(No Model.)

E. THOMSON.

DYNAMO ELECTRIC MACHINE OR MOTOR.

No. 369,754. Patented Sept. 13, 1887.

Fig. 1.

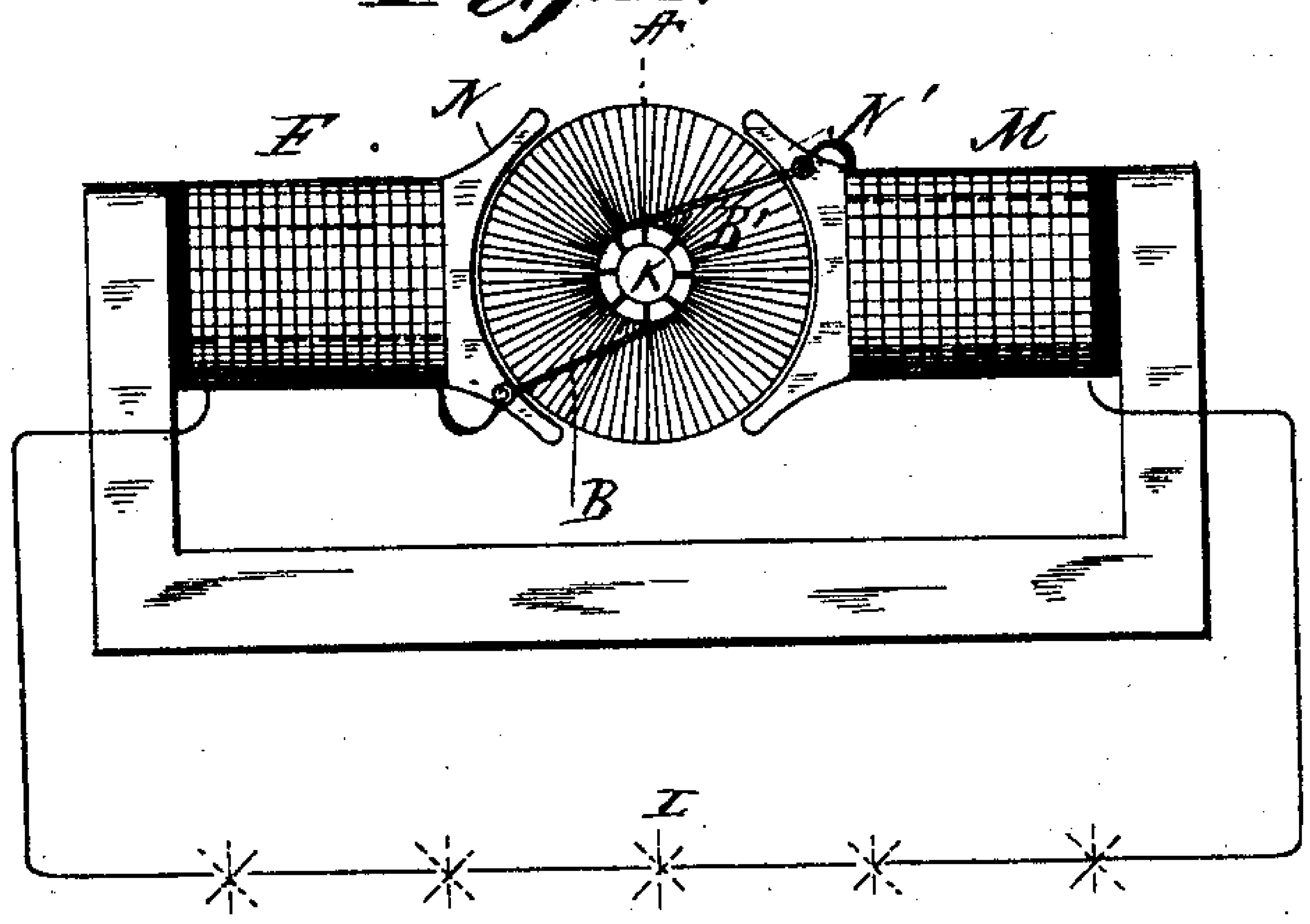


Fig. 3.

