(No Model.) 3 Sheets—Sheet 1.

J. J. SKINNER.

APPARATUS FOR DISTRIBUTING AND REGULATING ELECTRIC CURRENTS.

No. 303,403. Patented Aug. 12, 1884.

Fig. 1.

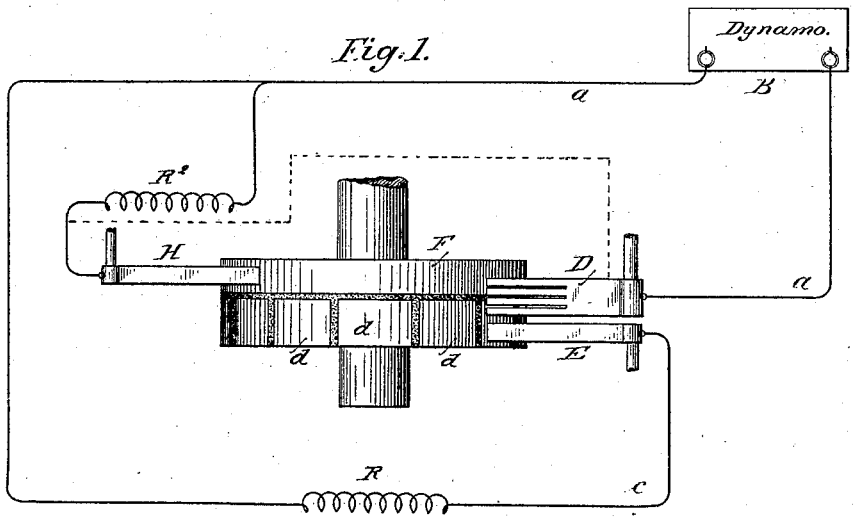

Fig. 2.

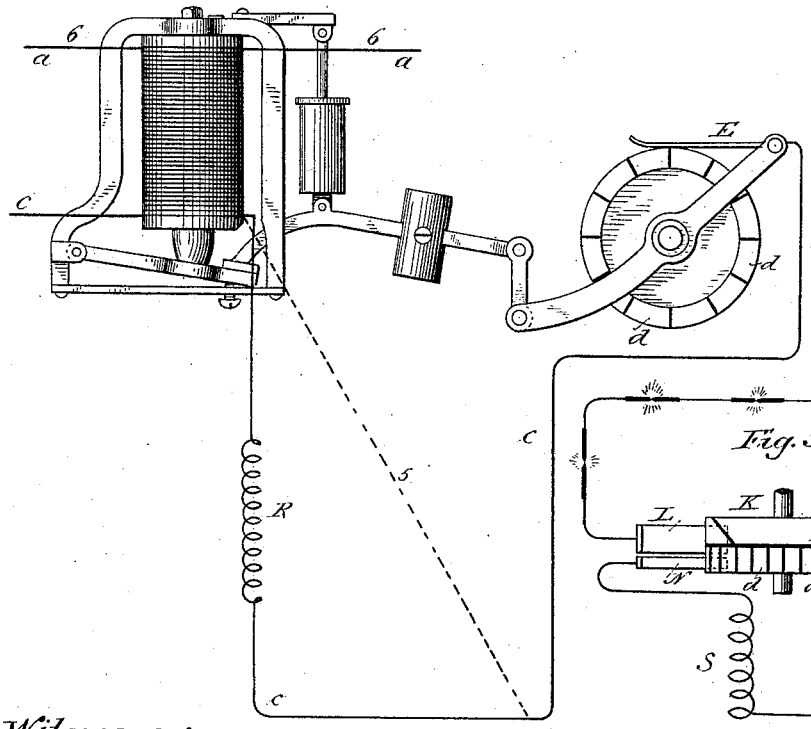

Fig. 5.

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(No Model.) 3 Sheets—Sheet 2.

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Fig. 3.

