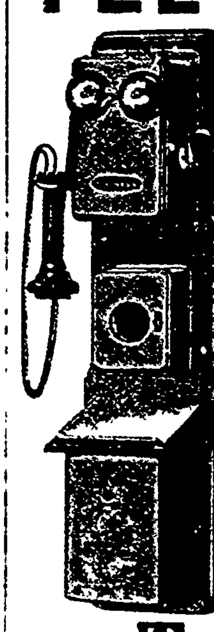

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Yours truly,
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CANADIAN
ELECTRICAL NEWS
AND
STEAM ENGINEERING JOURNAL.

VOL. II. TORONTO AND MONTREAL, CANADA, AUGUST, 1892. No. 8.

VANCOUVER AND NEW WESTMINSTER ELECTRIC RAILROAD.

IN October of last year the Vancouver & New Westminster Electric Railroad was opened for traffic between these two cities, as well as a general service in the city of New Westminster.

The main line, which is fifteen miles long, passes through for the greater part, an immense forest of cedar and Douglas fir, which had to be cleared far enough with 8 crossings to prevent any danger from falling trees, is a single track and is laid with 40 lb. T rails, ties being laid two feet between centres. The over-head line is of the single bracket construction, except when it comes into town, when the usual double pole is used.

The road at present runs over some very hilly country and has some very quick curves, with grades of over 10% on the curves, which have a radius of 35 ft. in some cases, which makes it rather hard to operate. Notwithstanding this fact it is being very successfully operated.

The power house and car barn is situated nine miles from Vancouver, as is also a hotel for the men, and cottages for the superintendent and chief engineer. It is built entirely of wood, covered with corrugated iron; all the windows have folding shutters covered likewise, as a prevention against fire. The interior of the building, which, by the way, shows wisdom seldom seen, viz., that it is a long way too large for the present plant, is beautifully finished in pine, the floor, walls and roof being nicely stained and varnished, which makes it look in every way, a superior place and is besides, easily kept clean and in order.

The plant consists of 3 steel boilers of 80 h. p., two Leonard Ball tandem compound engines of 125 indicated horse power each, two upright tubular heaters and two Worthington duplex pumps of ample capacity to feed the boilers and for a fire service, hose connections being fitted on. Water is supplied from three wells sunk near the boiler house, but it is intended in the near future to connect with the New Westminster water service. The foundations for the engines have unfortunately given trouble, although they are built quite massive, the soft nature of the soil upon which they were built having proved treacherous.

VANCOUVER AND NEW WESTMINSTER ELECTRIC RAILROAD POWER HOUSE.

The dynamos are from the Edison works at Peterborough, Ontario, and are of 100 kilowatt capacity at 500 volts, and are belted direct. The switch board is built up of native curly wood polished. The switches, etc., as will be seen by the illustration, are plain but neat, and all that is necessary nothing to confuse the engineer when a break down occurs, but the opposite, so that he can see at a glance where the fault is There is nothing so annoying to the travelling public as these waits of 5 or 10 or 15 minutes which is thus so far helped to be avoided.

Owing to the long distance and the nature of the road, feeders are run each way, at Vancouver these cars connect with the Vancouver City cars, but in New Westminster there are three miles of very heavy road which is operated by this company.

The present car equipment consists of 4, 24 ft. Biell vestibule cars fitted with Burton electric heaters. The trucks are of the maximum traction type, and are equipped with the Edison Company's No. 12A single reduction motors, giving each caran equipment of 60 h. p., 1 passenger and freight car, combined, same as above, and 3, 18 foot cars built by Patterson & Corbin, St. Catharines, Ontario, which have the Biell no. 7 rigid truck and are equipped with the Edison Company's No. 6 double reduction motor, giving each car an equipment of 30 h. p.

The main line cars run two together every hour. At first it was meant to run only one car every two hours, but such a traffic developed almost from the start that the whole of the rolling stock had to be at once pressed into service. Even then the traffic could not be handled satisfactorily, and as a consequence at the last directors' meeting, contracts were closed for 4, 30 foot vestibule cars, two 18 foot cars, two No. 60 Edison generators, two 250 h. p. Ball engines and four 150 h. p. steel boilers. It was also agreed on to change the two present 125 h. p. Ball engines for two 150 h. p.

At the expiry of the 30 days engine guarantee, a test was made by Mr. Angus, Mechanical Superintendent for the manufacturers, Messrs E. Leonard & Son, London, Ontario, in presence of the Chief Engineer of the company and several of the officials, which proves the strength and efficiency of the engines for railroad work.

Seven cars were put on the road, and when on the grades a reading of ampere meter shewed 170. The voltage went down on the application of this overload to 475, but in less than 15 seconds was raised to 515 while ampere meter stood at 170. When ampere meter was at zero the voltage was 525, which shews the efficiency of the governor as the loss was less than 2. The indicated horse power during the heavy load was 135 h. p. and at one period ran up to 140.97 as indicated by the cards taken. These engines have been running continuously for about 18 hours per day. As it was not known whether the traffic would pay for any extraordinary expense in the building of the road, it at present generally follows the general contour of the country through which it passes, but now that the traffic will warrant it, the line will be improved very considerably. Instead of going around them, heavy cuttings will be made in several small hills, long trestles will be built over the hollow spots and the heavy grades lowered.

QUESTIONS AND ANSWERS.

"A. M." writes: Send a sample copy of the NEWS, and name a good book for the study of electricity, stating price. For the purpose of learning electrical engineering, would an electric light station be a good place to start, and what would be the customary wages.

ANS.—For a list of books adapted to your requirements, see ELECTRICAL NEWS for June. An electrical manufactory would be the best place to acquire a practical knowledge of the business. The salary you would obtain would in any case not be large at the outset, and would depend somewhat upon the knowledge you possess to start with. Should an opportunity be afforded you of obtaining a situation in a manufactory of this kind, it would pay you if necessary to give your services without charge for a time in return for the information which it would be possible for you to acquire.

R. J. B. writes: I am a fireman in a stave factory. Have some knowledge of the steam engine, and have been around the electric light plant here a little. I wish to qualify myself to operate an electric light plant, but cannot afford to go into a manufactory to learn the business. If I were to secure a position as fireman where an electrician and an engineer was employed, and were to pay particular attention to all that came under my notice would I be likely to get a sufficient insight into the business to enable me to operate an electric plant myself? Will you please give me a few pointers in order that I may put myself in a position to learn the business.

ANS.—Circumstanced as you are, possibly you could not adopt a better plan than you have suggested, to become familiar with the principles of electricity and the operation of electrical apparatus. If you could secure such a position as you mention, where you would be in association with some person competent and willing to instruct, and at the same time devoting as much time as possible to the study of suitable works on electricity, you would no doubt be able to fit yourself to take the management of an electric plant. In the June number of the ELECTRICAL NEWS you will find an editorial article giving a list of books which are considered to be most suitable for students of electricity.

"Subscriber" writes: Please give rule for finding ratio of expansion of air when applying heat. One cubic foot of air at 100 Fah., 60 lbs. pressure, absolute, how much would it expand (retaining the same pressure) if heated to 300° Fah.?

ANS.—The volume of air varies as the absolute temperature when the pressure is the same. Absolute temperatures on Fahrenheit's scale are usually reckoned from 461° below zero. 100° Fah. measured from absolute zero will then be 561° and 300° Fah. becomes 761°. The volume is increased as 761 is to 561, or one cubic foot will expand to 135 cubic feet.

M. C. G. asks: What is the lighting power of one cubic foot of carbonic acid gas as applied to a balloon?

ANS.—Carbonic acid gas is 1½ times heavier than atmospheric air, consequently can have no lifting power unless by difference of temperature, and as carbonic acid gas is so heavy it would be much better to use warm air.

HORSE POWERS OF SINGLE LEATHER BELTS.

No one can tell at sight what a leather belt will drive; almost any one knowing the width, thickness, and speed, can figure it out in a minute. This table is to save figuring; and is correct for belts 7/32 inch thick, in good condition, wrapping half way round cast iron pulleys, and joined by single leather lacings.

The rule by which it is got says "the horse power is equal to the width in inches multiplied by the speed in feet per minute and divided by 650." Thus a ten inch belt at 2000 feet a minute should be good for (10 x 2000) divided by 650, equals 30.77 horse power, a 20 inch belt at 2500 feet, for (10 x 2500 divided by 650 equals 76.92 horse power; and so on.

This table is for leather belts in good condition, wrapping 180 on cast iron pulleys and joined with single leather lacings:

WIDTH INCH'S	BELT SPEED, FEET PER MINUTE.								
	1000	1250	1500	1750	2000	2250	2500	2750	3000
1	1.54	1.92	2.31	2.69	3.08	3.46	3.85	4.23	4.62
2	3.08	3.85	4.62	5.38	6.15	6.92	7.69	8.46	9.23
3	4.62	5.77	6.92	8.08	9.23	10.4	11.15	12.7	13.8
4	6.20	7.70	9.20	10.8	12.3	13.8	15.4	16.9	18.4
5	7.69	9.62	11.5	13.5	15.4	17.3	19.2	21.	23.
6	9.23	11.5	13.8	16.2	18.5	21.	23.	25.	28.
8	12.3	15.4	18.5	22.	25.	28.	31.	34.	37.
10	15.4	19.2	23.	27.	31.	35.	38.	42.	46.
12	18.5	23.	28.	32.	37.	42.	46.	51.	55.
14	22.	27.	32.	38.	43.	48.	54.	59.	65.
16	25.	31.	37.	43.	49.	55.	62.	68.	74.
18	28	34	42	48	55	62	69.	76.	83.
20	31	38	46	54	62	69.	77	85	92
24	37	46.	55	65.	74.	83.	92.	101.	110
30	46.	58.	69.	81.	92.	103.	115.	127.	138.
36	55	69.	83	97	114	125.	138.	152.	166.
48	73	92	111	129.	148.	166.	185.	231.	222.
60	92.	115.	138.	161.	185.	208.	231.	254.	277.
72	113.	138.	166.	194.	227.	249.	277.	305.	332.

—*Power and Transmission.*

TRADE NOTES.

The Guelph Gas Co., have purchased from the Ball Electric Light Co., Ltd., of Toronto one of their 65 light 8 ampere dynamos, to be used for all night lighting in their new station, now nearly finished. This station will be one of the finest in Canada. The Guelph Gas and Electric Co., have used the Ball system for commercial and street lighting for over 5 years.

Mr. Chas. F. Ernst, formerly with the Ball Electric Light Co., has opened a general electrical supply agency for Canada, at New Hamburg, Ont. He will represent both Canadian and American manufacturers, and has already secured the sole agency for Canada for the National and Standard Carbon companies, of Cleveland. Readers of the ELECTRICAL NEWS should be on the look-out for Mr. Ernst's announcement in the advertising pages of our next number.

The Ball Electric Light Co., Ltd., report the following sales: Guelph Gas Co., 65 light dynamo and 2,000 c. p. arc lamps; Palmerston Electric Light Co., 500 light alternating current incandescent dynamo and outfit; Also Ball motors have lately been sold to the following. Nasmith & Co., Restaurant, King st., Nasmith & Co., Resturant, Yonge st., A. Doig & Co., Machinists, Nelson st., Toronto, Preston Lithographing Co., 10 h. p., D. H. Wolfe, printer, Queen st., etc., etc.

THE "ELECTRIC."

We present our readers in this issue with an engraving of the steam yacht "Electric" owned by Mr. J. J. Wright, President of the Canadian Electrical Association. It is from a photograph taken in Oakville harbor. The boat was modelled by, and built under Mr. Wright's supervision, and intended for rough weather service. She has already proved herself to be a good and seaworthy craft. Her owner is an enthusiastic sailor, and many is the Saturday evening cruise that is made by the "Electric" to some quiet port along the lake shore or across to Niagara or Port Dalhousie. Each summer, if her owner can manage to get a week away from business, the cruise is extended as far as Kingston, by way of the Murray Canal and the beautiful Bay of Quinte. Those who are acquainted with the region around Presque Isle and South Bay will be aware of the jump of a sea that old Ontario is able to kick up on very slight provocation around those parts, and will understand that it is not always smooth sailing on such an excursion. The slight spice of adventure, however, that is pretty certain to be met with only serves to add zest to the enjoyment of the cruise, and enables the jolly crew to absorb their full share of oxygen from the lake breezes, and to return with a full stock of vigor to the serious work of life. Besides a small and serviceable dingy, the "Electric" carries a 14 ft. whale boat with air-tight compartments and double skin, and a full complement of anchors and cables, and has, moreover, sufficient canvas to enable her to make a port in good shape in the event of accident to her machinery or shortage of fuel. She is also fitted with 6 in. spent compass and binnacle, adjusted for magnetic deviation on any course. In fact nothing in her outfit has been neglected that would be necessary to meet with any condition or stress of weather likely to be met with in her wanderings.