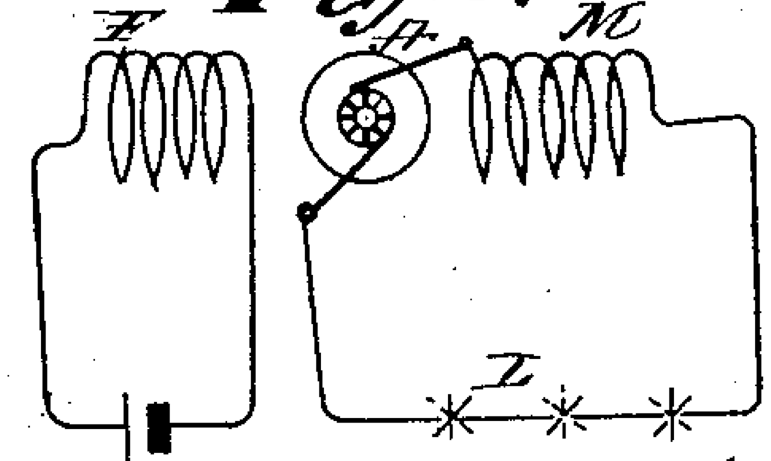


Fig. 4.

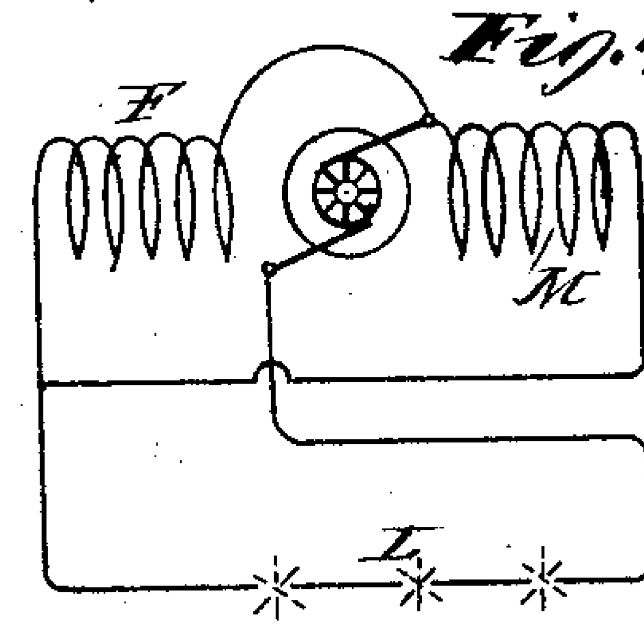


Fig. 2.