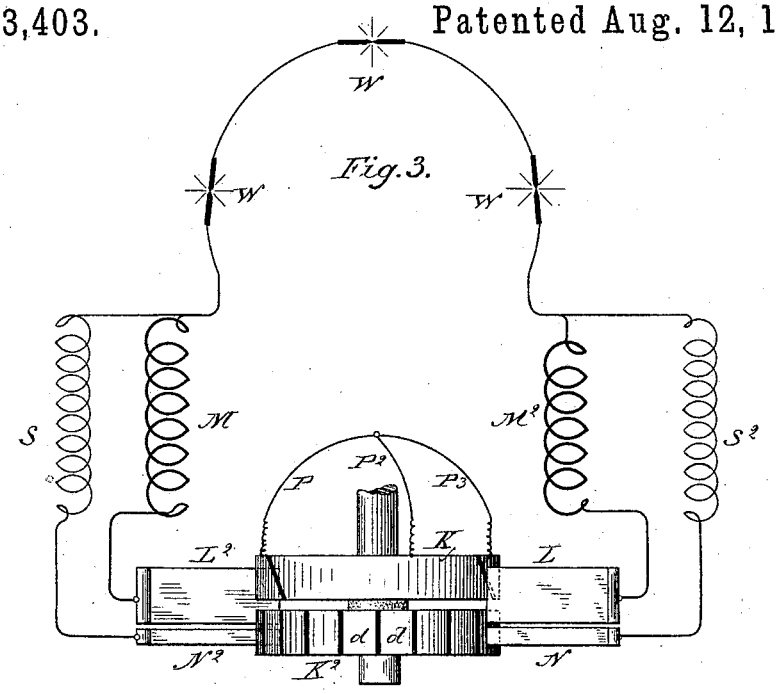
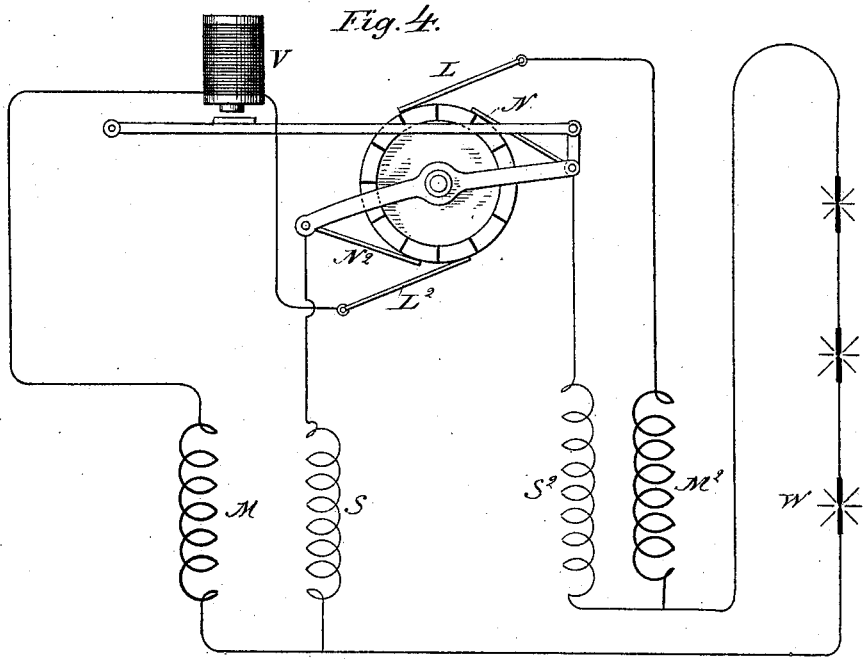


Fig. 4.



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(No Model.) 3 Sheets—Sheet 3.

