

eration of Labor, to which the electricians formerly belonged. A large number of the men met on Sunday, March 28, to perfect the plans for a national organization. An effort will be made to get the co-operation of all organized electrical workers in other cities and to organize unions in all cities and towns, where there are a sufficient number employed. The leaders in the movement claim that the introduction of telephones and electric lights in cities and towns is going on at such a pace that it is not chimerical to predict that there will not be less than 500,000 electrical workers in the United States in 1900. They expect that the census of this year will show 80,000 or more men, who are engaged directly or indirectly in the electric industries. As an argument in favor of this movement it was stated by one of the men interested, that they are often placed in positions where it would be impossible for an outsider to act as arbitrator, and for that reason it is essential that in the event of any difficulty between employees and the companies they should have men among their own number, who might act as judges in the case. The organization will be open to all men employed around and in connection with electric light stations, and the object will be to advance and improve the condition of the members of the organization. There are about 200 men employed as electric workmen in this city and all of them will join the organization. Another meeting will be held within a few days when the arrangements of the organization will be completed and the officers are to be elected.

A syndicate has been organized in this city with the object of buying up all the old-fashioned street car lines throughout the country and then equip them with the electric motor system. The syndicate is composed of Pittsburgh, Philadelphia and Boston capitalists with a capital of \$20,000,000 at their disposal. Mr. H. Sellers McKee, the well known Pittsburgh millionaire and Mr. E. H. Clarke, of Drexel, Morgan & Co., Philadelphia, are at the head of the affair.

A corporation, known as the Homestead & Pittsburgh Connecting Railway, has been chartered in Harrisburg a few days ago with a capital stock of \$300,000. This is the latest organization in this city incorporated for the purpose of building an electric road. The new line is to be a feeder of the Pittsburgh Traction Road, and it will run from Oakland, this city, to Homestead, a distance of over three miles. Operations on the road are to be commenced immediately.

Three bills in equity were filed in the Pittsburgh court on Saturday, March 28, against the Duquesne Traction Company. This is the corporation which succeeded a few weeks ago in having eleven ordinances passed in its favor in councils, mention of such fact was made in this correspondence at the time. The plaintiff is the Pittsburgh Traction Co., which claims that the Duquesne Traction Co., is about to construct car lines on streets and avenues, for which the plaintiff already holds the franchises.

PITTSBURGH, April 4, 1890.

LETTERS TO THE EDITOR.

Notice to Correspondents.

We do not hold ourselves responsible for the opinions of our correspondents.

Anonymous communications cannot be noticed.

The Editor respectfully requests that all communications may be drawn up as briefly and as much to the point as possible.

In order to facilitate reference, correspondents, when referring to any letter previously inserted will oblige by mentioning the serial number of such letter, and of the page on which it appears.

Sketches and drawings for illustrations should be on separate pieces of paper.

All communications should be addressed EDITOR OF THE ELECTRICAL ENGINEER, 150 Broadway, New York city.

THE LOSSES DUE TO HYSTERESIS IN TRANSFORMERS.

[121].—In your issue of April 2, in referring to certain remarks made by me at the recent meeting of the American Institute of Electrical Engineers on the subject of hysteresis you make the statement: "It is this constancy of relation that, as Mr. Tesla pointed out * * * may ultimately establish the correctness of the hypothesis advanced, that in reality there is no loss due to hysteresis, and that the changes of magnetization represent a charging and discharging of molecular energy without entailing an actual expenditure of energy."

I do not recollect having made such a statement, and as I was evidently misunderstood, you will greatly oblige me by inserting the following few lines, which express the idea I meant to advance:

Up to the present no satisfactory explanation of the causes of hysteresis has been given. In the most exhaustive and competent treatise on the theory of transformers, by Fleming, static hysteresis is explained by supposing that "the magnetic molecules or molecular magnets, the arrangement of which constitutes magnetization, move stiffly, and the dissipation of energy is the work done in making the necessary magnetic displacement against a sort of magnetic friction." Commonly it is stated that this is a distinct element in the loss of energy in an iron core

undergoing magnetic changes entirely independent of any currents generated therein.