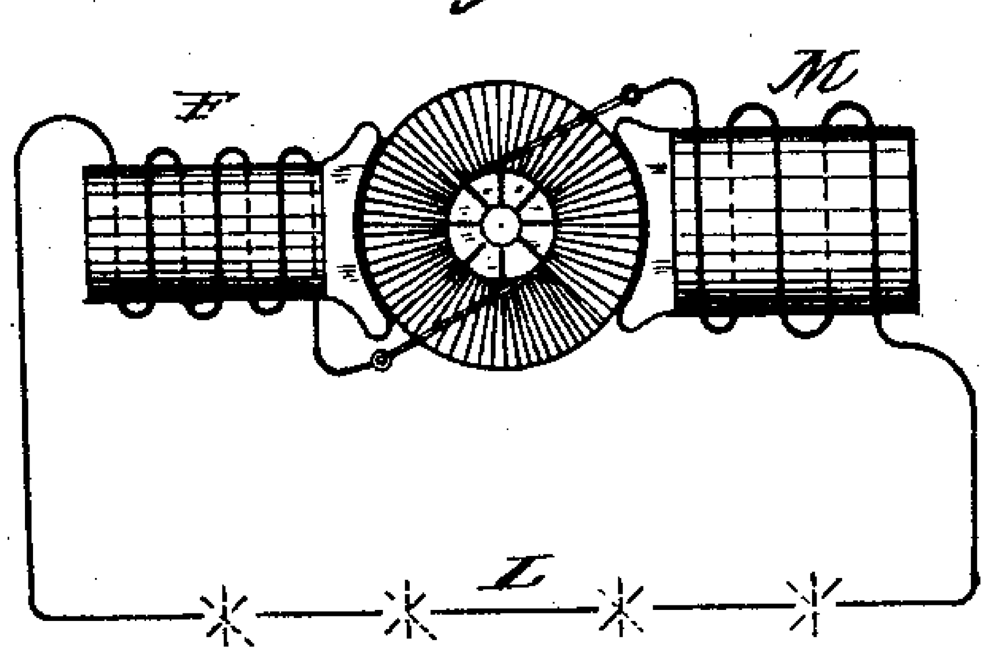


Fig. 5.

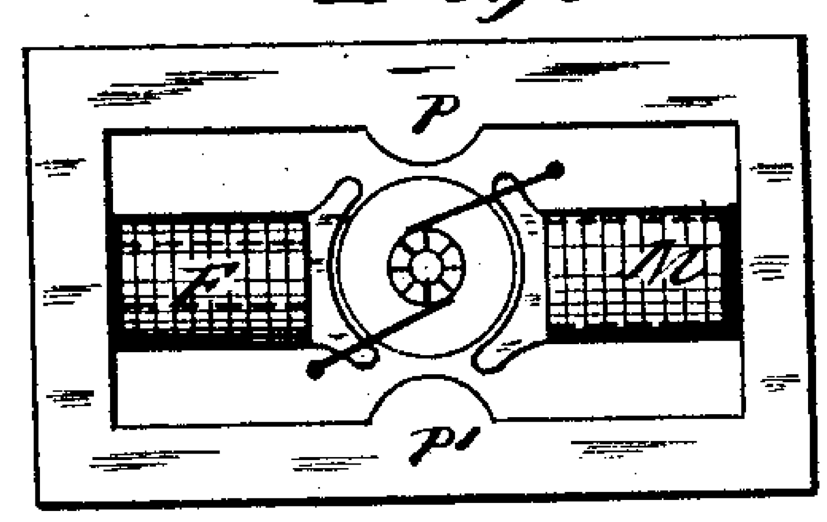


Fig. 6.

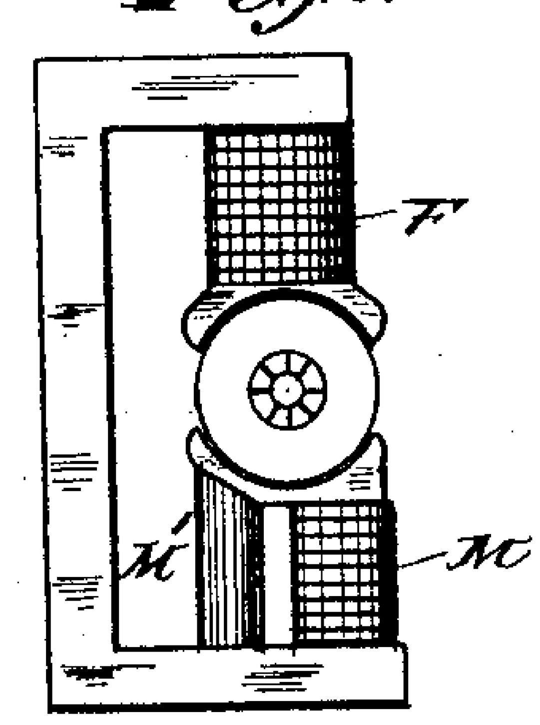


Fig. 7.

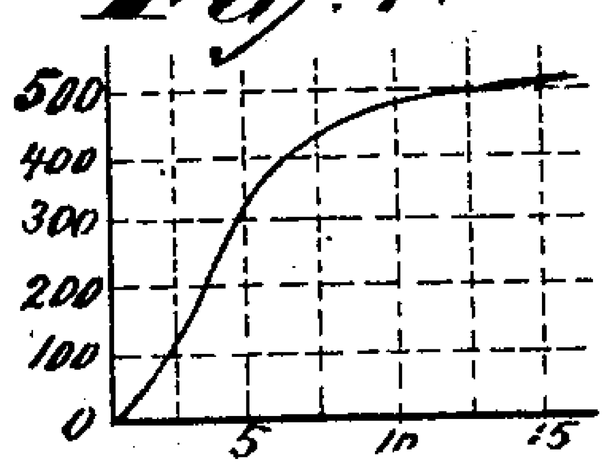


Fig. 8.