Mr. J. J. Wright's Steam Yacht, "Electric."

WHY DYNAMOS GET HOT.

Any dynamo which is in good condition and well designed will become heated a few minutes after starting to about 170°. The cause of such heating is the loss of electricity in the machine. When ever a current passes through or along a wire, every particle of metal is set in motion, vibrating back and forth exactly as if a stick of timber were struck on one end with a hammer. In the latter case it is easily understood that the particles move in transmitting the blow. It can be seen that were the blow hard enough, particles would be drawn from each other, and the timber split in pieces.

This takes place to a certain degree, in every wire which carries a current of electricity. The blow is struck by the voltage, and the higher the voltage and the smaller the wire, the greater the vibrating effect. When the blow becomes too great, a current which is too large for such a conductor is forced through the wire. It nearly tears the atoms apart in trying to get through. It is possible to send so much current, and thereby strike so hard a blow, that the wire is heated and even melted, by the terrible commotion set up among the particles of metal.

Therefore, when a dynamo heats above 170, it is evident that something is wrong, either the armature is composed of wire which is too small to carry the current generated, or the armature core is not made of thin discs, or layers of iron. If these layers are thick the armature will heat worse than when they are thin. The contractor may have cheapened his work by putting in thick discs over a solid armature. The result is heating at all times. Sometimes an armature gets pretty hot through rubbing the bands against the pole pieces. No good engineer will ever let such a thing occur. He will detect the trouble as soon as the dynamo is started.

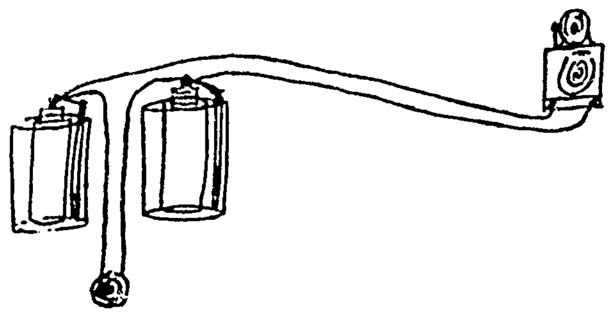
Short circuiting between two armature coils will also cause heating. This can only be detected by disconnecting each coil, and testing separately with a resistance box. This is a tool which no engineer should be without; he can construct one himself, and learn how to use it without much trouble.

A poor connection between the armature coils and the commutator may result in heating, but it surely will cause sparking at the commutator, and perhaps a flat place on one or more of of the bars. Copper, or other metallic dust, which forms a connection between two bars of the commutator, will surely cause great trouble in the dynamo. It will cause several coils to heat, and probably result in heating one or more of them so hot that the insulation will be burnt off, and the engineer left with a burned out armature on his hands.—*Flotsam.*

BERLIN, June 19th, 1892.

Editor ELECTRICAL NEWS.

DEAR SIR,—I enclose you a sketch of how a local dealer in electrical supplies was trying to get an electric bell to ring.



You will notice the zincs are "not in it" at all.

Yours truly,

H. A. ALDRICH.

MECHANICAL METHOD OF DETERMINING THE M. E. P. OF DIAGRAMS.

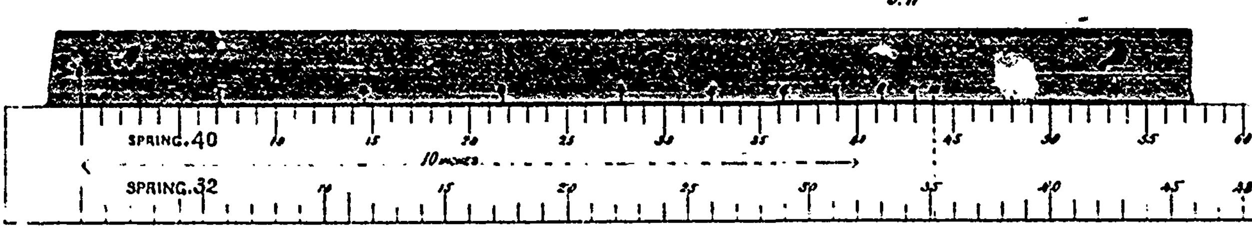
Editor ELECTRICAL NEWS.

SIR,—During the reading of the paper on "The Measurement of Work," before the Stationary Engineers' Association of Montreal, on the evening of March 3rd, reference was made to a mechanical method of determining the M. E. P. of diagrams. After reading the paper, the author took one of the cards on the table, marked scale 40, and determined the M. E. P. by the following process, which is illustrated by the accompanying figure:

M.E.P. SCALES—40 & 32.

FOR 10 DIVISIONS.

J.W.



After dividing the diagram into 10 divisions, take a strip of paper, marked A. B. in the figure, and mark on the edge with a sharp pencil or the point of a knife, the mean height of each division successively. The aggregate height of the divisions is then measured with a M. E. P. scale, on which a length of 10 inches is divided into 40 equal parts, each divisional part being then 10 40ths of an inch. By this scale the distance from 0 to 10 is 44 parts, which is the M. E. P. of the diagram. If a fraction of a division had been over, it could be read to 10ths with the scale of the spring.

On the other edge is a scale for a 32 spring, on which 10 inches is divided into 32 equal parts, each part being 10/32 of an inch. It will be observed from the dotted line on the figure, that if the diagram on hand had been taken with a 32 spring, the M. E. P. would have been 35.2 lbs.

There is an accuracy and exemption from error in this method of finding the M. E. P. of a diagram, that entitles it to be better known among engineers than it appears to be. If the diagram is divided into 12 or 14 parts, then 12 or 14 inches is the unit of the scale, and it is divided into 30, 40 or 50 equal parts, corresponding to the number of the spring. The M. E. P. is read off as before.

With 10 divisions of diagram, the M. E. P. to scales of 10, 20, 40 and 80, can be read with a foot rule, but the M. E. P. scale is preferable. With a strip of good card board 18" long by 1½" wide, an engineer can make scales to suit the springs he has or get a draughtsman to lay them out for him, and with a dividing or gird iron parallel ruler to lay off the divisions, and a strip of paper to lay off the heights, he will work up a diagram in less time, and with less labor, than with an Amstler or a Crosby Planimeter, and I will add, with less chance of error and no use for arithmetic.

Yours truly,

J. W.

THE STRATHROY ELECTRIC STATION.

Editor ELECTRICAL NEWS.

DEAR SIR,—Being in the town of Strathroy recently, I visited the Central Electric Station in that town, and for the information of your readers I submit a short description of the same. Mr. T. N. Saylor, who owns the station and plant, at once told me that I was welcome to go and come as I pleased.

The station is a white brick building 18 ft. x 75 ft. and is situate just off Front street, near the Queen's hotel. Mr. Saylor came to Strathroy a few years ago and bought the lot and built a station on it, having previously bought the contract for lighting the town from the Reliance Electric Co., who had made arrangements with the town to supply the light.

The plant consists of one 25 lt., 8 amp., 2000 c. p. Reliance dynamo; one 25 lt., 4 amp., 1000 c. p. of the same make. The 8 amp. machine is used for street lighting and some private lights, while the 4 amp. machine is used exclusively for private stores for both 1000 c. p. arcs and 50 c. p. Bernstein lamps on the same circuit. The number of lamps supplied with current at present is fourteen 2000 c. p. street arcs, fifteen 1000 c. p. private arcs, and thirty 50 c. p. Bernstein lamps, which are run every night in the year till midnight.

The motive power is supplied by a 12 x 20 Wheelock engine. Steam is generated by a 54 x 15 Inglis & Sons steel boiler, with 65 3" tubes, which is fed by a plunger pump driven off the crank shaft of engine. The feed water is raised from a well by a common well pump, operated by a crank on one side of plunger pump, and is pumped into a tank from which feed pump is supplied.

The fuel consumption for this plant is ½ cord of good wood, from 7 p.m. till midnight.

Mr. Saylor has attached to the governor of his engine, a device of his own, which he has patented, and which does away with the spring on the trip rod. The resistance to the centrifugal force of governor is obtained by a dead weight and a system of levers. Mr. Saylor informed me that he could with this device throw off the load on his engine without increasing the speed one revolution.

As I seemed rather skeptical, he said if I would come around when he shut down, he would prove to me that his device would do what he claimed. It is needless to say I was on hand at the time appointed. The engine was started up light, and I counted the revolutions per minute and found them to be 76; the load was then suddenly thrown on by closing the switches, and I counted the revolutions again and found that no change had taken place. Anyone wishing further information regarding the device can obtain it from Mr. Saylor at Strathroy.

Mr. Saylor expressed himself as being well satisfied with the Reliance system. This plant is a model of its class; everything is clean and tidy from one end to the other, and is a credit to the owner, who acts as his own engineer and electrician. Any one passing through Strathroy can make sure of a hearty welcome if they wish to visit the plant, especially if they are in the business.

Yours truly,

"TRAMP."

She wasn't on the play-ground, she wasn't on the lawn,
The little one was missing and bee-time coming on.
We hunted in the garden, we peeped about to see
If sleeping under rose-tree or lilac she might be.
But nothing came in answer to all our anxious call
Until at length we hastened within the darkening hall.
And then upon the stillness there broke a silvery tone—
The darling mite was standing before the telephone,
And softly as we listened, came stealing down the stairs:
"H'lo, Central! Give me Heaven, I want to say my prayers."

—*Pick-Me-Up.*

OTTAWA ELECTRIC LIGHT COMPANY.

THE above company was organized in 1884, the officers being as follows: G. B. Pattee, President; J. C. Brown, Sec.-Treas.; T. B. Badger, son of the City Electrician of Montreal, electrician; W. R. Thistle, H. E. Irvine, Hiram Robinson, H. K. Egan, John Christie, Alex. McLean, first Directors. The plant was at first installed and owned by the Royal Electric Co., whose interest was purchased by the present company in 1886.

The present officers are: Robert Blackburn, President; Senator Clemow, Vice-President and general manager; Directors Messrs. Blackburn, Clemow, Thos. Patterson, Samuel Howell, Allan Gilmour, James McLaren (deceased); Thos. C. Keefer, Alex. Spittall, Secretary-Treasurer. Mr. W. G. Bradley is the electrician in charge of the plant.

There are ten circuits leaving the station, seven for city and three for commercial lighting. There are in use in these circuits in the neighborhood of 125 miles of wire, extending to Rochesterville, New Edinburgh, the Exhibition grounds, the Experimental Farm, etc. The company supply the city with 304 street lights, the government with 26 in the government buildings, and 86 for commercial use. They have a ten years' contract with the city, which has three years yet to run. Mr. Bradley, the company's electrician, was formerly with the Royal Co. He has had charge of the plant ever since the company started.

THE TECHNICAL EDUCATION OF THE ELECTRICAL ENGINEER.*

It is impossible for many, and doubtless undesirable for the majority, to take a year from the midst of their college course for outside work. The summer vacation between the third and fourth year should, therefore, be occupied in some such employment as wiremen on electric light or telephone construction, or better, in the station and repair-room of an electric railway, under the eye of an appreciative superintendent. Three months spent in this work may seem very little, but it will do a deal of good in giving an apt student a fair idea of how far exact formulas will carry him. It is only by the generous co operation of employers that students can obtain this summer's work. At first thought it appears that the employer gains no advantage from it, but upon careful consideration an advantage is evident. To begin with, the properly trained student will not prove useless during the summer, and the satisfactory one will usually find employment after graduation, with the interests of those who afforded him summer work, and who thus gained the benefit of his greater advancement during his last year at college. In a similar manner, the manufacturer gains an advantage from placing his apparatus in the technical school laboratories for *proper* use in instruction.

