(No Model.)

J. E. WATSON.

REGULATOR FOR DYNAMO ELECTRIC MACHINES.

No. 300,420. Patented June 17, 1884.

Fig. 1.

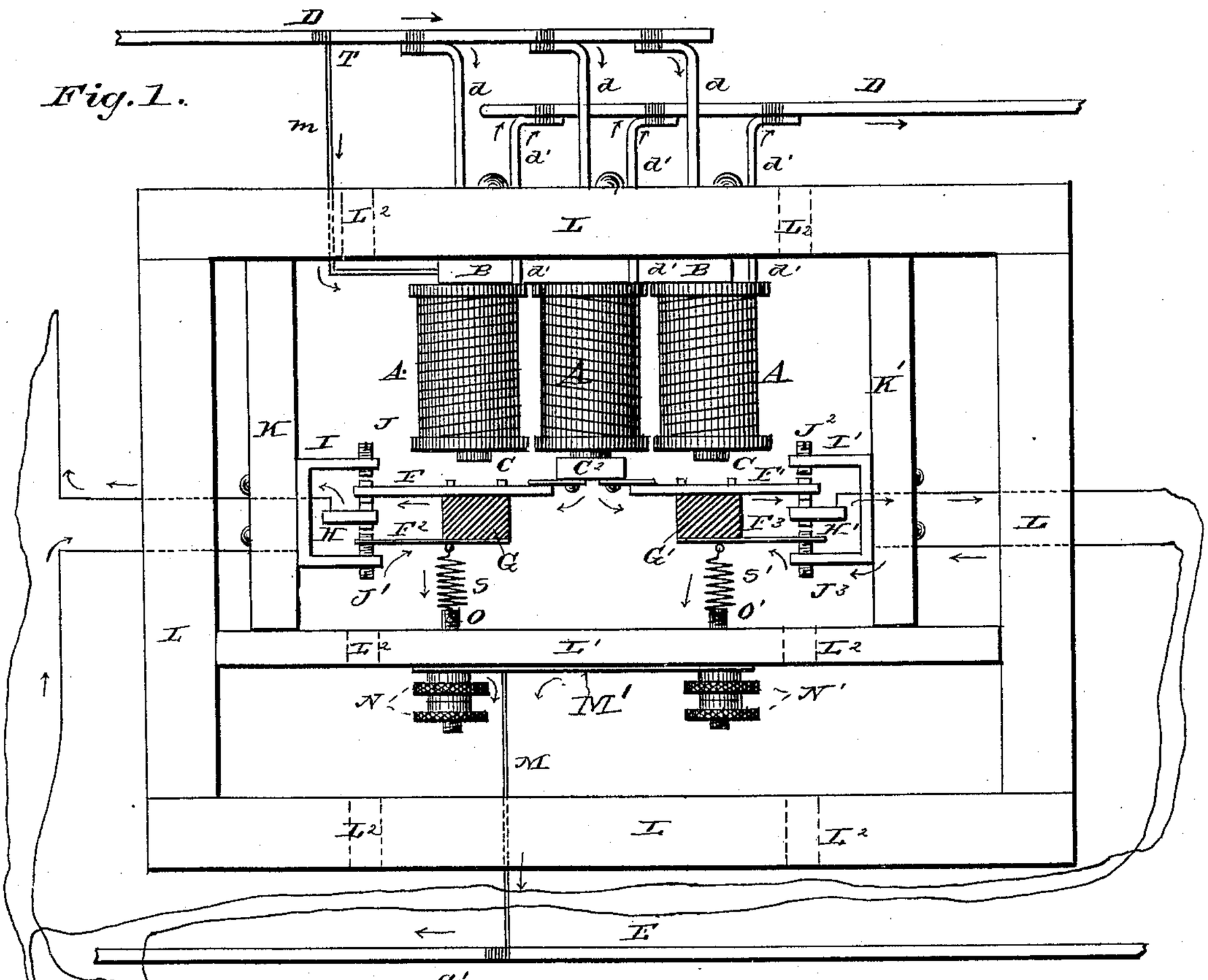


Fig. 2.