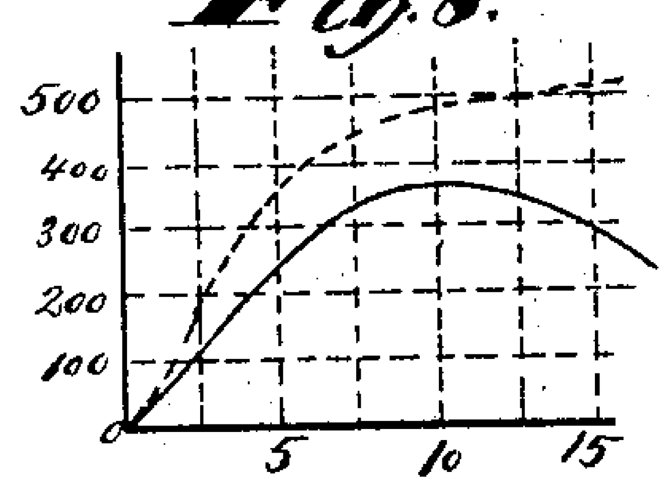


Fig. 9.

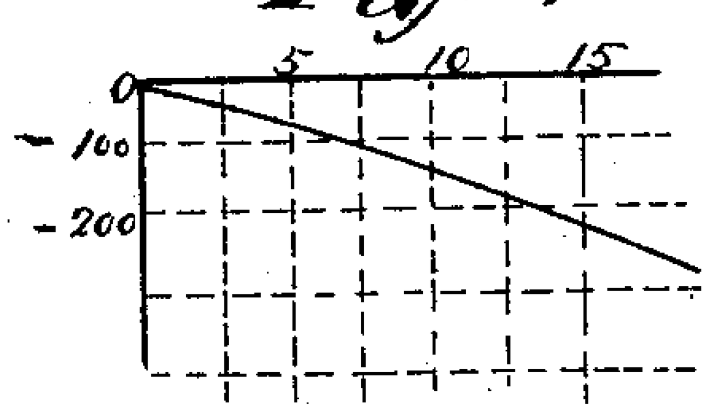
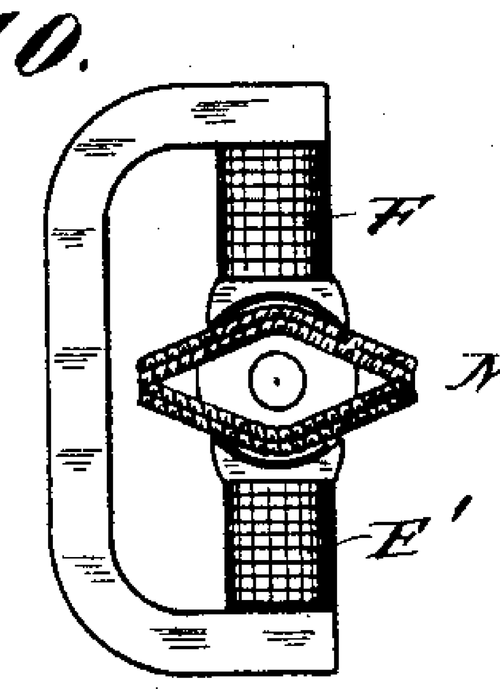


Fig. 10.



WITNESSES:

Gabriel J. W. Galster

Wm. H. Capel

INVENTOR

Elihu Thomson

BY

Townsend & MacArthur

ATTORNEYS

UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF LYNN, MASSACHUSETTS.

DYNAMO-ELECTRIC MACHINE OR MOTOR.

SPECIFICATION forming part of Letters Patent No. 369,754, dated September 13, 1887.