Suppose a student has completed the prescription college course, and has done a proper portion of repairing armatures, stringing wires, or similar work, at some interval between his terms at college, what shall we call him? A few of the technical colleges of the front rank call their graduates engineers, but we have already seen that they must pass through a transition period during which the claim to the title can be proved. To call an untried graduate an engineer does not seem proper respect for himself or the successful workers in his profession. The transition period may never end for some graduates, while its length must always depend upon the man. Until the graduate has been in practical life a sufficient time to show his capacity, and has reached a position of responsibility, he has no right to claim from his college an engineer's degree. Upon this ground the University of Wisconsin, as do many others, confers degrees in engineering upon graduates of its engineering school of not less than three years' standing, who have held engineering positions of trust for at least one year. The minimum transition period is thus tacitly recognized as three years. Upon completing his college course, the student is given a graduating degree of Bachelor of Science by the engineering school, which is simply an endorsement by the university that he has received a good technical college education and is in a fair way to profit by it.

That the rigid specialization required in the technical school may not diminish the graduate's field of vision and thus his usefulness to society, is a matter of much concern. With the college left behind there is little opportunity to gain a broadening culture, except that received by contact with broad men, while we have seen how little opportunity for this can be afforded in the technical course. With this in view we recommend at the University of Wisconsin, that *all* who can afford the time and money complete a four-years' undergraduate course in the University School of Arts and Sciences before entering the School of Engineering. By proper elections during the general course, the studies of an engineering course can be completed in two additional years. By this plan a solid educational foundation is laid for the specialized studies of the engineering student, and the best conditions are developed for his ultimate success in professional work. The plan offers two other points of advantage: First, the student comes to his professional studies in the engineering courses with a more matured mind, which is of much importance; second, students without the taste of hard engineering work, which is required for their future success in technical industries, will not often attempt a technical course after having completed a general course.

We can now usefully inquire into the specialized work that should be prescribed for the average electrical engineering student during his last two years at college. Up to this point students in mechanical and electrical engineering courses have received virtually the same instruction. Here, we hold, with several others, their path should diverge. The student of mechanical engineering goes into careful study of shop practice, designing and utilizing various types of machinery, and similar subjects. The electrical engineering student must receive a good working knowledge of the problems of the mechanical engineer, but he must, above all, be trained in the practical problems of electrical engineering. He therefore goes into a study of that which will aid most in making him truly an electrical engineer. His knowledge must all be based on mechanical laws, but he must be much more than one-tenth electrical.

Before reaching his truly professional studies, the student should gain, during his course in physics, a common-sense grasp of the elementary notions of electricity and magnetism, and of the "all pervading law of Ohm." The latter can be properly enforced in the laboratory by placing in the student's hands ordinary electrical instruments, such as bridges, galvanometers, ampèremeters, voltmeters, etc. Before beginning his specialized work the student's knowledge of Ohm's law and its common results should have become almost instinctive.

With due regard for his preparation, it seems best to arrange the professional studies for the average electrical engineering student in four divisions, thus:

1st. Electro-magnetism and its application to practical uses, with special reference to dynamos and motors.

2nd. Electro-chemistry (including primary and secondary batteries) and electro-metallurgy.

3rd. Alternating currents and alternating-current machinery, including dynamos, converters, condensers, etc.

4th. The special application of the preceding divisions in electric light, power, railway, mining and other types of plants.

The last division is allotted about twice the amount of time given to each of the others. . . .

The student who satisfactorily completes a *proper* professional course at college, whether laid down in the college catalogue or carefully selected from that prescribed, is not likely to become one who "turns out results like a cornsheller, and never grows wiser or better tho' it grinds a thousand bushels of them." In order that he may have a fair opportunity of growing "wiser and better" in the practice of his art, he should be given reasonable encouragement. As Mr. Holley one time said, an understanding should obtain—"among the owners, directors, and commercial managers of engineering enterprises that it is not a matter of favor, but a matter of as much interest to themselves as to any class that young men of suitable ability, and of suitable preliminary culture, however acquired, should have an opportunity and encouragement to master the practical features of technical education *in works*, not as mere apprentices, but under reasonable facilities for economy of time and completeness of research. A legend on the cover of a circular lately issued by the Engineering School of the University of Wisconsin, gives the true object of the technical college, when it says, "We do not aim to produce engineers, but to produce men with great capacity for becoming engineers." If our product is accorded the treatment advised by Mr. Holley (himself an experienced manufacturer), we feel sure the work of our school and of similar technical schools will not be useless.

*Abstract of paper read at the general meeting of the American Institute of Electrical Engineers, Chicago, Ill., June 6, 7 and 8, 1892.

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

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NOTICE OF REMOVAL.

On or about the 20th of September next, the publication offices of the ELECTRICAL NEWS will be removed to the new Confederation Life Association Building, corner of Yonge and Richmond Streets, Toronto.

THE convention of the Canadian Association of Stationary Engineers, will be held in Hamilton, Tuesday, August 30th. All the associations will be represented, and an interesting meeting is looked forward to. The Hamilton members are making every effort to give the visitors a pleasant time. Several interesting papers will be read during the convention.

HEAT applied underneath water always makes more steam than the same quantity of heat applied over the water, or sideways. Hence in boiler setting, have the brickwork arranged so as to compel the currents of heat to pass along the bottom of the boiler, rather than along the sides. A quantity of oil was burned on the surface of a pot of water. Result, the temperature was raised one degree. The same quantity of oil was burned under the pot. Result—the water was boiled and the most of it evaporated into steam.

THE Bell Telephone Co. recently laid a cable, consisting of three pairs of stranded wires, across the Bay at Toronto from the water works dock to the crib work at Hanlan's Point on the Island, a distance of one mile. The cable, which weighed nearly six tons, and was heavily armored, was wound on a reel, the reel being placed on a scow and the scow being towed by a tug. The cable was laid in the channel which contains the intake water pipe. Considerable difficulty was met with, owing to the tug getting aground whenever it happened to get outside of this channel. The whole undertaking occupied about nine hours, although after the difficulty of getting out from land had been overcome, the bay was crossed in 35 minutes.

REPORTS from several electric lighting companies in the Dominion who have extended their plant so as to include the the supplying of power by means of electric motors, show that in some cities there is a veritable boom in that direction. One concern which we have in mind, and which has only been operating a generator for about four weeks, reports twenty motors in operation, ranging in size from one-half to fifteen horse power, all of which goes to prove what we have frequently pointed out to our readers, that there is money to be made in operating such a plant in connection with electric lighting. An editorial which we printed some two or three months ago, gave prices at which the power could be supplied to customers at a good profit to those supplying it.

IT is with pleasure we observe that abstracts from some of the papers read at the first annual convention of the Canadian Electrical Association and in some cases the entire papers have been reprinted in the leading electrical journals of the United States. This must of course be pleasant to the writers of the papers, and is a recognition that there is some electrical ability in Canada as well as in the U. S. From our own standpoint we know that some of our Canadian electricians rank just as high in the scale of electrical knowledge, as do those of our neighbors, but the fact remains, and is sometimes very apparent, that the latter are apt to think differently. There can be no doubt whatever but that the field for obtaining knowledge in electrical matters is much greater in the United States than in Canada. There is a draw-back, however, in the fact that such a large force of workmen is required to handle the amount of material turned out, that it becomes necessary to keep a man in one department only, consequently he does not get that shifting about, first at this thing and then at that, which is bound to give him a wide and varied experience and so make a more thorough and practical man of him. From this point of view at least, there is some advantage in being a Canadian.

THE question is frequently asked of electricians if a watch carried in the pocket of a person riding on an electric tramway or street car, will thereby be affected by magnetism. As this is a question that any of our electrical readers may be called at any time to give an opinion upon, we have taken pains to propound the question to a party prominent in electrical matters in Canada. His reply is as follows. "There cannot be any doubt whatever but that the increased use of electricity, particularly in the operation of street railway cars, is bound to affect more or less the watches that are worn by the passengers; particularly is this the case where there are many steel parts about the works of the watch, such as a steel balance wheel, and steel escapement and hair springs. Perhaps the greatest amount of damage will be done when a heavily loaded car is ascending a grade, at which time the motor calls upon the trolley wire to supply it with an amount of current far in excess of what is required to propel the same vehicle on a level track and with very little load, so that the iron of the motor reaches saturation or nearly so, under which conditions there is sure to be an extending out wards from the motor as it were, of magnetic lines that must have some influence on the fine hardened steel parts of a watch, and induce destruction of its utility as a time keeper." After reading the above the question will naturally arise as to the remedy for such a state of affairs. At the present time we are only able to say, have the movement changed to a non-magnetic; true, the magnetism can be removed or neutralized in a watch affected, but it will only last as long as its owner keeps it away from the magnetic influence.

THE first city in Canada to equip its street railway so as to be entirely operated by electricity, is Hamilton, and the management of the Hamilton Street Railway Co deserve praise for the expeditious manner in which they have made the change. The street car horse is now a thing of the past, and some 20 miles of track have the electric cars flying along them at such a rate as to make an ordinary street railway that is yet using horses green with envy, not solely on account of the increased speed attained, but also from the fact that nowat least two nickels will fall into the box for every one that fell into it when the road was operated with horses, thereby materially increasing the company's revenue, and at the same time reducing operating expenses. Statistics show that an electric road can be operated by the trolley system with the saving of at least 20 per cent. over that operated by the old slow going quadruped. Then there is another point to be considered, which is, that with a street railway operated at the speed at which an electric road can be operated, a person going in the direction of a car cannot afford to waste time enough to walk the distance when for a few pennies he can be deposited at his designation perhaps 20 or 30 minutes sooner It increases the vim and push and energy of the people generally to have the trolley cars travelling along the streets at a "get there" pace; they are bound to get into the way of moving energetically themselves. It gives us much pleasure to congratulate the people of Hamilton on their street railway, and it proves once again that the name of the "Ambitious City," is well chosen.

PERHAPS one of the most troublesome things that central station managers and superintendents are compelled to handle is arc light carbons. They are one of the very few things connected with the electric lighting industry that are to-day almost as they were some ten years ago, except in the matter of price. The effort seems to have been to make as good an article at a less figure, while the ingredients used and the quality of the product are as nearly identical as possible with what those existing when carbons were 12 cents apiece. It strikes us very forcibly that there is a rich field for the experimenter in this direction. There cannot be any doubt but that the best of carbons made to-day would stand a great deal of improvement. Surely a carbon should be made that would burn with a fixed amount of current, and give a steady non-flaming and noiseless arc, doing away entirely with the spluttering frequently seen in the general run of arc lights. We predict that such a carbon will be manufactured at some time in the near future. It only remains for some bright individual to find the material and hit the combination to produce this result; of course, we are not ignorant of the fact that fully one-half of the fault that is found with carbons can be placed on the poor adjustment of the lamps in which they are used, but the other half we feel sure is clearly to be blamed on the carbons themselves. Then again, manufacturers should use the most stringent measures to produce an absolutely straight carbon, for much of the quiet burning of an arc lamp depends on this as well as on the quality. We regret that we cannot find this the case in any instance, be the carbons manufactured either in the United States or Canada, and though it may seem a bold assertion to make, yet we feel that we are not overstepping the bounds of truth when we say that there cannot be found to-day, a box of 1000 carbons of 7/16 in. in diameter that will not average more than 25 to 35 per cent. of crooks—not such as may be designated so by the manufacturers themselves, but crooks, nevertheless, simply because they are not absolutely straight. Now, the purpose of this article is not to tread on any of the manufacturers' toes, but only to point out to them in what direction they should seek to improve their goods, and thereby not only benefit themselves, but save the electric light men worry and annoyance; its mission will be more than fulfilled if it but points the way to improvement in any one of the above mentioned directions.

THE DYNAMO.

DYNAMO and magneto-electric machines consist essentially of a coil of wire—"the armature"—rotating between the poles of a large magnet, the poles being bent round so as to approach each other and have the armature between them. This magnet may be either a permanent magnet of hard steel, or an electro-magnet consisting of wire coiled round a soft iron core, a current of electricity being made to circle round the wire coil, and thus magnetizing the iron core while it lasts. A magnet produces an influence in the neighborhood around it, and this surrounding neighborhood is known as the "field of force" of the magnet; *i. e.*, the sphere in which its influence can be felt.

