(No Model.)

3 Sheets—Sheet 1.

R. J. SHEEHY.

ELECTRIC LIGHT REGULATOR AND CUT OUT.

No. 295,058. Patented Mar. 11, 1884.

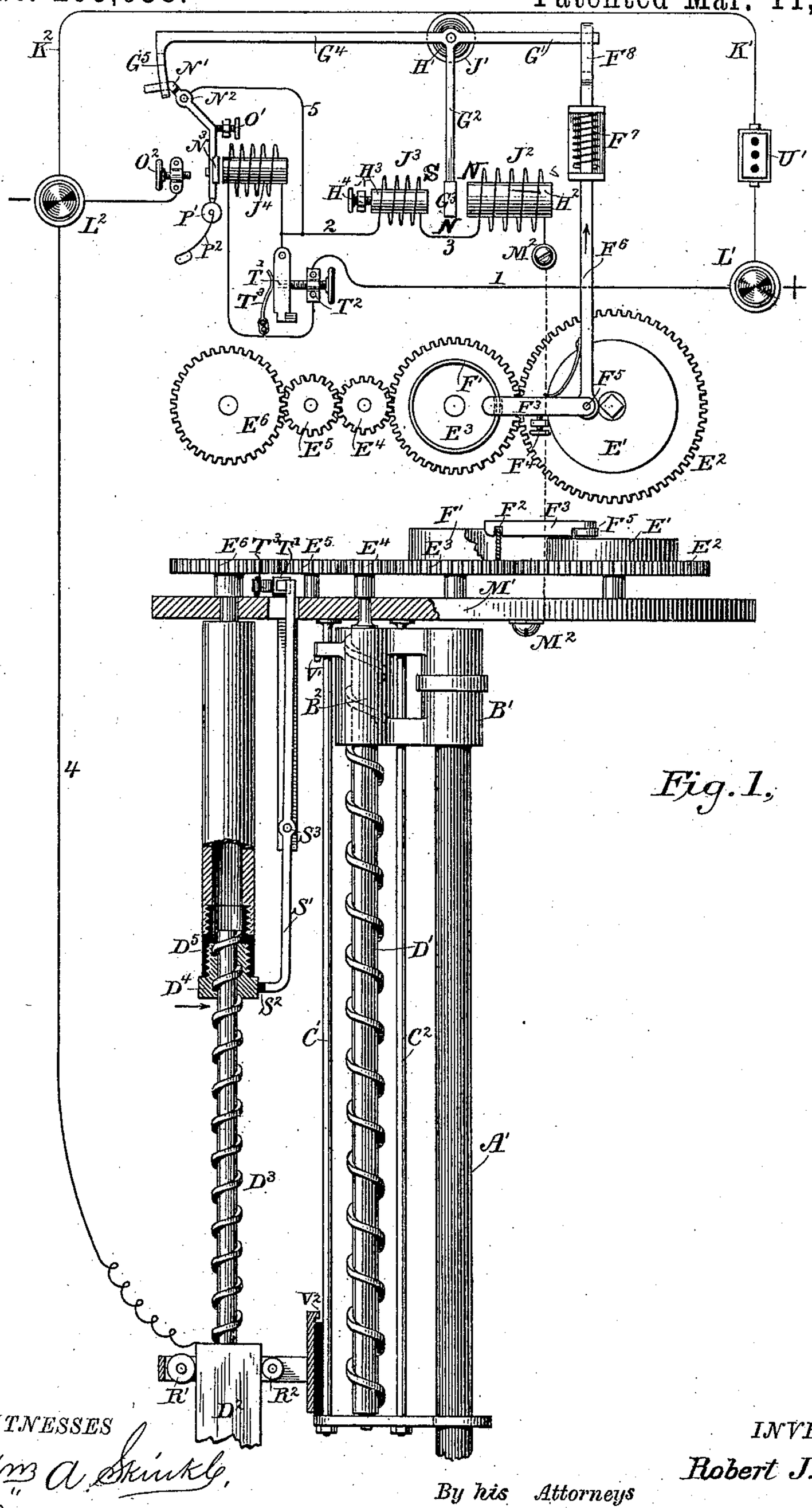

Fig. 1.

WITNESSES

Wm A. Skinkle.

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(No Model.) 3 Sheets—Sheet 2.