Application filed March 30, 1887. Serial No. 232,943. (No model.)

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, and a resident of Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Dynamo-Electric Machines or Motors, of which the following is a specification.

My invention relates to the construction of dynamo-electric machines and motors designed for use in supplying current to arc lights or other working-resistances in series under conditions where there is a liability to variations of the main-line resistance, or for use as motors on circuits where the currents supplied to the motor are variable, but it is desired to maintain, notwithstanding, an approximately constant speed in the motor.

My invention is primarily intended for application to machines used as generators, and I shall hereinafter describe my invention with reference to such use of the machine.

The application of the invention to a motor will be obvious from the subjoined description of its application to a generator.

Dynamo-machines employed in running arc lights in series must possess peculiar properties in order to insure stability of current and freedom from oscillation. This is due to the fact that when the current increases in an arc its resistance diminishes, and vice versa. Therefore a machine whose electro-motive force is sustained or increased when its current is increased by a momentary fall of resistance in the circuit will give rise to a further current increase, only limited by the separating power of the arc lamp mechanism in opening the arcs; but this latter action of compensation is too sluggish and behind time, and the general result has been that oscillations of periodic frequency are set up in the current and in the arcs. It has generally been found necessary to limit the iron used in the machine, and so proportion its field strength relatively to the magnetism of the armature that the condition as above stated is avoided; but such limitations are usually made at a sacrifice of efficiency and general output for a given weight.

My invention has for its object to provide means whereby there may be a large amount of iron used in the construction of the machine, a relatively small amount of copper, and to confer the property of yielding a lower electro-motive force when the current surpasses the normal. Siemens, Gramme, or other armature arrangements may be used, and the armature may contain a much larger amount of iron relatively to the wire than in arc machines as ordinarily constructed.

The field-magnet I construct so that a part thereof shall be magnetized to full saturation by the current of the machine or by another current; or a permanent field-magnet may be employed. The other part I construct with much heavier iron core and with a very small number of turns of wire in which the current flows, which current magnetizes, or, rather, tends to magnetize, the magnet-core in opposition to the magnetism induced in it from the induction of the saturated or permanent part.

In the accompanying drawings, Figure 1 is a side elevation of a machine embodying my invention. Fig. 2 illustrates in detail the principle of the invention. Fig. 3 is a diagram illustrating a modification. Fig. 4 is a diagram illustrating a modification in the connection of the two coils. Fig. 5 shows a form of field-magnet that may be employed for facilitating the action. Fig. 6 illustrates another form of the invention. Figs. 7, 8, and 9 are diagrams explanatory of the effects produced upon the electro-motive force of the machine. Fig. 10 illustrates a further modification of the invention.

In Fig. 1, A is the armature of the Siemens or Gramme type or other form; K, the commutator; B B′, the brushes bearing thereon at neutral line.

F is the coil on a field-core of moderate section. The coil F, which may be a main-circuit or other coil, energizes the core to saturation, being suitably proportioned as to convolutions with the normal current. Its pole N is thereby given a strong polarity opposite the armature. Many convolutions of wire in F are required. The coil M is either coarser than F or at least has much fewer turns—say one-fifth those in F—or its magnetizing effect is much less—for instance, as one-fifth that of F; but the core of M is of large body and is far below saturation. The current in M, which is in the main circuit, is in a direction opposing that in F, or tending to make a pole at the pole-face N′ of the same name as F makes at N. In reality, however, the strong induction from N through the armature A overcomes this tendency and forces N′ to assume an opposite polarity to N.

L represents a series of lights, as arc lamps.

Fig. 2 shows the relation of parts and direction of winding of the field-coils.

Fig. 3 shows that F may be excited from a separate source.

Fig. 4 shows that F and M may, if suitably wound, be connected in multiple. In this case coil M is of much higher resistance—say five times F—and is of so few turns that it still has, say, one-fifth or even less magnetizing power on its core than F has on its core.

Fig. 5 shows the iron field-frame connecting F and M as provided with projections toward the armature acting as false poles. They somewhat assist the action of M in opposing the magnetism of F, by permitting lateral diversion of magnetism from the armature.