A magnetic needle or a bit of iron filing placed in this field sets itself to point along the "lines of force" of the field; that is, the lines along which the magnetic force acts, and which form curves around the magnet, running out, as it were, from pole to pole, curving from one to the other. When a coil of wire, or armature, is made to revolve rapidly in the strong field of force which occupies the space between the poles of a powerful electro-magnet currents are produced in the coil. These currents alter their direction through the coil every time the latter changes its position with reference to the poles of the magnet. The side of the coil which was opposite the north pole is after half a revolution opposite the south pole, and the influence of the south pole tends to produce an opposite current to that of the north pole. Here we have an "alternate current" dynamo machine. As the coil, or armature, rotates with great speed some hundreds of revolutions per minute—these currents in alternating directions, succeed each other very rapidly, and if an electric arc lamp is placed on the circuit it will be lit up. In this case it is not necessary that the current be sent around the circuit in one direction only; but although the terminals of the lamp are constantly changing their politary—that is the north pole, where the current enters, the next instant becomes the south pole, where the current leaves—yet, as this occurs many times in one second, the effects produced is the same as if the current was in one uniform direction.

In a "continuous-current" dynamo, which is necessary for some purposes, such as electro-plating, where the effect desired could not be produced if the direction of the current was continually altering, the electric current is made to pass always one way round the external circuit. This result is got by using the ingenious device of a commutator, which automatically deflects the current so as always to send it in an unvarying direction. This commutator consists simply of a split tube, which is attached to the revolving armature, and may be seen in any dynamo working on the continuous system. This tube revolves with the revolving armature, and it is divided by an insulating substance into two parts. Each half is alternately on the left and right of the space between the poles of the magnet and the "brushes" which collect the current from the armature; *i. e.*, the bundles of copper wire spread out like a brush, which form each end of the outer circuit, are fixed in position, and the revolving commutator attached to the armature brings alternately one of its half-tubes into contact with a brush. Thus the half of the commutator which receives the current changes at the same time the direction of the current though the coils of the armature is reversed; in this way the current sent out to the brush which receives the electric current from the armature is always in the same direction.—*Boston Journal of Commerce.*

ELECTROMOTIVE FORCE.

THE most terrifying term in the electrical vocabulary to the uninitiated and beginner is the word "potential." This word has been discussed by scientists and electricians to such an extent that many students regard it as possessing a meaning inexplicable by ordinary language and utterly undefinable, and that it can only be comprehended by the development of a sort of special sense, which enables us to understand things without being able to explain them.

There is no reason, however, why any more mystery should attach to the word "potential" than to the word "motion," and, to be more general, there is no reason why any of the technical terms used in the electrical science should be enshrouded with mystery; they are all easily understood if a little thought is bestowed upon their meaning. The mere verbal *expression* of a technical term, whether it be volt or megohm, does not necessarily convey its meaning. Thought is required, as well as an expression, and in this respect the study of electricity is no different to the study of the multiplication table.

The definition of "potential" is, briefly, *possessing latent power;* that is, stored power which may be utilized to perform work under proper conditions. If we take a weight *w* (Fig. 1) weighing, say 10 lbs., and haul it up from the ground a distance of 10 feet, it will be endowed with a certain amount of power to do work, which it can be made to perform by its descent to the ground. This work can be applied in a great many ways. For instance, the end of the rope *a* might be attached to a train of clockwork which would be set into motion by the descent of the weight; or it might run a fan, a sewing-machine, or do any other kind of work, providing the weight was sufficient to overcome the friction of the mechanism. The weight then at a height of ten feet from the ground has a *potential energy* of a given amount -- potential energy, meaning latent energy, which is transformed into work when the weight descends. Should the friction of the train of clockwork *c*, and the pulley *p*, be so great as to prevent the weight *w* from descending, no work will be performed; but if the total friction is slight, then the energy of the weight can be utilized to perform work in some form or another.

Now if we make the weight *w* 20 lbs. (twice its original weight), it will have twice the potential energy at the height of ten feet than it did before, and consequently, all things being equal, will perform twice the amount of work; it has twice the power to overcome resistance that it formerly had.

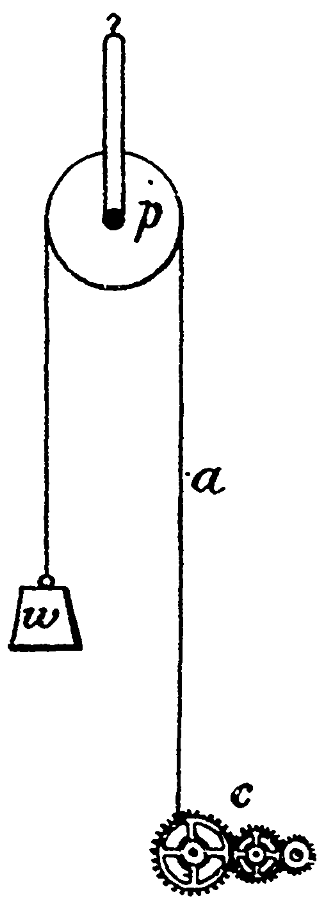


FIG. 1.

It is evident from these considerations that the greater the friction the less will be the amount of useful work available, and, on the contrary, the less the friction the greater the work. The same idea as to potential, or potential energy, is applicable to electric currents to express the power of a current to do work.

It is a difficult thing sometimes for beginners to get a clear conception of work done by electricity, but when it is remembered that work is required of the electric current to overcome the resistance of the conducting wire, to produce light in the electric lamp, to deposit metals in the plating bath and to propel street cars and operate machinery, just as work is required of the weight in the example, to overcome the friction of the pulley and clockwork a better idea of it will be possible. In an electric circuit of great resistance and with little potential energy at the source of current little or no useful work will be performed, because all or most of the power of the current is wasted in overcoming the resistance of the wire, which is analagous to the friction of the pulley and the wheels of the clockwork in Fig. 1. It is evident, therefore, that in order to get the greatest amount of power or work from a given electric current, the resistance to the current must be made small, so as to enable us to deliver as much of the current as possible at the point where the work is to be performed.

Electric potential, or electromotive force, is the power an electric current possesses to do work. All its energy may be spent in overcoming the resistance of the conducting wire, in which case none will be available to operate a telegraph instrument, give us light or drive an electric fan motor to keep us cool in hot weather, and it is the business of the electrical engineer to so regulate the conditions that everything else is subordinated to the one central object, namely, to get as much current as possible from a given source to the point where it is to be used.

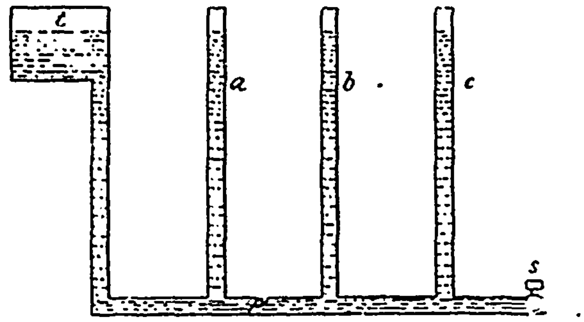


FIG. 2.

The phenomena of electrical potential can be represented graphically in a way that will give us some conception of its nature.

Electricity, however, is something that cannot be seen or felt; therefore it cannot be represented by visible characters, so that we can get some idea of its nature through the eye. For this reason we are compelled to resort to analogy when we desire to illustrate the phenomena of electrical action.

It has been found that water, to a great extent, obeys laws which are very similar to those governing electric currents, and for this reason it is customary to illustrate the action of electric currents by analogy with the action of water under similar conditions.

Fig. 2 shows a tank of water *t*, to which is connected a pipe *p*, having at the opposite end a stop-cock *s*. Along the horizontal limb of the pipe are erected other pipes, *a*, *b* and *c*, in which the water can rise. Now when the stop-cock is closed and the tank is full of water, the water in the pipes and in the tank will be at the same height; under these conditions the same potential exists in the water in the tank and the pipes, but the moment we open the stop-cock and allow the water to escape the conditions are greatly changed, as will be seen in Fig. 3. The potential of the water in the tank will remain the same as it was before, provided that the supply is equal to the waste, to keep it at the same height, but the potential in the pipes decreases to the extent represented by the diagonal line *d*. When the water reaches its lowest level *g*, its potential is said to be zero, and if we tap the pipe *p* at any point along its horizontal length and insert other pipes perpendicularly, the water will rise in each of these to exactly the point where the diagonal line crosses (Fig. 3).

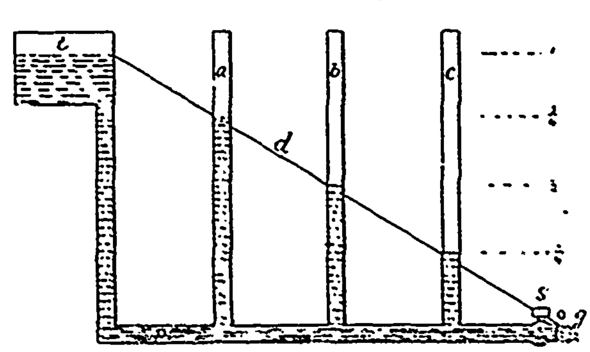


FIG. 3.

By actual measurement it will be shown that the water in pipe *b*, is exactly one-half the perpendicular height of that in the tank, therefore the potential of the water in that pipe is one-half of that in the tank; the potential in pipe *c* is only one-fourth that of the original, and the potential at *a* is three-fourths.

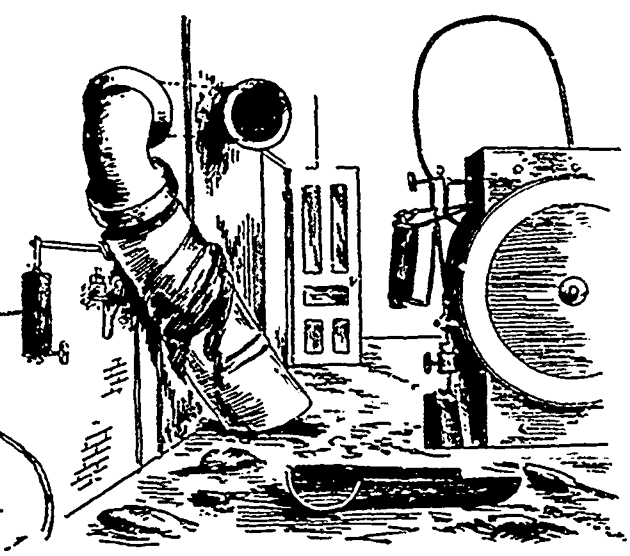
To the beginner this water illustration may seem irrelevant to the subject of this article, but such is not the case, because what is true of the action of the water in these examples is equally true of electricity under analogous conditions. If we now substitute the word "electricity" for "water," and go over the same ground, we have the exact facts before us as to an electric current. In the place of the tank *t* we put the dynamo or battery, or whatever the source of current may be, and connect thereto one end of a wire which will take the place of the pipe *p*, and insulate the further end of the wire; that is, not connect it with anything, but leave it free, hanging in the air for instance, the electric potential at the free end, or at any point along the wire between that end and the source of the current will be the same as that of the source itself, as in the case of the water illustration (Fig. 2). If, however, we connect the free end with the ground or earth at *g*, the potential or electro-motive force will drop at the rate indicated by the diagonal line in Fig. 3 until it reaches the earth, where it will be zero—the potential of the earth being zero.

By taking measurements at any point along the wire the potential will be found to be exactly that shown by the intersection of the diagonal line (drawn from the point of highest to the lowest potential) with a perpendicular drawn from the point of measurement.

We have endeavored in this article to give as clear an idea as possible of the meaning of the term "electric potential" or "electromotive force."—*Electrical Age*

AN ACCIDENT IN AN ENGINE-ROOM.

A short time ago a serious accident occurred in the engine-room of a New England mill, which was instructive enough to merit wider publicity than it has yet had. The engine is a 1, 200 horse power Corliss, and it is supplied with steam by a 14-inch



THE ENGINE ROOM AFTER THE ACCIDENT.

steam main, which enters the room about nine feet above the floor, passing horizontally along the wall for about eight feet, and then turning downward and connecting with a pipe under the floor that supplies the engine from beneath. This main steam-pipe is fed by smaller pipes running into it from each of the ten boilers in the boiler-room, and it is provided with a main stop-valve which is just outside and above the engine-room door, shown in the cut.

The engineer was just starting his engine up in the morning, when, without warning, the eight-foot section of pipe running along the wall (indicated by the dotted lines) burst with a noise like a cannon, and steam at 100 pounds pressure rushed into the engine-room with frightful velocity. The engineer was at the throttle-valve between the two cylinders (to the right of one shown in the cut), and the powerful current of air and steam rushed against him bore him helplessly across the engine-room, by a door that our artist has not shown. He struck the casing of the door, succeeded in gaining sufficient footing to jump out instead of being blown out. The ground is twenty feet or more below the floor still, and the engineer says it seemed fully a minute before he landed. His right knee was badly sprained by the fall, but he hobbled around to the boiler-room, and with the assistance of the two firemen, tried to close the main stop valve over the engine-room door. This was a difficult thing to do in the blinding blast of steam that issued from the engine-room, and the effort proved fruitless. The valve failed to work, and the smaller stop-valves on the individual boilers had to be closed before the draught of steam could be checked.