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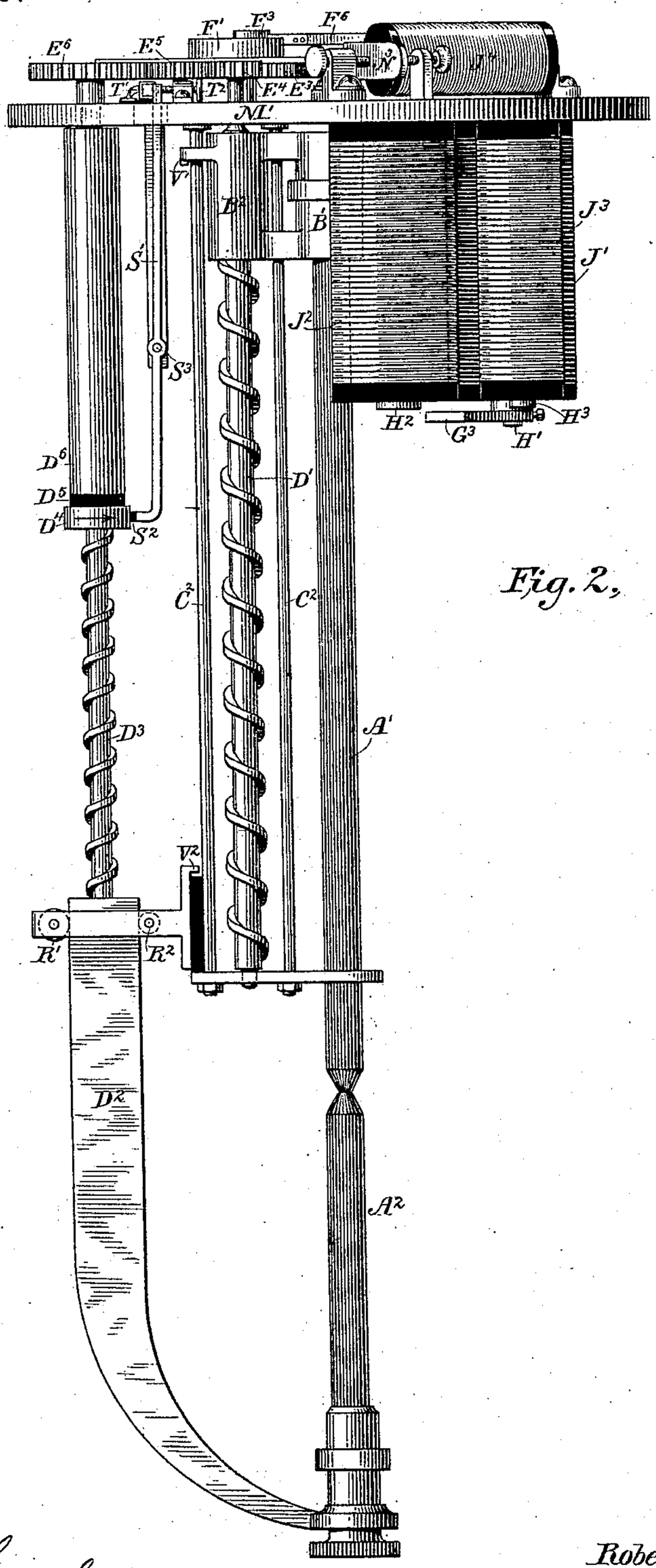

Fig. 2.

WITNESSES

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(No Model.) 3 Sheets—Sheet 3.