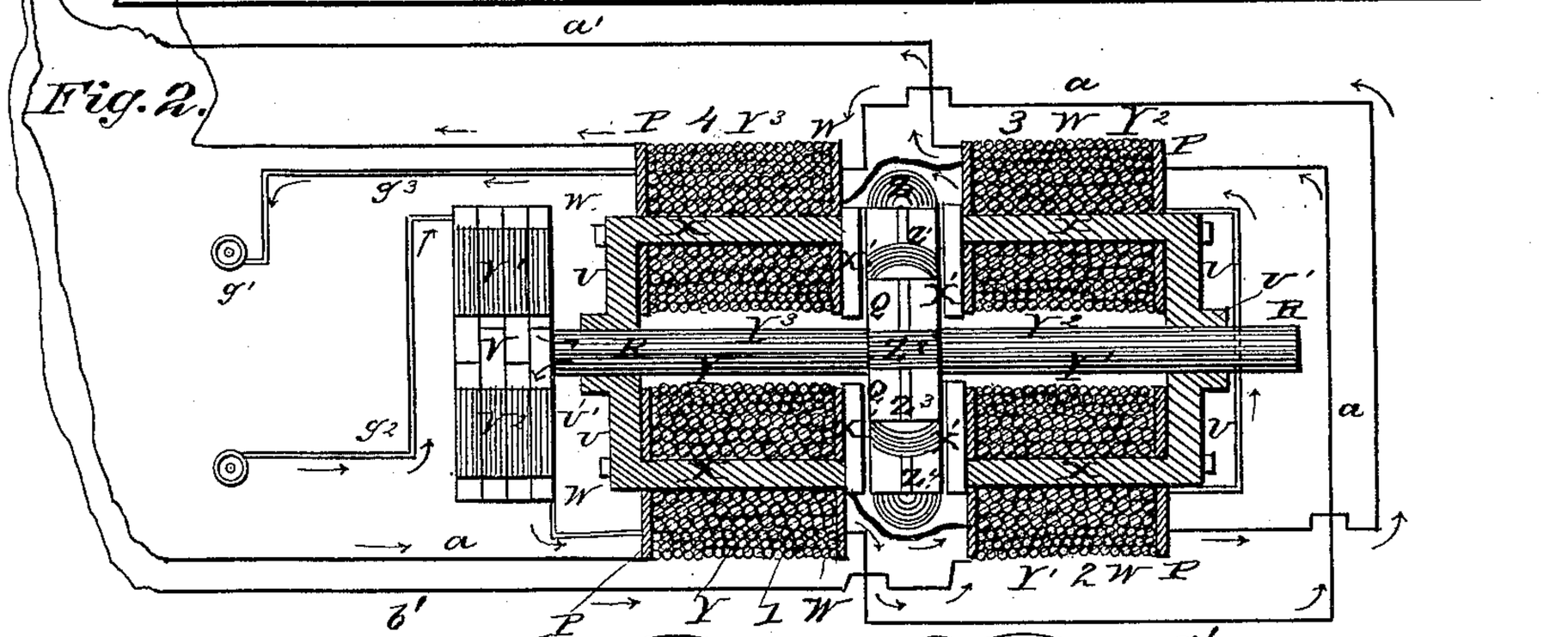
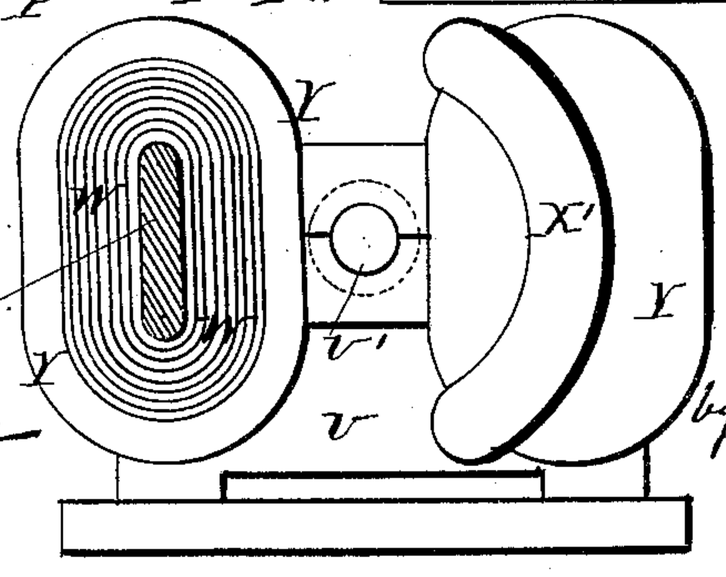


Fig. 3.