When the engine-room could be entered it was found that the heat of the steam had unsealed the automatic sprinklers on the ceiling, and a perfect storm of water was pouring down on the engine. The water supply was shut off, and the engine was examined and found to be uninjured, save for some rust that afterwards formed on the wet metal.

The large cast-iron main that had burst was found to be split in halves, lengthwise, and fragments of it lay about the floor. An examination of the large piece shown in the foreground of the cut revealed the cause of the accident. On either side of this piece, where had been the parting of the mold, the casting was defective, and for perhaps four feet on both sides the metal was hollowed and blown, so that there was no union whatever, the casting being held together by a scale of iron hardly a sixteenth of an inch thick in places, and hardly an eighth of an inch thick is most of its length. The upright length of pipe that ran down through the floor was blown over about six feet, so that the joints and valves under the floor were badly twisted and bent. Fragments of the bursted pipe struck and ruined the valve oiler on the cylinder, and a Locke damper regulator on the wall was also broken, the weights belonging to it being strewn all over the engine-room floor. One weight, weighing about ten pounds, was driven across the room and inbedded in the wall, making a hole eight inches deep and a foot in diameter.

The engineer was carried to his home after the accident, and it was found that his injuries, although serious and painful, were not fatal.

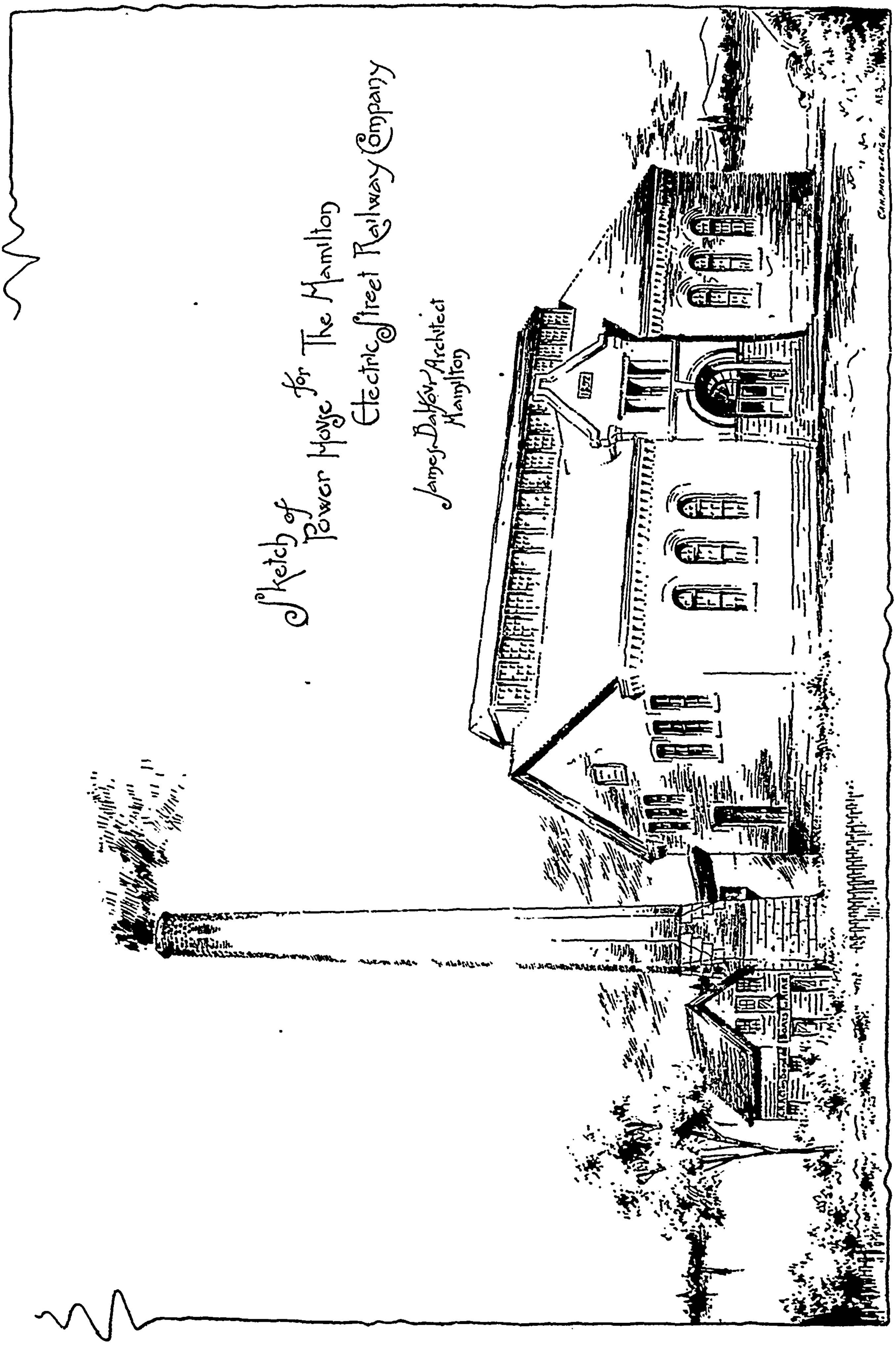
The moral of this accident is, that cast-iron ought not to be used for large steam mains carrying heavy pressures. Certainly, such pipes ought not to be used unless they have been thoroughly tested hydrostatically and with the hammer; and our opinion is, that wrought-iron pipes are always much safer and better.

While the failure of this pipe was due to its inherent weakness, accidents of a similar nature are often caused by the pipe being improperly supported. Supports provided for main steam pipes should receive the most careful attention, especially if the pipe is a long one. Steam pipes are exposed to great variations in temperature, and the consequent expansion and contraction is often very considerable, and needs to be properly provided for. —*The Locomotive.*

LIABILITY OF TELEGRAPH COMPANIES.

In a suit for damages, recently brought for delay in the delivery of a message announcing the death of the father of the plaintiff's wife, it appeared that had no delay occurred the plaintiff and his wife could have reached the place in time to aid and direct the funeral and burial, going by train, but owing to the delay they were only able by private conveyance to reach the place in time to meet the burial procession. The telegraph company admitted liability for actual damage in the extra expense of the trip, but denied liability for injury to the feelings. The Texas Commission of Appeals, Section A, held (Western Union Telegraph Company vs. Erwin) that it was the right of the plaintiff and his wife to be present before the funeral, and to aid and direct it; that the delay was the direct cause why they were deprived of this privilege; that the injury to feelings and mental suffering sustained in being deprived of this right was but the effect occasioned by the wrongful failure of the defendant to perform its duty, and for damages resulting therefrom the defendant was liable.

Induction is a wide subject. The telegraphist both uses and endeavors to get rid of it, the telephonist depends entirely upon it, and his subscribers vilify it, while the electric light installer finds it necessary to eliminate it here and appropriate it there. We now have a system from Edison of telegraphing without wires between elevated surfaces, the whole intervening space being rendered inductively active at will by an interrupted current. What limits are there to the effects of electrical induction through space, or action at a distance, and what may not come of it?—*The Engineer* (London).


Sketch of Power House for The Hamilton
Electric Street Railway Company
James Balfour Architect
Hamilton

HAMILTON ELECTRIC STREET RAILWAY POWER HOUSE.

The accompanying illustrations represent the now power house of the Hamilton Electric Street Railway. The building is constructed of red brick, on a stone foundation, and is situated on Cruise street, foot of Hughson street, on the shore of Hamilton Bay. Thus facilities are afforded for the direct landing of coal from the boats and an abundant supply of water for condensing and other purposes.

The engine and dynamo house is 64 x 102 feet, and the boiler house 40 x 102 feet. The chimney stack reaches 140 feet in height, the foundation being secured by cement and spiled.

The motive power consists of three Wheelock tandem compound condensing engines, 260 h. p. each, manufactured by the Goldie & McCulloch Co., of Galt, three 250 h.p. Westinghouse dynamos, supplied by Ahearn & Soper, of Ottawa. Two of the dynamos are kept constantly in use, the third being in reserve. There are six boilers, supplied by the Goldie & McCulloch Co., four of which are in operation and two in reserve. Generators, two in number, have a capacity of 250 h.p., and are called upon to operate at times 26 cars and 10 trailers.

A special feature is the belting of the dynamos direct from the engine fly-wheel, the pulleys employed ranging in size from 18 feet down to 34 inches.

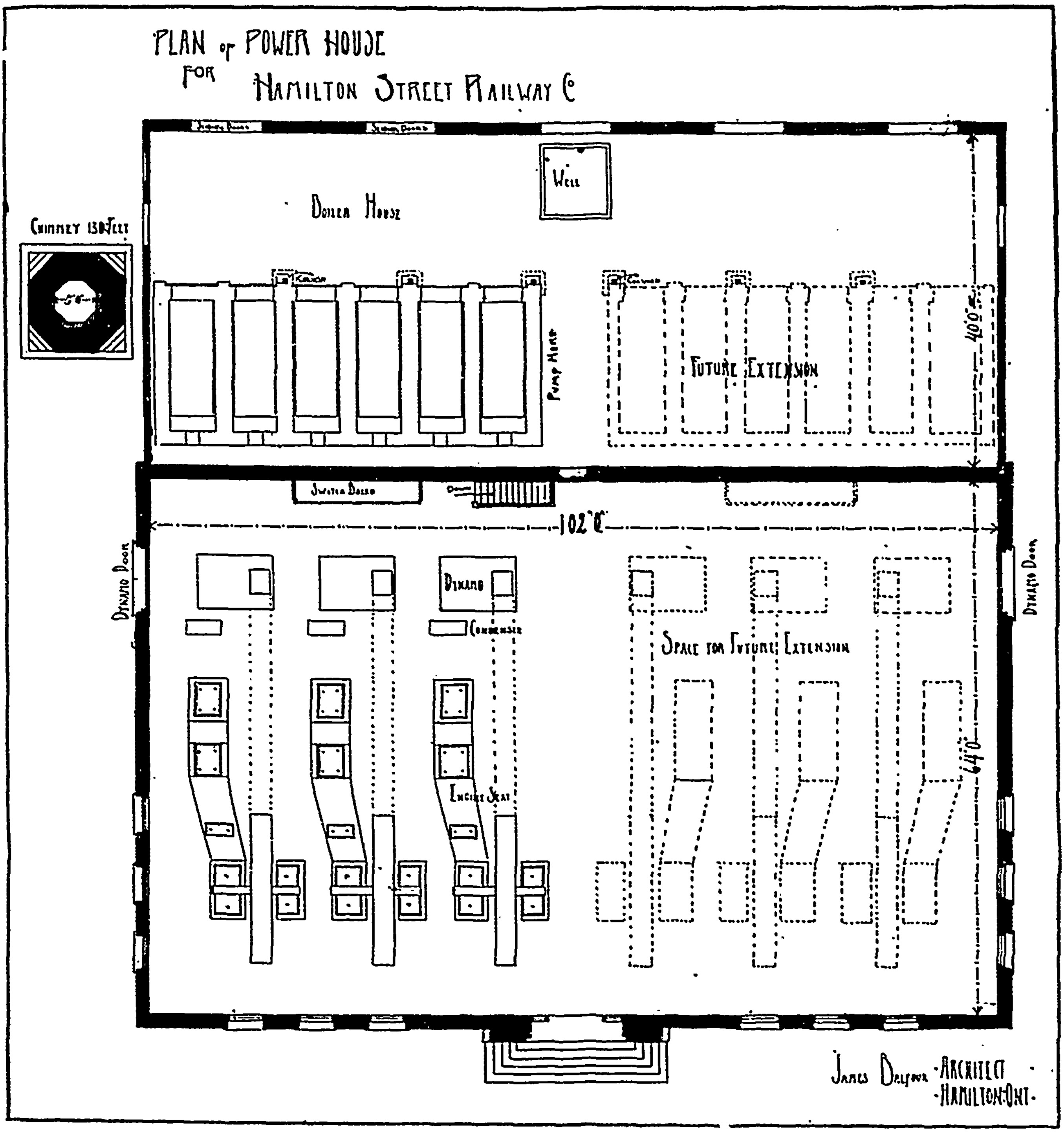
The switchboard is of mahogany. All the apparatus connected therewith is perfectly insulated.