Now it is difficult to reconcile these views with our present notions on the constitution of matter generally. The molecules of iron cannot be connected together by anything but elastic forces, since they are separated by an intervening elastic medium through which the forces act; and this being the case is it not reasonable to assume that if a given amount of energy is taken up to bring the molecules out of their original position an equivalent amount of energy should be restored by the molecules reassuming their original positions, as we know is the case in all molecular displacements? We cannot imagine that an appreciable amount of energy should be wasted by the elastically connected molecules swinging back and forth from their original positions, which they must constantly tend to assume, at least within the limit of elasticity, which in all probability is rarely surpassed. The losses cannot be attributed to mere displacement, as this would necessitate the supposition that the molecules are connected rigidly, which is quite unthinkable.

A current cannot act upon the particles unless it acts upon currents in the same, either previously existing or set up by it, and since the particles are held together by elastic forces the losses must be ascribed wholly to the current generated. The remarkable discovery of Ewing that the magnetization is greater on the descent than on the ascent for the same values of the magnetizing force strongly points to the fact that hysteresis is intimately connected with the generation of currents either in the molecules individually or in groups of them through the space intervening. The fact observed accords perfectly with our experience on current induction, for we know that on the descent any current set up must be of the same direction with the inducing current, and, therefore, must join with the same in producing a common effect; whereas, on the ascent the contrary is the case.

Dr. Duncan stated that the ratio of increase of primary and secondary current is constant. This statement is, perhaps, not sufficiently expressive, for not only is the ratio constant but, obviously, the differential effect of primary and secondary is constant. Now any current generated—molecular or Foucault currents in the mass—must be in amount proportionate to the difference of the inductive effect of the primary and secondary, since both currents add algebraically—the ratio of winding duly considered,—and as this difference is constant the loss, if wholly accounted for in this manner, must also be constant. Obviously I mean here the transformers under consideration, that is, those with a closed magnetic circuit, and I venture to say that the above will be more pronounced when the primary and secondary are wound one on top of the other than when they are wound side by side; and generally it will be the more pronounced the closer their inductive relation.

Dr. Duncan's figures also show that the loss is proportionate to the square of the electromotive force. Again this ought to be so, for an increased electromotive force causes a proportionately increased current which, in accordance with the above statements, must entail a loss in the proportion of the square.

Certainly, to account for all the phenomena of hysteresis, effects of mechanical vibration, the behavior of steel and nickel alloy, etc., a number of suppositions must be made; but can it not be assumed that, for instance, in the case of steel and nickel alloys the dissipation of energy is modified by the modified resistance; and to explain the apparent inconsistency of this view we only need to remember that the resistance of a body as a whole is not a measure of the degree of conductivity of the particles of which it is composed.

S. TESLA.

New York City.

.... THOSE who give of their substance to aid in the promotion of science are entitled to hardly less honor than those who devote life and health and strength to the good work.—*Professor Robert H. Thurston.*

.... WE may expect that measurement classes, boldly so called, will readily find endowments; and as an incidental advantage, they may help to extinguish the popular fallacy of college workshops.—*Fleming Jenkin.*

THE great names in connection with our progress in knowledge as to the real nature of electricity, irrespective of a mere study and extension of its known facts, are Franklin, Cavendish, Faraday and Maxwell.—*Oliver J. Lodge.*

.... WHAT is needed is a continuation of the effort already commenced, of vigorous protest against the tariff laws on the subject [scientific publications and philosophical instruments] as at present existing; laws which obstruct knowledge at its fountain head; which impose onerous burdens on a class which works gratuitously for the public good, and which place our country in a false position among the enlightened nations of the earth.—*Professor Edward D. Cope.*