WITNESSES

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REGULATOR FOR DYNAMO-ELECTRIC MACHINES.

SPECIFICATION forming part of Letters Patent No. 300,420, dated June 17, 1884.

Application filed September 24, 1883. (No model.)

To all whom it may concern:

Be it known that I, JOHN E. WATSON, a citizen of the United States, resident at Louisville, in the county of Jefferson and State of Kentucky, have invented certain new and useful Improvements in Automatic Regulators for Dynamo-Electric Machines; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

Figure 1 of the drawings is a representation of an elevation of the regulator. Fig. 2 is a longitudinal sectional view of the dynamo-machine, and Fig. 3 is a detail view showing the iron cores and the extended pole-piece.

This invention has relation to regulators for dynamo-electric machines; and it consists in the construction and novel arrangement of devices, as will be hereinafter fully described, and particularly pointed out in the claims appended.

A A A designate three electro-magnets, the two outside ones being wound in the same direction, while the center one is wound in the opposite direction, said magnets being formed of two or more courses of No. 14 insulated copper wire perfectly insulated from the iron cores and also from the spool-heads, should the spool-heads be made of metal, as the cores of the electro-magnets are a portion of the shunt-circuit. These electro-magnets are to be connected in branches of the main or lamp circuit, and are constructed in this peculiar manner in order to offer the least resistance to the passage of the main current passing through them. This mode of winding is used in order to have the two outside electro-magnets of a like polarity, leaving the center electro-magnet of an opposite polarity, thus giving two bipolar electro-magnets.

B B designate a soft-iron yoke, into which are screwed or otherwise secured the soft-iron cores of the three electro-magnets A A A. The lower end of the central electro-magnet core is provided with a flat elongated head or terminal, C^2. To this elongated head are fastened the two current-reversing armatures F and F′ by two pieces of thin steel, in order to make them flexible.

F and F′ designate two soft-iron pole-changing or current-reversing armatures having flexible ends, which are attached to the elongated head C^2 of the central electro-magnet. The opposite ends of the armatures F and F′ are each provided with two platinum points, one on each side of the armature. Securely attached to, but insulated from the two soft-iron armatures, F and F′, are two metallic return strips or keys, F^2 and F^3, which must be made slightly elastic, having their extreme ends also provided with two platinum points each, one on each side of the keys or strips.

G and G′ designate two insulating-blocks of any suitable non-conducting material, separating the two keys or strips F^2 and F^3 from the two soft-iron armatures F′ and F.

H and H′ designate two metallic stops, each provided with two platinum points on each side of the stops. The two stops are securely fastened to the braces or stands K and K′. To the stop H′ is secured a wire connection, supplying the current to the fine wire wound on the outside of the coarse wire of the field-magnets No. 1 and No. 3, and to the stop H is secured a wire connection, supplying the current to the fine wire wound on the outside of the coarse wire of the field-magnets No. 2 and No. 4.

I and I′ designate two metallic brackets securely fastened to the braces or stands K and K′, but so fastened as to insulate the brackets I and I′ from the two stops H and H′. The ends of the two brackets I and I′ are bent inward, so as to face each side of the stops H and H′, said bent ends being provided with adjustable platinum-points.

J, J′, J^2, and J^3 designate four metallic screws fitting tight in the ends of the brackets I and I′, having their ends terminating in platinum points to be capable of nice adjustment in the two brackets I and I′. To the bracket I is secured a wire connection from the fine wire on the outside of the field-magnet No. 3, and to the bracket I′ is secured a wire connection from the fine wire on the outside of the field-magnet No. 4.