In Fig. 6 there are two cores opposed to F, one only of which is wound with the coil M, while the other, M′, serves merely as a conductor of magnetism, and is made of rather limited section. The presence of M′ does not prevent the effect which M has in the structure.

The actions of the machine so constructed are as follows: Instead of the machine exhibiting a "characteristic curve" similar to that of Fig. 7, where the ordinates represent electro-motive forces and the abscissas the currents generated, (which curve is that given by a machine with a strong saturated field and with an armature with considerable iron and moderate amount of copper winding,) it gives a curve more like that of Fig. 8. They differ in these respects. Let the normal current of the machine be ten ampères. Then, in Fig. 7, when ten ampères exist, the curve would indicate about four hundred and seventy-five volts, but at fifteen ampères more nearly five hundred volts. For arc lights such a condition is unstable, because there is in a machine of low internal resistance nothing to limit the current to its normal ten ampères; but in Fig. 8, which shows very nearly the curve of my machine at ten ampères, the volts are, say, three hundred and fifty; but should the resistance of the circuit fall so as to bring the current to fifteen ampères, the volts would be less than three hundred. This condition tends to limit the current in arc lights to the normal ten, as any tendency to surpass it is accompanied by a fall of electro-motive force of the machine. If the saturated magnet F were alone acting, the curve of the machine would approximate that of Fig. 7, and the curve Fig. 8 given is the result of the compounding of that of Fig. 7 with the effect of the opposing coil M on its non-saturated and large core.

The effect of coil M is shown in Fig. 9 by the line *o e*. As it is an opposing coil, its effect is negative, or it tends to cause fall of electro-motive force nearly in proportion to the current in its coils. Thus at ten ampères, Fig. 9, it gives a negative electro-motive force of about one hundred and fifty volts, and at fifteen ampères about two hundred volts. The conditions above are assumed; but the effects with other numbers of ampères and machines for higher or lower voltage will be similar to the illustration given. In brief, the magnetizing effect of current in F soon limits itself by saturating its core, while the opposing effect of same current in coil M does not reach a limit, but goes on accumulating as the current is increased, by virtue of the non-saturation of its core of large size and of its few turns of wire.

Fig. 10 shows how two saturated cores, with coils F F′, may be applied to the armature and the opposing coil M be wound to surround the armature, especially when the core of the latter has a large proportion of iron and the cores in the coils F F′ are limited in section.

By suitably altering the number and disposition of the field-magnet cores my invention may be applied to other forms of armature, as flat rings, spheres, cylinders, &c.

What I claim as my invention is—

1. The combination, with the saturated field-magnet, of a feeble opposing coil wound over a mass of iron inductively acted upon by the saturated magnet, as and for the purpose described.

2. In a dynamo-electric machine or motor, a field-magnet normally maintained by a coil which saturates or approximately saturates the mass of iron upon which it is wound, in combination with a weak demagnetizing-coil normally tending to cut down the magnetism or magnetic field developed by the first-named coil and varying in its effect with the current on the circuit, as and for the purpose described.

3. The combination, in a dynamo-electric machine or motor, of a field magnet coil which saturates or approximately saturates its core and a weak demagnetizing-coil wound on a core whose pole is inductively magnetized from the pole of the first-named core.

4. In a dynamo-electric machine or motor, the combination, with the same armature, of a saturated field-core and a non saturated core wound with a feeble magnetizing-coil which opposes the magnetism induced in its core from the saturated core, as and for the purpose described.

5. In a dynamo-electric machine or motor, the combination of a saturated and a non-saturated core diametrically opposite one another and wound with coils in the main circuit.

6. In a dynamo-electric machine or motor, a field-magnet maintained solely by the action of a main-circuit coil, which saturates its core, in combination with a feeble opposing coil connected into the main circuit.

Signed at Lynn, in the county of Essex and State of Massachusetts, this 24th day of March, A. D. 1887.

ELIHU THOMSON.

Witnesses:

E. WILBUR RICE, Jr.,
J. W. GIBBONEY.