The wires are encased in wood sheeting the entire length of the power house, with doors for access. The Edison Co.'s wire is used—No. 0000 cable.

Only about one-half the space in the building is at present utilized, the remaining portion being available for future increase of plant.

The installation of the plant was done under the supervision of Mr. R. S. Fiecht, electrician for the Westinghouse Co., of Pittsburgh. Mr. Potter is chief engineer.

It is the intention to extend the water intake pipe further into the bay, as under present arrangements the water has proved to be too warm for condensing.



PERSONAL.

An invitation to attend the annual clam bake, under the auspices of the Eugene Phillips Electrical Works, found its way to us while rusticating in the wilds of Muskoka. Unfortunately for ourselves there was no fast train available to convey us to the scene of festivity, but we do not doubt that to many more favorable circumstanced, the occasion was one of much pleasure. Mr. John Carroll, of the Canadian branch, was one of the committee of management.

The cross-head sometimes gives trouble. When it slips up and down between the sides, and is loose, it shows that it has worn the lower brasses, and as a consequence the piston has dropped and is out of line. This has a tendency to cut the piston, and if out of line to a great extent, will cause very serious trouble. Liners should be put in and the cross-head properly raised until it is not loose.

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

By William Barnet Le Van.

(Continued from June Number.)

AN IDEAL SAFETY VALVE.

The theoretical action of an ideal safety valve would be to prevent the slightest accumulation of pressure above the amount intended and not to contribute to the falling of the pressure below that amount; that is to say, the moment the normal pressure began to be exceeded, the valve would rise to admit the escape of steam, and would rise to just the extent necessary to allow the proper quantity of steam to escape, and the moment the tendency to undue accumulation ceased, the valve would close; and at all intermediate stages of time between its first opening and its closing, the amount of opening would be exactly proportioned to the surplus steam formed. Practically, we know it is impossible to construct such a valve, the first difficulty we encounter being the friction of the valve and its holding-down apparatus, which prevent the valve rising until some slight accumulation of pressure has taken place, and which prevents its closing until the pressure has fallen somewhat below the normal point. In practice, a valve never presents at its first opening sufficient orifice for the escape of all the surplus steam the boiler can generate, but it is only after the pressure has risen somewhat above the point necessary to open the valve, that the orifice becomes sufficiently large. The cause of this is generally understood to be that the further the valve rises from its sit the greater is the decrease of pressure due to the issue of tha steam compared with the pressure inside the boiler, therefore the greater the height to which it is necessary to raise the valve the greater the surplus pressure in the boiler must be to raise it, and thus, to give sufficient area for the discharge of all the steam a boiler can generate, the pressure must rise in the boiler above the intended limit—that is, above the point at which the valves are arranged to begin to blow off.

THE FIRST EXPLOSION BY AN OVER-WEIGHTED SAFETY VALVE.

Dr. S. Gravesande, secretary of the Dutch embassy, who were in England in *1716*, saw Captain Savery's pumping engine, and afterwards had one erected for a friend. He gives the following description of the boiler exploding—the first on record:

"The boiler was made spherical. Upon the safety valve there was a steelyard, the place of whose weight shows the strength of the steam, and how high it was capable of raising water (24 feet high). But when the weight was at the very end of the steelyard, the steam then being very strong, would lift it up, and go out at the valve rather than damage the boiler. But a man who was entirely ignorant of the nature of the boiler, without any instructions, undertook to run it, and, having hung the weight at the further end of the steelyard, in order to collect more steam to make his work quicker, hung also a very heavy plumber's iron upon the end of the steelyard. The consequence proved fatal, for, after some time, the steam, not being able, with the safety clack, to raise up the steelyard, loaded with this unusual weight, burst the boiler with a great explosion, and killed the poor man in attendance, by the pieces that flew asunder, there being otherwise no danger, by reason of the safety valve being made to lift up and open upon occasion."

VACUUM VALVES.

A vacuum valve is a safety valve, opening inwards, for admitting air and preventing collapse in the shell when the pressure in the boiler is much less than that of the atmosphere. Falling of pressure in the boiler may arise from condensation of steam by gradual cooling after the fires are withdrawn.

THE DEVIL RAN AWAY WITH THE SOUP.

The advantage of having vacuum valves on steam boilers and steam supply pipes, is best illustrated by W. F. Durfee's description of how the devil ran away with the soup from the kitchen at the old City Hospital, which formerly stood for many years on the west side of Broadway opposite Pearl street and between Duane and Anthony streets, New York city.

Mr. Durfee says: "About the year 1850, I accompanied my father to New York, his purpose being to visit some of the public institutions with a view of studying the various methods then in use for cooking and heating by steam, and among other places of note we went to the above named hospital, whose superintendent very courteously showed us through the building and explained the system used for heating, ventilating and cooking. When we came to the kitchen, we found three (I distinctly remember that they seemed to me enormous) large iron caldrons grouped together in the centre of the room. These were provided with wooden covers having hinged lids, and we were told that they were used to boil the soups and meats by blowing steam directly into them through a pipe which entered the centre of their bottom. On my father inquiring if that method was found to be satisfactory, the superintendent replied: 'Yes; except one instance.' He then told us that one day the chief cook (who was a Frenchman) came rushing into his office with every hair on end, and his face livid with fright, exclaiming: 'Monsieur! sacré Moise! ze diable avez rund away mit mon soup. Zer es not un piece of ze soup; ze diable avez him entierement. Ah! Monsieur, wit me come, vouz sal see wiz vouz eye. I say ze vérité. Parbleu! Monsieur, et es ze grand Satan!' I supposed, said the superintendent, that my cook was either insane or drunk, but I accompanied him to the kitchen, and on lifting the lids of those kettles, there was not one drop of soup to be seen, and only a few grains of rice to show that there had been any there. Voila! vous zee vat I tell'd vouz; zee diable il a ze soup! Sacré Moise, vat sal ve do?' exclaimed the cook, and I had began to think that his theory had appearances to justify it, if nothing more, and I certainly had no explanation of my own ready for the occasion. However, investigation was in order, and its result showed that the cook was not far from right, for we very promptly discovered that the fireman was dead drunk, and, of course, had allowed the fire under the steam boilers in the cellar to go out, and as the boilers cooled, a vacuum was formed in the place of the steam, due to its condensation by the cold air surrounding the steam pipes and the top of the boiler, and as a consequence all the soup intended for that day's dinner had been drawn into the steam space of the boiler to satisfy its hunger; so the incarnate devil of drunkenness, in the person of the fireman, had deprived the establishment of a very important part of that day's dinner."

The lesson taught by this experience, is to be sure and put vacuum valves on boilers and check valves on steam pipes, when used under similar conditions. Probably the colloquialism, "In the soup" may have had its origin in the kitchen of the New York City Hospital forty years ago.

ATMOSPHERIC PRESSURE ON SAFETY-VALVE DISK.

The effect of atmospheric pressure on a disk can best be illustrated by the following simple experiment: If any one will take a piece of writing-paper about one inch in diameter, and place it on the open part of the head of a common tobacco-pipe, and insert in the paper three small pins as guides, he

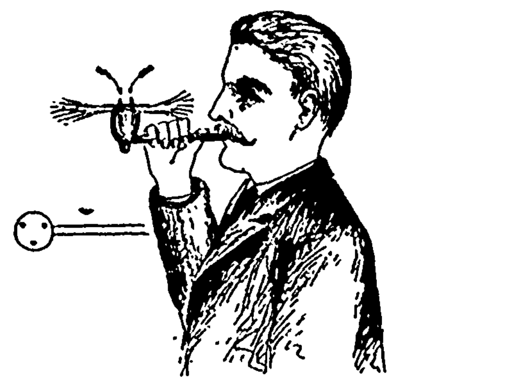


Fig. 55.

will find it utterly impossible to blow the paper disk off the pipe by blowing down the stem. By reversing the pipe while blowing, the paper will not fall off, but in this position the moment one leaves off blowing it will drop. A disk of metal may be suspended in the same manner.

This phenomenon in steam was first observed by Clement Desormes, who communicated it to the Academy of Sciences of Paris, on the 4th of December, 1826. He observes that "when steam is compressed in a boiler so that a strong current is made to blow out through a small orifice, a metal plate or disk, on being presented at a little distance from the orifice, is forcibly repulsed; but if it is brought near, and pressed so as nearly to close the orifice and cause the steam to escape in a star-like form around the outside of the disk in radiant directions, an external pressure will be found to act upon the disk, and it can only be set at liberty by forcibly raising it."

On the facts observed by M. Desormes, Jacob Perkins makes the following remarks: The steam forces off horizontally in every direction, as M. Desormes observes, in a star-like form. Now, as a strong current of air will be created by the velocity of the steam, and pass off with it, the surrounding air will follow, and in its course, as in Fig. 56, it will impinge on

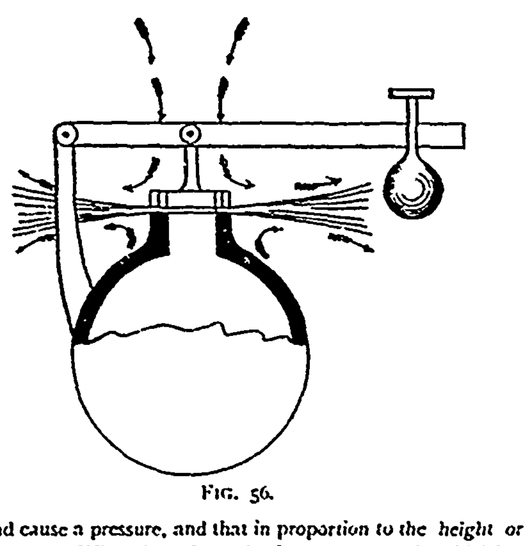


Fig. 56.

the disk and cause a pressure, and that in proportion to the height or velocity of the steam. When the safety valve is so constructed—which is sometimes the case—as to allow the steam to pass off in a horizontal direction, the pressure will be greater than when the valve is conical, which gives a different direction to the steam, as in Fig. 57, making it more difficult for the air to impinge upon the valve."

The peculiar behavior of a ball placed within the influence of either a vertical or inclined jet, was noticed by Professor Leslie, of Edinburgh, in 1825, as already mentioned; and Professor Faraday delivered a lecture at the Royal Institution, sometime between the years 1825 and 1829, in which the general action of jets upon the surrounding air, and, through this medium, upon balls and disks, was discussed. The "pneumatic paradox," in various forms, was illustrated in vols. IX. and XI. of the London *Mechanics' Magazine*, for the years 1828 and 1829, and received the attention of Professo and other writers in the early volumes of *Silliman's Journal* and the *Journal of the Franklin Institute*. In the second edition of "The Boy's Play-Book of Science," published in 1860, Professor Pepper, in speaking of currents of air that are dragged into an escaping jet of steam, says: "This tendency of the air to rush into a jet of steam, was discovered by Faraday, and explains those curious experiments with a jet of steam by which balls, empty flasks, and globular vessels are sustained and supported either perpendicularly or horizontally. If steam, at a pressure of about 60 pounds

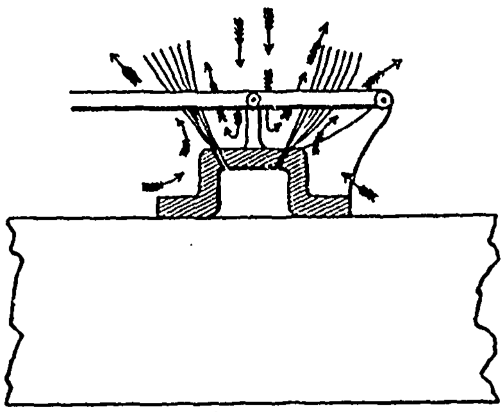


FIG. 57.

per inch, is allowed to escape from a proper jet, and a large lighted circular torch, composed of tow dipped in turpentine, is held over it, the course of the external air is shown by the direction of the flames, which are forcibly pulled and blown into the jet of steam with a roaring noise, indicating the rapidity of the blast of air moving to the steam jet."