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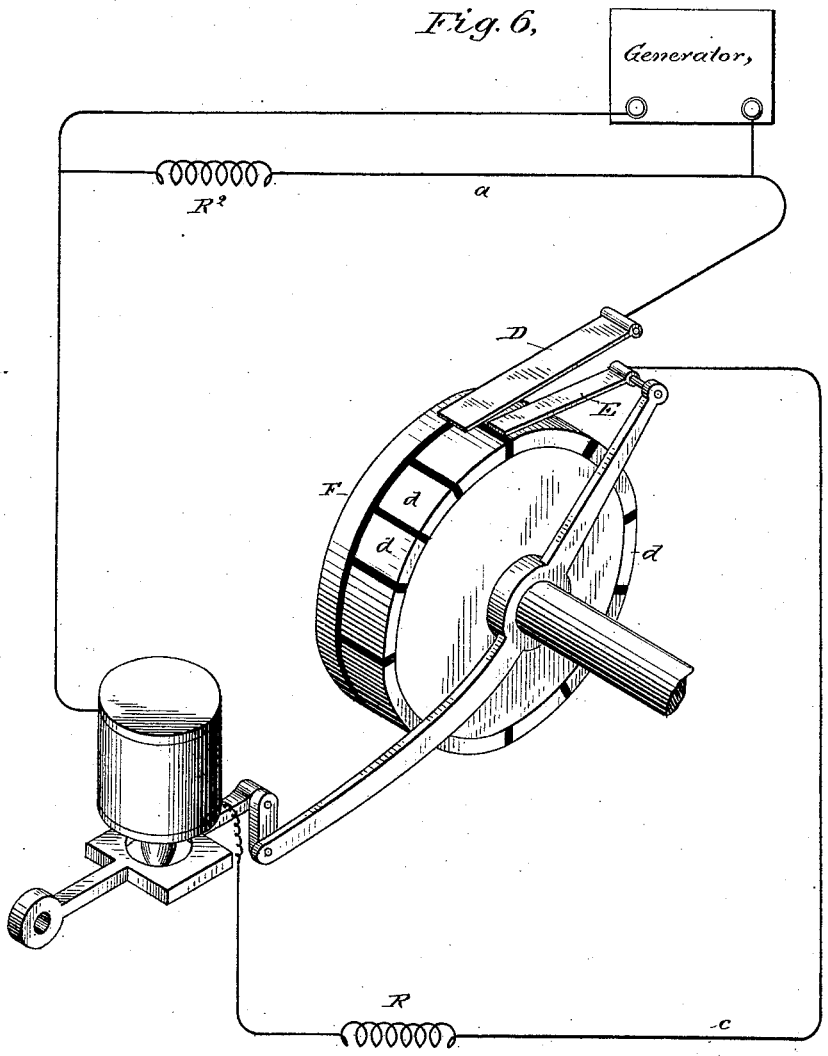
Fig. 6,



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UNITED STATES PATENT OFFICE.

JOSEPH J. SKINNER, OF NEWTONVILLE, MASSACHUSETTS.

APPARATUS FOR DISTRIBUTING AND REGULATING ELECTRIC CURRENTS.

SPECIFICATION forming part of Letters Patent No. 303,403, dated August 12, 1884.

Application filed December 17, 1883. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH J. SKINNER, a citizen of the United States, and a resident of Newtonville, in the county of Middlesex and State of Massachusetts, have invented certain new and useful Improvements in Distributing and Regulating Electric Currents, of which the following is a specification.

My invention relates to the distribution of electric currents, and its primary object is to furnish a means whereby the amount of current taken from a main or supply conductor to a branch, shunt, derived, or sub circuit may be varied or regulated without the employment of an adjustable resistance as such.

A further object of my invention is to furnish a means whereby incandescent electric lamps or other translating devices or groups of translating devices may be introduced at various points on a main or supply conductor, and fed each with a current of a determinate or regulated amount, without interfering with one another or with the operation of other kinds of translating devices—as, for instance, electric-arc lamps—placed in the same supply-circuit in series with one another and with the first-named devices.

In carrying out my invention I propose to govern the flow of the current from the supply-conductor by intermittently or periodically and at quickly-recurring intervals making electric connection with the supply-conductor, and to determine or regulate the total amount of current thus flowing by governing the period or duration of each intermittent or periodic closing; and my invention consists partly in a certain novel means whereby such intermittent closures may be produced and regulated.

My invention consists, also, in governing or determining the amount of current that shall flow to a working resistance or translating device, or a group of translating devices, placed in a supply-circuit leading from a dynamo-machine or other source, by intermittently and at intervals, each of regulated length, permitting the current of the supply-conductor to flow in a branch circuit around said working resistance. In the method of carrying out this portion of my invention that I have herein shown I also include in such branch another translating device or group of translating devices—such as a storage-battery or a group of incandescent lamps—and the flow of current to the latter is under such circumstances also governed by the duration of the intermittent or periodic connections thereof with the supply-conductor, which occur every time that the current is diverted from the first-named translating device. The intermittent or periodic closures are made to recur with sufficient frequency to produce the practical effects of a continuous current in the branch, derived, or sub circuit, and the duration or extent of each closure may be determined by various devices, working automatically or otherwise.