K and K′ designate two braces or stands, made of any suitable non-conducting material,

suitably secured to the case L. To the two braces or stands K and K′ are secured the two stops H and H′ and the two brackets I and I′, but so attached as to insulate the stop H from the bracket I, and the stop H′ from the bracket I′.

L designates any suitable form of case or frame for receiving the regulating mechanism and composed of any suitable material.

M′ designates a metallic strip or plate secured to the cross-piece L′ of the case or frame L, against which operate the thumb-nuts N and N′. To the strip M′ is secured a wire connection, M, connecting the strip M′ to the negative or return wire E of the main or lamp circuit.

S and S′ designate two spiral springs attached to the two metallic strips or keys F^2 and F^3, with their free ends terminating in two square or triangular screw ends, which pass through the strip or plate M′, and are provided with two metallic nuts each, N and N′, and are intended to secure the proper tension to the armatures F and F′, and also to serve as a pathway for the return-current from the fine wire wound on the outside of the field-magnets of the dynamo-electric machine.

L^2, L^2, L^2, and L^2 represent any suitable form of opening in the case or frame L to admit a screw-driver or other tool suitable to adjust the screw platinum points J, J′, J^2, and J^3.

d d d and *d′ d′ d′* represent the wire connections proceeding to and from the low-resistance magnets A A A, and show the manner of connecting the magnets in the main or lamp circuit.

m designates a wire connection, being the termination of the derived circuit from the positive wire of the main or lamp circuit D, commencing at the point T, and connecting directly to the yoke B, making the core of the electro-magnet A a part of the derived or shunt circuit to supply the current to the fine wire wound on the outside of the field-magnets of the dynamo-electric machine. The changes necessary to be made in the dynamo-electric machine, making it a part of the regulator, are as follows:

U designates the frame or stand of the dynamo.

U′ designates the journal boxes or bearing, in which fits the armature-shaft R.

X X X X designate the iron cores, on which is wound the fine and coarse wire forming the field-magnets.

X′ X′ X′ X′ designate the extended pole-pieces, secured to the cores of the dynamo, and between which rotates the armature Q.

W W W W designate the space around the iron cores of the field-magnets, in which is wound the coarse wire.

Y Y′ Y^2 Y^3 designate the space on the outside and around the coarse wire, in which is wound the fine wire, said fine wire to be wound in the same direction as the coarse wire.

Z Z′ Z^2 Z^3 Z^4 designate the bobbins wound on the revolving armature.

V designates the commutator.

V′ V^2 designate the metallic brushes for taking up the current induced in the armature.

P P P P designate the spool-heads on the field-magnets, between which is confined the coarse and fine wire forming the said field-magnets.

I make no further claims to any improvement in the dynamo-electric machine more than the mode of constructing the field-magnets—viz., winding them first with coarse wire next the iron cores; then on the outside of the coarse wire winding a greater number of turns of fine wire. The coarse wire on the field-magnets is all connected together in series, and connecting through the line, brush, and armature back to the coarse wire of the field-magnet cores, making the coarse wire of the field-coils a part of the main or lamp circuit. The fine wire, however, is connected from the main line in a derived circuit, and each diagonally-opposite pair of coils are connected together, back through the current-reversing mechanism to the negative wire of the main line or lamp-circuit.

The mode of operation of this current-regulating device is as follows, viz: At the commencement of rotation of the armature of the dynamo-electric machine, which rotates between the pole-pieces of the field-magnets, there will be sufficient residual magnetism to induce an electric current in the revolving armature, which, being gathered by the brushes sent out on the line, through the lamps, back around the field-magnet through the coarse wire, increasing the magnetism of the field, which causes a further induction of current in the revolving armature and line until sufficient current has been induced to partially form ares at the junction of the carbons in the lamps, which action places an increased resistance in the main circuit, which resistance causes a certain amount of the current in the main circuit, commencing at the point T on the positive wire of the main circuit to be shunted, through the wire *m* to the yoke B of the electro-magnets A A A, core of central magnet, C^2, armatures F and F′ of the pole-changing mechanism, stops H and H′, wire connections *a* and *b* to the fine wire wound on the outside of the field-magnets No. 1 and No. 3 by the wire of *a*, and the field-magnets No. 2 and No. 4 by the fine wire *b*, these field-magnets being diagonally opposite each other and connected together. Thus No. 1 and No. 3 are connected together by their terminating inside wire, and fine-wire coils on No. 2 and No. 4 are connected together by their terminating inside wires, thus making the fine-wire magnet-coils wound on the outside of the coarse wire of the field-magnets No. 1 and No. 3 of an opposite polarity, and also the fine coils on the outside of the coarse wire of the field-magnets No. 2 and