Fig. 58 shows a jet discharging high-pressure steam; B, B, lighted torch held around the escaping steam. The flames from the latter all rush into the former. Egg shells, empty flasks, India-rubber or

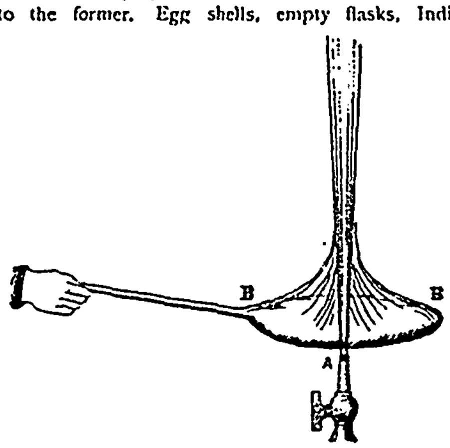


FIG. 58.

light copper and brass balls are suspended in the most singular manner inside an escaping jet of high-pressure steam, and before the explanation of Faraday reams of paper were used in the discussion of the possible theory to account for this effect; and what made the explanation still more difficult, was the fact that the jet of steam might be inclined to any angle between the horizontal and perpendicular, and still hold the ball, egg shell, or other spherical figure, firmly in its vapory grasp.

Fig. 59 is a ball-and-socket jet at an angle, and discharging steam. The egg-shells are supported by the enormous currents of air moving into the jet in the direction of the arrows.

In the latter part of the last century, the "principles of the lateral communication of motion in fluids," were investigated very thoroughly by

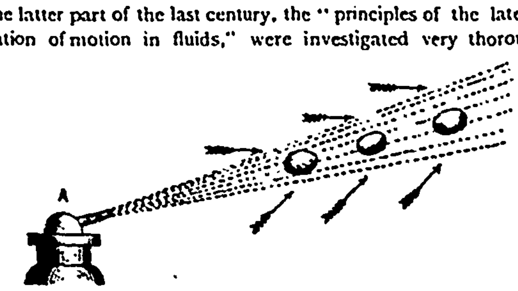


FIG. 59.

Professor Venturi, of Modena, and it is the action of the jet on the surrounding air, in accordance with the principles elucidated by him, that the support of the ball in all cases depends. The peculiar action of "induced lateral currents" of air is well illustrated by a simple experiment: Take a piece of ordinary writing-paper, roll it around a common lead pencil, and confine its outer edge with paste or gum, and on withdrawing the pencil you have a paper tube. Cut a circle of about 2½ inches across, out of a stiff card, and pierce its center with a hole about one inch in diameter; now attach the paper tube to the centre of the card by some sealing wax, and near the edge of the side opposite to that occupied by the tube, place three small drops of sealing wax at equal distances from each other; then cut another circle of card of the same size as the first; on putting this card on the drops of sealing wax before named, inverting the whole apparatus, and blowing forcibly through the tube, as shown in Fig. 60, it will be found to be impossible to displace the card, but as soon as the blast of air ceases the card will drop of itself; this is one form of the "pneumatic paradox" so called, and the support of the card is due entirely to the action of "lateral" or "induced currents" of air.

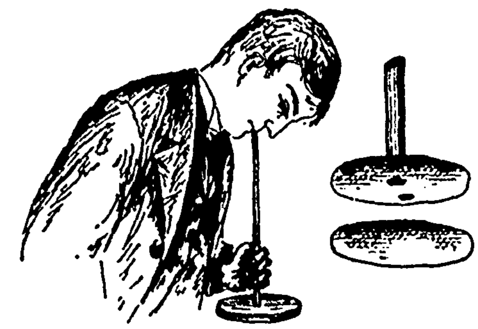


FIG. 60.

At the Centennial Exhibition at Philadelphia, in 1876, the curious phenomenon was shown of a ball sustained by an inclined current of air, which was shown in the exhibit of the Westinghouse Air-Brake Company. This company had a receiver filled with compressed air, at about 70 pounds pressure to the square inch. When the brake on exhibition was not in operation, the air of the receiver, being continually supplied by an air pump, was allowed to escape through a nozzle of about ⅛ inch bore, set to a vertical inclination of about 30°. Over this jet of air was placed a ball (see Fig. 61), which remains afloat in the air without any visible means of suspension. There were five balls;—first, a solid glass ball of 1½ inch diameter; second, two solid wooden balls of 3 inches diameter; third, one hollow rubber ball of 3 inches diameter; fourth, one hollow rubber ball of 5 inches

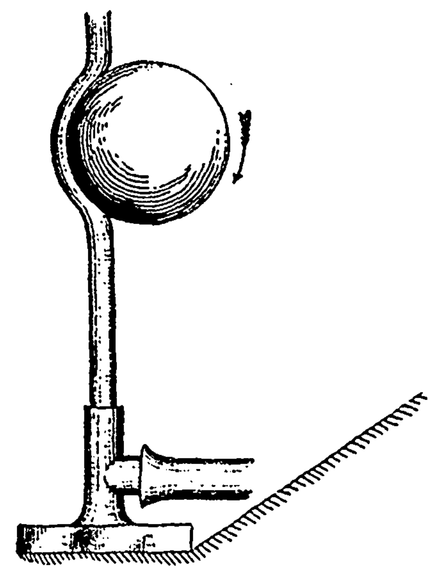


FIG. 61.

diameter. Each of the above balls, when placed in the air jet, showed this phenomenon.

Even more curious it appears when two balls are suspended simultaneously; the current of air, after leaving the small glass ball, being sufficiently strong to give support to the largest (5 inches in diameter) of the rubber balls. The impression this experiment created was very striking indeed. As a rule, the suspended ball rotates very rapidly in the direction shown by the arrow, but sometimes it remains stationary, owing to the fact of the center of gravity not coinciding with the geometrical center; for the same ball once

FIG. 62.

made to rotate by an external force, will continue the rotation with increased speed. The vertical inclination of the jet may be changed to about 45° before the ball loses its state of suspension and drops off.

A similar phenomenon—a ball dancing on top of the water-jet of a fountain—is often seen, and will likewise remain sustained if the jet is more or less inclined. (See Fig. 62.)

(To be Continued.)

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

At the last regular meeting, July 8th, of Toronto No. 1, C. A. S. E., the following officers were installed, (having been elected at the previous meeting): —A. E. Edkins, Past President; W. G. Blackgrove, President; Wilson Phillips, Vice President; E. Phillip, Secretary; C. Moseley, Financial Secretary; A. M. Wickens, Treasurer; W. Buttler, Conductor; J. Fox, Doorkeeper; Trustees, W. G. Blackgrove; W. Lewis; C. Heal.

After installation, Bro. Edkins being called upon, for a few remarks, replied as follows:

"When I was elected to the office of president of this association some two years ago, I was very doubtful as to whether or not, I was qualified to fill such a position. I was conscious of not having had any experience in an office of the kind at the time, and as I then said, I felt that there were many members of the association who were in every way better qualified. However, I did my best for the year I was elected, and it was a matter of pride to me when I was elected for a second term, as I was then satisfied that I had filled the office satisfactorily.

Now that my term of office has just closed, and my successor in office has been appointed, I want to express my thanks to the officers of this association who held office during the past two years, for the very kind treatment and assistance which I have at all times received at their hands, and though, of course, we have had differences of opinion at times, yet we have at all times, as the saying goes,—"Agreed to disagree." At the same time I I am constrained to the belief, that, no matter how many our differences of opinion may have been, everyone had the welfare of the association at heart.

This association is one of the grandest things for engineers on this continent. I never knew the good that was being done indirectly by this body, until I entered my present employment. The engineers in the country are waking up, and commencing to realize the fact that to be a successful engineer a man must know something more than how to shovel coal. I claim that this association is and has been the cause of this good work. Engineers read of our meetings in the papers, and are beginning to see that it is only a matter of time until every engineer will have to give proof of his knowledge of steam boilers and engines. Many of them are acting accordingly, and preparing themselves for examination. Of course there are men (and plenty of them) who would not prepare themselves if they knew for a fact that an engineer's license law would come into force next month; they would rather trust to some streak of luck, such as a good word from their boss, to get them a certificate. But when the time comes, these men will be "in the soup." By this I do not mean to say that men past the middle age, and who got no education when young, should be deprived of employment - far from it. I would fight for these men to have a certificate on passing a verbal examination, and producing proof of the number of years of their service as engineers. But I do maintain that the young men who have made up their minds to follow steam engineering for a living, and yet do not take any steps to post themselves in their business, will have only themselves to blame, when the day comes, that someone is appointed to question them and find out what they know.

But I am drifting a long way from what I started to speak on. We have only to stand by each other, and remain true to our obligation, to come out at the top. We must let no petty jealousies arise between us: if we do, they will do our organization more harm, than all our open enemies combined. Let us keep these points in view, and remember the fact, that, our employer's best interests are in the long run, our own. By studying his interests, we can as a rule, best convince him of our worth, as many engineers whom I could name have done, and have been rewarded by better wages.

In conclusion, I thank the members and officers of this association for the honor they have done me in electing me as president for the past two terms, and I can assure you that I shall always look back upon that time with a great deal of pleasure. I wish the association every success during the term we are now entering upon.

Presidents Blackgrove and Phillips promised to stir up old Toronto No. 1, during the coming year, so that the prospects are for a bright and prosperous year. The reports of committees show the association to be in good standing both financially and otherwise. During the past year the association has had many applications for engineers; the employers are beginning to see that it pays them better to have thoroughly posted men to handle their engines and boilers.

During the past year the associations at considerable cost purchased an indicator and planimeter for the free use of its members. A large number of the members have taken advantage of this, and have become thoroughly posted in its use. In some cases quite a saving of fuel has been effected by the application of this indispensable little instrument.

The annual union picnic and games of Toronto, Hamilton, Brantford, Stratford, and London associations, was held July 1st, at Dundurn Park, Hamilton, when a large number of prizes were competed for. The event of the day seemed to be the ladies race, open only to engineers' wives. Mrs. Bain, of Toronto, secured the first prize, a beautifully figured card receiver, presented by Ryrie Bros., Toronto. Among other contributors to the prize list were the following prominent engine builders: Goldie & McCulloch, Galt; Inglis & Sons, and the Polson Iron Works, Toronto. The thanks of the association are extended to all, who, by contributing to the prize list, assisted in making the occasion a success.

HAMILTON NO. 2, C. A. S. E.

Editor ELECTRICAL NEWS.

DEAR SIR, - At the last meeting of the above association held on July 15th, the officers elected for the ensuing year were installed by Brother J. Langdon. All the old officers retire except Bro. Langdon and Nash, the former as Conductor and the latter Financial Secretary.

After the new officers were installed they were called upon to make a few remarks, which they did, thanking the brethren for placing them in the different offices and promising to fulfill the duties to the best of their ability, also to try and keep the name of No. 2 to the front as it always has been since organization. A vote of thanks was tendered the retiring officers, which was responded to by the president, Bro. P. Stott.

Brother Langdon gave some good advice to the new officers and also to the members.

The officers for the ensuing year are; Bro. Sweet, President; Bro. Cherriton, Vice President; Bro. Langton, Conductor; Bro. Johnson, Recording Secretary; (Bro. Robb, who has held the position for four years, retiring); Bro. Nash, Financial Secretary; Bro. Nash, sr., Treasurer; Bro. Marshall, Door-keeper; Bros. Mackie, Dickenson and Robb, Trustees.

Fifteen new members have been admitted during the past year, and there are three applications in for membership.

Yours truly,

E. C. J.

LONDON No. 5, C. A. S. E.

Editor ELECTRICAL NEWS.

DEAR SIR, The members of the various Associations of the C. A. S. E. in the Eastern part of the country will be glad to hear of the re-organization of London Association, No. 5. This Association was first organized on April 15th, 1890, and gave promise of being a useful and healthy institution, but unfortunately, after one year of existence the meetings became so poorly attended, that the few members who remained constant in attendance, decided that it would be best to discontinue the meetings until a re-organization could be brought about.

Bro. A. E. Edkins, ex-President of Toronto, No. 1, and who now fills the position of Inspector for the Boiler Inspection and Insurance Co., has been here on business for his company, and some of the old members of No. 5, (thinking this would be a good chance to get some help toward re organizing) held a meeting and invited Bro. Edkins to attend. At this meeting it was decided to send out notices to the Engineers, asking them to attend a meeting on Thursday evening, July 21st, at 8 p.m.

At the time mentioned about twenty engineers put in an appearance, many of whom had not been members of the Association before. The meeting was called to order by Bro. Geo. Taylor, after which Bro. Edkins was asked to preside.