One of the minor ways in which my invention may be employed is in governing the current taken from or generated by a dynamo-electric machine, for which purpose the current diverted may be primarily used for energizing the field-of-force magnet, or may be employed for neutralizing the effects of the energizing-coil, and the amount of current diverted may be determined by automatically adjusting the duration of the intermittent closures by a suitable device controlled by an electro-magnet or other electro-responsive device, responding to changes in the current-flow upon the circuit of the working resistance or other translating devices. The commutator by which the diversions of current are produced or governed may be associated with or removed from the source of current-supply.

When I make use of my invention for regulating a dynamo-electric machine, it may, as hereinafter explained, be combined with or made a part of the commutator by which the currents are taken from the armature-coils. It may also be combined for taking off a portion of the current set up in the armature for any other purpose.

In the accompanying drawings, Figure 1 is a diagram illustrating the principle of my invention. Fig. 2 is a side view of a detail. Fig. 3 illustrates diagrammatically one method of applying my invention to the regulation of dynamo-electric machines. Fig. 4 is a side view of a device for automatically determining the duration of closure of the branch or derived circuit at each of the intermittent

closures, and consequently the total portion of revolution of the commutator during which the main or principal circuit shall be connected to the branch. Figs. 5 and 6 illustrate modifications.

Referring to Fig. 1, *a* indicates an electric circuit upon which current from a source, B, flows, and *c* a branch, derived, or sub circuit into which it is desired to divert a determinate or a variable amount of current from the circuit *a*. R indicates an electric lamp or group of lamps, or a storage-battery, the field-coils of a dynamo-electric machine or other translating device or working resistance in the branch; and R^2 another translating device or apparatus in the circuit *a*, interposing resistance to the flow of current in the main circuit, from which latter device or group of devices current is to be diverted at rapidly-recurring intervals of regulated length, for the purpose of determining the amount of current that shall flow in said device R^2. If the branch *c* be constantly connected with the main circuit *a*, the current will obviously flow through R and R^2 in the inverse proportion of their resistances. I aim to make the flow in *c*, and therefore of necessity the flow in *a* between the points where *c* joins it, depend upon another and variable condition—to wit, the time during which the branch *c* is connected to *a*—and this I accomplish by intermittently or periodically connecting *c* to *a* at intervals recurring with sufficient rapidity to produce the practical effects of a continuous current in *c*, thus governing the relative amounts flowing in the two circuits by the period or duration of each rapidly-recurring closure, the amount flowing in R^2 being obviously dependent on the amount flowing in the branch. As the main circuit is always closed through R^2, the interruptions produced in the circuit of the branch will obviously not prevent the continuous flow of current in the general circuit, and any number of translating devices or groups of devices may therefore be worked on this plan on the same general circuit and in series with one another. For the purpose of illustration, let it be supposed that the main circuit *a* is made to pass through or is connected with a brush, D, which is made to come at intervals into contact with a series of conducting plates or surfaces, *d*, insulated from one another. If, now, at every contact of the brush D with a plate, *d*, an auxiliary brush, E, connected to the branch *c*, simultaneously makes contact with such plate, the circuit to *c* will be closed, and a rapid breaking and closing of the connection to *c* will be produced, depending in rapidity upon the rapidity with which the series of plates *d* is made to pass beneath the brushes. If the brushes D E bear on the plates *d* on the same line, the period of each closure will be directly proportional for a given speed of movement of the brushes or plates to the length of each plate *d*; but if the brush E be shifted so that the plate will leave E before it does D, the period of each closure will evidently depend upon the circumferential distance between the points of contact of the brushes. The relative position of the brushes may obviously be changed with changing effects within the limits of the length of each plate.