No. 4 of an opposite polarity; but bear in mind that the fine wire forming the high-resistance coils on the outside of the coarse wire forming the field-magnet coils of the dynamo-electric machine is wound in exactly the same direction as the coarse wire. Now, by the wire connections *a'* and *b'* from the outside ends of the fine-wire coils on the field-magnets to the brackets I and I', lower adjustable point of platina to the platina points on the strips or keys F^2 and F^3, spiral springs S and S', square or triangular screws O and O', nuts N and N', plate M', wire connection M, to the negative or return wire E of the dynamo-electric machine. Now, so long as the spiral spring's tension is sufficiently great to keep the armatures F and F' and the keys F^2 and F^3 in contact with their lower points, as shown in the drawings, then the shunted current will flow through the coils on the outside of the coarse wire of the field-magnets in the same direction as the main current flows through the coarse wire of the same field, thereby increasing their magnetism greatly, or until sufficient current has been induced in the revolving armature to light up to or near to the normal arc all the lamps in circuit. After having all the lamps in circuit lighted is the time to adjust the tension of the spiral springs S and S', and they are to be so adjusted that one of the pole-changing or current-reversing armatures F and F' will be attracted by the electro-magnets A A A in advance of the other—that is, the tension on the spiral spring of one shall be somewhat greater than the other—in order that it will require the electro-magnets A A A to be more strongly magnetized to attract the second pole changing or reversing armature. Now, we will suppose one or more lamps on the main circuit to be switched or automatically cut out of circuit. We will then have more current than needed to maintain the remaining lamps; hence the arcs of the lamps then in circuit would tend to become longer, increasing the resistance, and at the same time shunting more current, which causes the increase of current sufficient to increase the magnetism of the electro-magnets A A A, attracting the weaker pole-changing or current-reversing armature—for instance, say F—opening the circuit, supplying the shunt-current to the outside fine wire of one pair of field-magnets—say No. 1 and No. 3—these magnets being diagonally opposite to each other and of opposite polarity, when the thus attracted armature will either remain open or commence vibrating just sufficiently to neutralize the fields to the extent of the one or more lamps cut out of circuit by weakening the field-magnetism by depriving one pair of field-magnets of the assistance of the shunt-current on the outside of said field-magnets. Now, should additional lamps be cut out of circuit, this arc will cause the second current-reversing armature to be attracted by the increase of magnetism in the electro-magnets A A A, thus opening the circuit to the fine wire around the other pair diagonally opposite the field-magnets—say No. 2 and No. 4—leaving the coarse wire of the field-magnets to perform the work of maintaining the lamps in circuit unaided by the shunt circuit or current flowing through the fine wire on the outside of the field-magnets. A still further removal of lamps or lights from the circuit will cause a further attraction of the weaker armature—say F—which has already closed the upper platina point on the key F^2 against the lower platina point of the stop H, (the adjustment of the upper adjustable platina points of the brackets I and I' being such as to close the points on the keys F^2 and F^3 with the lower platina points of the stops H and H' first, thus requiring an increase of magnetism or attraction in the electro-magnets A A A, to spring the keys F^2 and F^3, which are elastic, to close the upper platina points on the upper side of the armature F and F' against the upper adjustable platina points of the brackets I and I',) to form a connection with the upper point of armature F, with the upper adjustable platina point in the bracket I, thus sending the derived or shunt circuit through the fine wire on the outside of the coarse wire, forming the field-magnets—say No. 1 and No. 3—of one pair of diagonally-opposite fields in a direction opposite to that flowing through the coarse wire of the same field-magnets, which neutralizes the magnetism of that pair of diagonally-opposite field-magnets to the extent of the resistance in the main line, inducing a correspondingly less amount of current in the armature of the dynamo-electric machine, requiring less work on the part of the engine, and saving of fuel under the boilers. A continued reduction of lamps in circuit brings into action the second current-reversing mechanism, reversing the direction of the current flowing through the other diagonally-opposite pair of field-magnets in the fine wire wound on the outside of them, thus neutralizing the magnetism.