Bro. Edkins proceeded to explain the aims and objects of the Association, and gave a review of the work which had been done by the C. A. S. E. during the past five years. The engineers present were then asked, if all would rise to their feet who had made up their minds to become members, and every man in the room but one complied. After the Secretary had received the entrance fee from each of the new members, they were conducted by Bros. Taylor and Mungal, before the chair for initiation, the obligation being given by Bro. Edkins.

Nominations and election of officers followed and resulted in Bro. F. Mitchell, (Head Engineer, Dominion Oatmeal Mill), being elected President; Bro. T. Mungall, Vice-Pres.; Bro. J. McIntosh, Rec.-Secretary; Bro. Geo. Taylor, (Engineer *Advertiser* office), Treasurer; Bro. Powell, Conductor; Bro. Gilbart, Door-keeper; Trustees, Bros. Teen, Patterson and Westhead. The officers were then installed by Bro. Edkins.

President Mitchell made a neat speech, thanking the members for the honor they had done him, assuring them that he would do everything in his power to make No. 5 Association a success, and asking for the hearty co-operation of all present, in building up an organization of which they all might be proud.

A committee was appointed to secure a blackboard and question box. Bro. Edkins paid his entrance fee and was received as an active member of No. 5. The meeting adjourned to meet at 8 p.m. on the first Thursday in August.

There are many more good practical engineers in London who have signified their intention of becoming members, and, taking everything into consideration, No. 5 starts out with encouraging prospects.

Yours truly,

FOREST CITY.

ELECTRICAL ENERGY.

Whenever a current of electricity flows a certain amount of energy is expended, and it is necessary to be able to measure exactly the amount of energy so expended in any circuit or in any part thereof. The quantity of work performed in raising a mass of one pound through a difference of level of one foot against the force of gravity is generally taken as the unit of mechanical energy, and is known as the foot-pound. The work done in raising any mass through any height is found by simply multiplying together the number of pounds in that mass by the number of feet through which it is lifted. Somewhat similarly we can take, as the practical unit of electrical energy, the amount expended in transferring a unit quantity of electricity (one coulomb) through a difference of potential of one volt. And by multiplying the number of coulombs, which have flowed from one point to another by the difference of potential in volts between those points, we obtain the number of units of electrical energy expended during the passage of the current. The unit of electrical energy, or one coulomb multiplied by one volt, is called the joule. As a simple numerical example, we may suppose a current of 10 ampères to flow for 5 seconds, then the quantity of electricity passing through the circuit would be 50 coulombs, and if this current were maintained by a potential difference of 8 volts, the amount of energy expended in that time would be $8 \times 50 = 400$ joules.

As a rule, we wish to know the *rate* at which work is being done in any circuit rather than the amount which is done in a given time. It is evident that this rate can always be found by dividing the amount of work by the number of seconds taken for its performance; but the same same result can be arrived at by multiplying together the potential difference and the rate of transference or flow of electricity instead of the quantity actually transferred in a given time. Now the rate of flow of electricity is what we know as the current strength, which is measured in ampères. Therefore, if the difference of potential in volts, between any two given points is multiplied by the resulting current in ampères the product gives the rate at which energy is being expended, or the rate of working between those two points. The unit rate of working or the unit *of power* is called the *watt*—that is to say, 1 ampère × 1 volt = 1 watt. Therefore, if a difference of potential of 20 volts between the ends of a wire maintains a current of 3 ampères the rate of working is $3 \times 20 = 60$ watts.—*Electrical Age.*

GROUNDS.

BY R. E. DALLAS.

It is surprising to find in so many cases the omission, among the instruments on electric light station switch-boards, of any form of ground detector, the nearest instrument to it being the lightning arresters, which generally abound in number but serve for an entirely different purpose. Probably some are under the erroneous impression that grounds, and by grounds we mean leaks to earth or escaping currents, are of little or secondary importance and take care of themselves, while others, no doubt, consider them too difficult and expensive a matter to keep track of. For all such it is a pity that electricity was not favored with some sort of an odor, for instance, something similar to that of our ordinary illuminating gas, in which case leaks, etc., would probably be more frequently and speedily remedied.

The writer has in mind one large central station using low tension continuous incandescent current; the street feeders, mains etc., are run with bare copper, trees lie along the route of the poles, and in summer the wires are *insulated* with a dense covering of the green foliage; a wet night comes along, the lights burn cherry red, the fireman gets no chance to sleep, the consumer complains of unsatisfactory service, and the stockholder expects large dividends, with about one-half the station's output returning to mother earth, from whence it came, in the shape of coal. Surely this is a case of "dust returning to dust," and such an example ought to impress interested parties with the necessity of a high grade of insulated wires, and lines free from all grounds. Otherwise they always mean more steam coal, money, less dividends, and are like bad weeds which grow rapidly with out any fostering and no nourishment save that of the current.

New electric light companies should profit by the experience of their elders and "nip the evil in the bud" by starting in with clear lines and keeping them clear, which, of course, requires some little attention and care, but in the end undoubtedly pays. The mains being clear no service should be connected until they have been thoroughly tested and found clear. Experience teaches, also, that a few cells of some good type of battery and a galvanometer are much preferable to the magneto, ordinarily used in practice, and with the former much more accurate results will be obtained. This, together with some commerical form of wheatstone bridge and galvanometer are all the instruments required for ordinary testing.—*Electricity.*

TRADE NOTES.

Messrs. Darling Bros., of Montreal, manufacturers of the celebrated Claussen Clutch pulley and cut-off coupling, report the following recent sales: Grand Trunk Railway, Montreal, one 30" × 7" clutch pulley; Edison General Electric Co., one 66" × 10" pulley; The Rathbun Co., Belleville, one 40" × 12" pulley; Peck, Benny & Co., Montreal, two 36" × 12" pulleys; Citizens' Light and Power Co., three 300 h. p. clutch couplings.

It is customary, says the *Stationary Engineer*, to proportion the safety valve of a boiler to the amount of grate surface, allowing an area of one-half square inch in the valve, to one square foot of grate surface, but this can never be considered wholly reliable, as it does not consider the rapidity with which steam may be produced.

There is more trouble, in certain classes of engines, with the crank pin than with all other parts. If it gets hot, look carefully to the lubrication, and if the oil feeds properly you will probably find that the brasses are cutting. When this is found to be the case, take off the brasses, and if the pin is not much cut, use emery paper on it until smooth, or file it if necessary. Also file the brasses. If it is quite loose new brasses should be put on, and if they can not be had, the best thing to do is to drill holes in the brasses and pour in babbit metal. This often makes a better job than new brasses, but should be done carefully. The babbit plugs may slip out if not hammered in. If you want to fix them in so tightly that they can not come out by any means, drill your holes with a drill ground off at one side, so as to make it crooked, or larger at the bottom than the top.

SPARKS.

A branch of the Thomson Electric Welding Co. of Boston, has been recently established in the works of the Dominion Wire Co., Lachine, Que.

The Quebec & Levis Electric Light Co. has again secured the contract for lighting the Ancient City, at the price of $80 per light per annum.

The city street-car system of Quebec is to be improved and extended. Electricity will be partially adopted. The undertaking will probably not be commenced until next year.

Low speed dynamos are found more advantageous, in the long run than those operated at a higher speed. There is less wear and tear, consequently less repairs, and they require less attention.—*Stationary Engineer.*

The meaning of the term *earth* or *ground* in connection with an electric circuit, has been decided in the Lane-Fox trial in London, to embrace any return circuit whether connected to earth or carried by bare or insulated wires. Prof. Perry stated at this trial that *earth* was the technical term for a return conductor of any description and while strictly speaking this is probably correct, it is hardly the meaning ordinarily attached to the term in this country, and would cause confusion if not explained in every particular case.

A SINGULAR FATALITY.

The strange case of James Grant, a lineman employed by the Chicago Telephone Company, has excited much interest in Chicago. During the thunder storm of the afternoon of Monday of last week Grant had occasion to ring up the central office from the station at West Fortieth and Lake streets. A peal of thunder, following quickly upon a flash of lightning, rang out as he had the receiver to his ear. He fell to the floor. The bystanders ran to help him and found him breathing heavily and unconscious. He was taken to his home near by. Doctors came promptly. Efforts to restore him to consciousness were useless, and he lay insensible until Tuesday. When at last he awakened from the stupor his first words were : "Hello, ring off!" and this he muttered day and night. It was evident that the unfortunate man had become insane, and on Wednesday night he became violent, still laboring under the delusion that he was at the telephone. It was necessary to summon help from the neighborhood to restrain him. All night long he muttered, "Hello, ring off!" at intervals making frenzied attacks upon the men who were holding him in bed. The patrol wagon was called on Thursday morning and he was carried, feebly fighting, into a ward at the detention hospital. Throughout the day the afflicted man struggled pitifully with his delusion, and at 6 o'clock it was necessary to administer quieting medicines in order to get him to bed. At 9 o'clock he was quiet at last and breathing easy, with a decreased temperature. Twenty minutes later he aroused himself shouting, but without attempts at violence. The attending physician was called, and, as Grant's voice seemed to grow fainter, he found his pulse failing with it. At 10:25 o'clock, still persisting in his cry of "Hello, ring off!" sunk to a whisper, James Grant died.

The case is a mysterious one, and it is not known whether the lightning itself or the fall to the floor was the cause of the insanity and subsequent death. There are several instances recorderd in medical journals where persons have been rendered delirious by shocks of lightning, but none is known precisely parallel to Mr. Grant's sad fate.—*Western Electrician.*

Many persons imagine that the electric light gives no heat, and are much puzzeled when told that the electric arc is the highest temperature known at the present day. It is perfectly true that arc lights are cool for illuminating purposes, for the actual mass raised to so high a temperature is extremely small for the enormous amount of light given out. It must also be borne in mind that arc lamps give off noxious nitrogenous fumes which are very noticeable in confined situations. Incandescent lamps emit absolutely no fumes, since they are hermetically sealed in glass globes. On the other hand, they produce a considerable quantity of heat, but far less than gas, or oil lamps, light for light, and, difficult as it may be to believe, wax candles give more heat, light for light, than either of the latter illuminants.—*Electrical Age.*

NOTES.

An engineer calls attention to the placing of a lubricator on a steam pipe, and thinks it makes a difference which side of the pipe it is placed on. Placing the cup on the side nearest one end of the cylinder, he found that end of the cylinder got the bulk of the oil which ran down the inside of the pipe. He now enters his oil supply pipe into the steam far enough to let the oil come into the center of the column of steam. This is [illegible] by tapping and running a short length into the steam pipe before attaching the lubricator.—*Boston Journal of Commerce.*

Some causes which produce over heating: Heavy fire and sluggish draft; [illegible] boiler with the spaces between tubes filled up [illegible] [illegible] with scale and [illegible] [illegible] furnace too [illegible] [illegible] that throws off intense heat with not enough air to mix with it; clinkered grate bars and heavy fire on top; putting too much solvent in boiler, which causes all the stuff to fall on bottom of boiler; smoke stack neither large enough nor high enough. All the above will be indicated when too much heat burns off the liners of the fire front and throws an intense heat out towards the fireman. Another cause is the practice of filling furnace too full of fuel, and then, when steam is generated too rapidly closing all dampers and draft [illegible]. When tubes leak at back end particularly at the top rows, water has been let down too low in boiler; the same cause produces leaks in [illegible] side [illegible] and seams [illegible] at water line. Too much mud in boiler, either at bottom or around tubes at rear end, produces leaks.—*American Miller.*

The substitution of lead instead of zinc for coating or galvanizing conductors is advocated in an article in *L'Electricien.* Zinc has certain disadvantages: tendency to form an alloy, high melting temperature and tendency to flake. Lead seems to be *preferable for certain reasons* and its application is similar to that of zinc. The objects are cleaned electrically, and immersed in an aqueous solution containing 10 per cent. of hydrochloric acid and 1 per cent. of hydrofluoric acid, heated to 50° C. in a vessel coated with lead. They are connected to one pole of a dynamo as anode, the lead coating constituting the other pole. After this preparation they are dipped into limewater of the same temperature, and then into an alloy of equal parts of zinc and tin in hydrochloric acid, which greatly favors the adherence of the melted lead into which they are then dipped. The process is economical and is not confined in its advantage to iron or steel articles, but may be used for chemical and electrolytic vessels. The iron or steel wires serving as protection in armored cables, it is suggested, might be advantageously treated by this method in preference to the ordinary galvanizing process.