The contacts *d* may be arranged in the circumference of a circle, and mounted on a revolving shaft driven by any suitable power at any desired rate of speed, and the main circuit may either be continued from D around to R^2, as shown by the dotted line; or it may pass to R^2 by means of the continuous disk F, upon which the brushes D and H may constantly bear. The mechanical construction of similar devices—such as commutators for dynamo-electric machines and circuit-closers or commutators for other purposes—is well understood, and the mechanical constructions and devices for insulating employed in such cases may be employed in carrying out my invention. If the disk or commutator indicated be rapidly turned, the current will flow to circuit *c* in rapidly-recurring impulses, and the current may be shunted to such circuit for variable portions of each complete movement or revolution of the disk by simply adjusting or determining the position of the brush E with relation to D, and the consequent duration of each individual recurring closure. The longer each individual closure and the greater the total portion of each revolution, during which *c* is connected to *a*, the greater the current-flow on *c*, at the same time the less is the current-flow on that portion of the general circuit containing R^2. As shown in Fig. 2, the brush E may be mounted on a rocker-arm after the manner of adjustable commutator-brushes in dynamo-electric machines, and may be adjusted by hand or by means of an electro-magnet energized by the current in the circuit *c*, or sub-branch thereof, as indicated by the dotted line 5, or by current in *a*, as indicated by the line 6, or by any other current or device controlled or varied in any desired manner.

Since the heating, magnetic, or other effect of an intermittent current in a conductor will depend largely on the relative duration of the intervals of electric flow and rest, it is obvious that a current shunted and controlled according to my invention will be well adapted to supply a variable number of incandescent lamps or various other translating devices.

If the resistance R^2 consists of a variable number of translating devices in parallel arc, each one requiring a current of definite amount, an automatic current-regulator like that, for example, shown in Patent No. 271,948 to E. Thomson, may obviously be placed in the circuit of any one of these translating devices, and operatively connected with the brush E, to control its position.

In Fig. 3 is illustrated a method of carrying out the invention in connection with the

commutator of a dynamo-electric machine, for the purpose of applying the current diverted to the regulation of the current of the machine. In this instance K indicates the ordinary commutator-cylinder of a dynamo-electric machine of any construction, and L L^2 the commutator-brushes bearing on said cylinder, but each wide enough to lap upon the auxiliary cylinder K^2, made up of a series of insulated contact-plates, *d*, insulated from one another, and from the other commutator, K. The plates *d* correspond to the plates *d* of Fig. 1, and each of the commutator-brushes L L^2 bears the same relation to said plates and to the brushes N N^2 as does the brush D of Fig. 1 to the plates *d* and brush E of that figure.

It is obvious that the brush N^2 might be dispensed with by connecting L^2 directly to S.

P P^2 P^3 indicate the three armature-coils of a dynamo-electric machine wound according to the invention of E. Thomson and E. J. Houston, patented by Letters Patent of the United States No. 223,557. The particular armature construction or winding is, however, obviously not material. Current may be taken off into a branch connected at its terminals to the brushes N N^2, and may be governed in the manner described in connection with Fig. 1 by adjusting said brushes so as to determine the duration of each of the intermittent or periodic connections between the same and the main brushes, and the consequent total portion of the revolution of the commutator during which connection is made. I effect the regulation of the machine by taking the current from the brushes N N^2 to field-magnet coils, which coils may be the principal energizing-coils, or may be auxiliary coils employed to oppose or cut down the magnetism of the field.

M M^2 indicate field-magnet coils used for energizing the field-magnet and supplied with current from the commutator-brushes L L^2. In the present case they are shown as in the main or principal circuit with the electric lights W, or other translating device, although they might be connected in other and well-known ways.

S S^2 indicate coils, preferably of comparatively high resistance, although this is not necessary, which coils are reversely wound or connected to M M^2, so that the current in them will tend to oppose the influences of the current in M M^2, and to consequently diminish the strength of the magnetic field for the armature. The current which passes through said coils may or may not pass through the working resistance, as desired. The amount of current in said coils S S^2 and the strength of the field is determined by the adjustment of the brushes N N^2, which may be effected by an electro-magnet, V, Fig. 4, whose armature is connected to the rocker arm carrying the brushes N N^2. The strength of said magnet, and the consequent position of the brushes N N^2 with relation to L L^2, is made to vary with the strength of the current on the supplied circuit, by connecting such magnet into said circuit, or by otherwise connecting or controlling the magnet so that its strength shall be made to depend upon the condition of the exterior or working circuit supplied by the machine. Said magnet may, for instance, be controlled in the same manner as in patent to E. Thomson, No. 271,948, and may have any suitable form.