It is plain to be seen that the combined neutralizing effects of all four of the fine-wire coils will leave a field of force capable of inducing but a small amount of current in the armature of the dynamo-electric machine. Now, to suddenly switch into circuit any number of lamps momentarily causes a decrease of current in the line; hence a loss of magnetic attraction in the magnets A A A, causing them to allow the spiral springs S and S' by their tension to draw down the armatures, and keys to close their points of platina in contact with the upper points of the stops H and H', and the lower adjustable platina points of the brackets I and I', changing the direction of the current in the fine wire on the outside of the field-magnets to the same direction as the main current flowing in the coarse wire forming the fields, assisting the coarse wire in strengthening the magnetism, causing an in-

crease of induction in the rotating armature of the machine until all the lights in the circuit are again lighted to or near to their normal arc, the derived or shunt circuit on the outside of the fields and the coarse wire on the inside of the same fields both operating mutually, of course any intermediate action to be governed by bringing either one of the reversing-armatures into operation.

It is plain to be seen that there can possibly be no permanent polarization of the iron cores of the field-magnets, as a slowing of the engine will cause the armatures of the reversing mechanism to send a derived current through the fine-wire coils in the outside in the same direction as the coarse wire, acting mutually with each other in magnetizing the field-magnet cores.

Having described my invention, what I desire to secure by Letters Patent is—

1. An automatic current-regulator for dynamo-electric machines, composed of any suitable form of current-breaking, vibrating, and current-reversing mechanism connected in a derived circuit or shunt from the main-line or lamp circuit, operated by one or more low-resistance electro-magnets connected in the main-line or lamp circuit, having the derived or shunt circuit through the current-breaking, vibrating, and current-reversing mechanism so connected as to pass through a set of fine-wire coils wound on the outside of the coarse wire forming the field-magnet coils of any form of dynamo-electric machine, the fine wire on the outside of the field-magnets being wound in the same direction as the coarse wire and connected together in diagonally-opposite pairs to produce magnets of unlike polarity, but of the same polarity as is produced by the coarse wire, for the purpose of automatically regulating the current induced in the armature of such dynamo-electric machine and supplied to the lamp-circuit, as specified and set forth.

2. The field-magnet coils of a dynamo-electric machine, made of a number of turns of coarse insulated copper wire connected in series, so as to make like and unlike poles opposite each other, and having the coarse wire a part of the main or lamp circuit, and having wound on their outside and in the same direction a greater number of turns of fine wire, connected together in diagonally-opposite pairs and supplied from a derived or shunt circuit from the main-line or lamp circuit through any suitable form of current-breaking, vibrating, and current-reversing mechanism operated by one or more low-resistance electro-magnets connected in the main-line or lamp circuit for the purpose of automatically regulating the current induced in the armature of the dynamo-electric machine, and supplied to the lamp-circuit, as specified and set forth.

3. A dynamo-electric machine having its field-magnet coils formed of a number of turns of coarse insulated copper wire connected in series, and in the main-line or lamp circuit, so as to make the coarse wire a part of the main-line or lamp circuit, with a greater number of turns of fine wire wound in the same direction on the outside of the coarse wire, and so connected together as to make the iron cores of the field-magnets the same polarity as the coarse wire, but connected together in diagonally-opposite pairs, and supplied from a derived or shunt circuit from the main-line or lamp circuit, in combination with any suitable form of current-breaking, vibrating, and current-reversing mechanism, composed of one or more low-resistance electro-magnets connected in the main-line or lamp circuit operating such mechanism.

In testimony whereof I affix my signature in presence of two witnesses.

JOHN EDWARD WATSON.

Witnesses:
GEO. S. ALLISON,
LOUISE W. STONEBRAKER.