In the operation of the apparatus any increase of current on the main line, due to cutting out of lights or other cause, will increase the magnetic power of V, thus moving the brushes N N^2, so that they will be in connection with L L^2 for longer periods, thus increasing the current in coils S S^2, and cutting down the field-magnetism so as to adjust the current generated to the changed external resistance. Owing to the magnetic inertia of the field-magnets, the intermittent nature of the governing-current will produce no injurious effect.

In addition to the regulation herein described, or in conjunction therewith, the brushes L L^2 may be adjusted automatically by any desired means, such as those described in prior patents.

If desired, the coils S S^2 may be the coils for energizing the field-magnet, and in such case may be in a derived circuit or shunt, preferably of high resistance, to the working circuit or circuits. Such an arrangement is indicated in Fig. 5. The coils S S^2 are in the shunt, and are connected with the brushes N N^2, so that by the adjustment of the latter, automatically or otherwise, the amount of current flowing in the coils may be determined or regulated in the manner before explained, and thus the strength of the field and tension of the current.

The number of plates *d* may be largely varied, and may be greater or less in number than the segments of the commutator K.

The brushes N N^2 may obviously be in front of or behind the brushes L L^2. I do not limit myself to the manner of adjusting the brushes N N^2. It is obvious that either the brushes or the cylinders might move.

One of the modifications hereinbefore mentioned is illustrated in Fig. 6, where the main circuit is divided into the branches *a c*, and the branch *c* contains a regulator in the shape of a controlling-magnet, operatively connected with the current-controller. The adjustment of the current-controller, by determining the flow of the current in one branch, governs the distribution of the current between the two branches.

What I claim as my invention is—

1. The combination, with a working resistance placed in a general supply-circuit, of means for intermittently and at rapidly-recurring periods of determinate or regulated length closing a branch circuit around the same, whereby the amount of current flowing in

said resistance may be governed without interfering with the operation of other devices on the same general circuit.

2. The combination, with a main and one or more branch or sub circuits, of translating devices in any or all of the circuits, one or more brushes connected to the main, and one or more brushes connected to each branch, a series of insulated contact-plates mounted on a cylinder and adapted, in certain positions of said cylinder, to make electrical connection through the brushes from the main to the branch or branches, and means for varying as much and as often as desirable the relative circumferential position of the different brushes.

3. The combination, with a main and a branch or sub circuit, of two brushes—one connected to the main and the other to the branch—a series of insulated contact-plates moving beneath said brushes, and means for varying the distance between the brushes at their points of contact with the plates.

4. The combination, with a dynamo-machine commutator, of a series of insulated subsidiary contact-plates upon which the commutator brushes or collectors bear, brushes or collectors bearing on said subsidiary plates only, and means for varying the relative position of the latter brushes and the commutator-brushes, as and for the purpose described.

5. The combination, substantially as described, of field-magnet coils, a subsidiary set of insulated conducting-plates upon which the commutator-brushes bear, a set of brushes connected to the field-magnet coils and bearing on the subsidiary set of plates only, and means for adjusting the relative position of said brushes, as and for the purpose described.

6. The combination, in a dynamo-electric machine, of a field-magnet having a neutralizing-coil, and means for diverting current through such coil during variable portions of the revolution of the commutator, as and for the purpose described.

7. The combination, with a main and one or more branch or sub circuits, of translating devices in any or all of the circuits, and means for diverting into any sub-circuit a current from the main circuit during rapidly-succeeding intervals of a determinate or regulated duration and intermission.

8. The combination, with a main electric circuit divided into two or more branches, of a working resistance in a branch, a circuit-controller adapted to rapidly open and close another branch for variable intervals, and an automatic current-regulator in one of said branches, said regulator being operatively connected with the circuit-controller.

9. The combination, with a main and two or more branch or sub circuits, of a circuit-controller for rapidly and intermittently opening and closing one of said branches for variable intervals, and an automatic current-regulator in a branch, said regulator being operatively connected with the circuit-controller.

10. The combination, with the field-magnet in a dynamo-electric machine, of an auxiliary opposing or neutralizing coil, a circuit-controller for rapidly and intermittently opening and closing an electric circuit for variable intervals, and a current-governor for acting on the circuit-controller, whereby the flow of current in the auxiliary coils may be adjusted.

Signed at Boston, in the county of Suffolk and State of Massachusetts, this 14th day of December, A. D. 1883.

JOSEPH J. SKINNER.

Witnesses:
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B. B. PERKINS.