R. J. SHEEHY.

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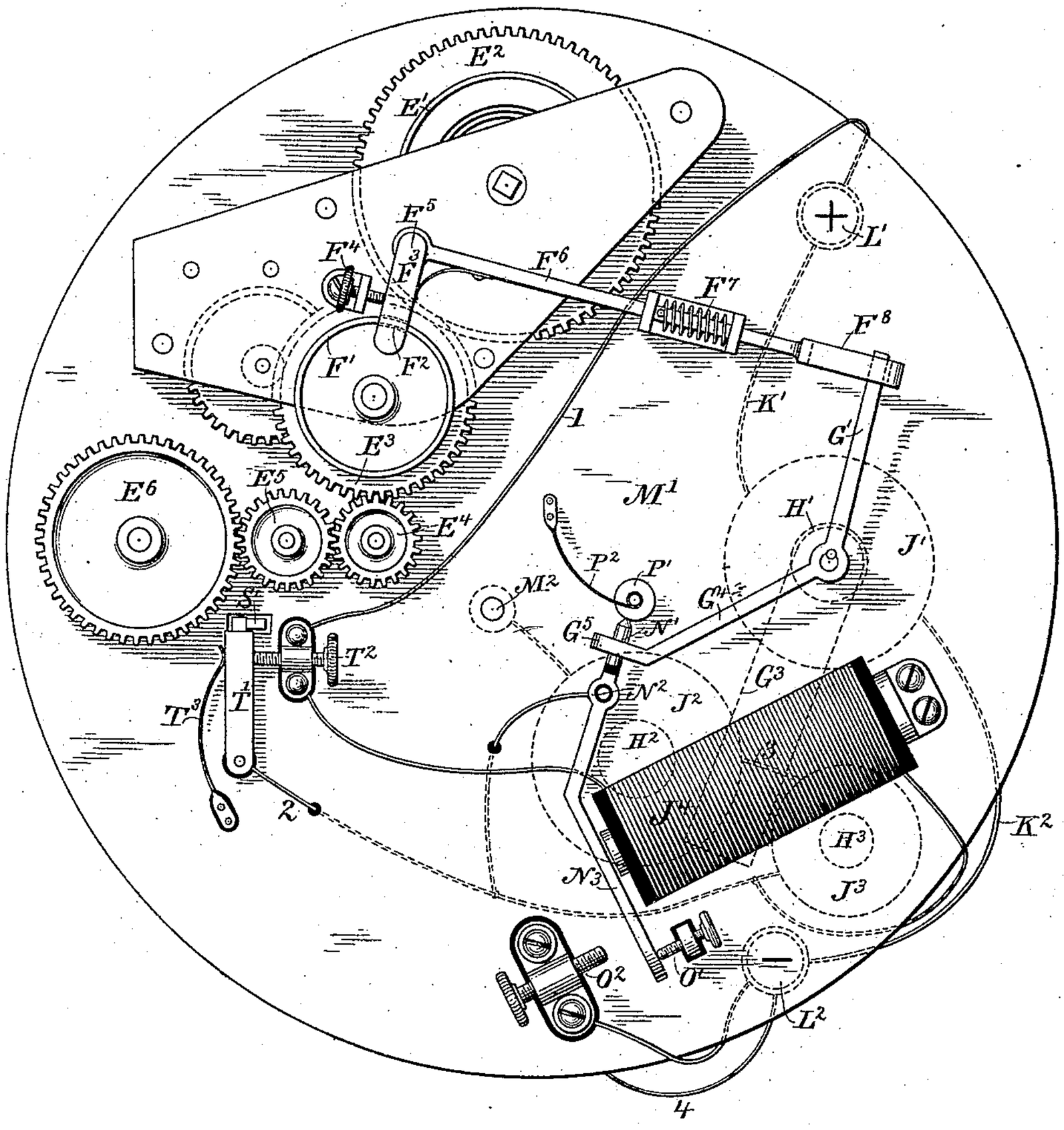
Fig. 3.



WITNESSES

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INVENTOR

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UNITED STATES PATENT OFFICE.

ROBERT J. SHEEHY, OF NEW YORK, N. Y.

ELECTRIC-LIGHT REGULATOR AND CUT-OUT.

SPECIFICATION forming part of Letters Patent No. 295,058, dated March 11, 1884.

Application filed July 17, 1882. (No model.)

To all whom it may concern:

Be it known that I, ROBERT J. SHEEHY, a citizen of the United States, and a resident of New York, in the county and State of New York, have invented certain new and useful Improvements in Electric-Light Regulators and Cut-Outs, of which the following is a specification.

My invention relates to that class of electric lights in which the so-called "electric arc" is maintained between two carbon electrodes. It particularly relates to a class of devices or appliances commonly denominated "regulators," the office of which is to automatically maintain said electrodes in that relation to each other which is essential to the production of a uniform and maximum degree of illumination, and also to certain devices or appliances commonly denominated "cut-outs," the function of which is to automatically withdraw from an electric circuit in which two or more lights are included any one of said lights in the event of its failure to operate, or in case it presents an abnormal resistance to the passage of the current from any cause.

To these ends my invention consists in a method of and apparatus for automatically maintaining the proper relative positions of said electrodes; in a method of and apparatus for automatically withdrawing a defective lamp from the electric circuit, and in automatically reintroducing said lamp into said circuit when the conditions necessary for successful operation are restored.

With reference to the said system of regulation, the several steps of my improved method may be described in general as follows:

First. The carbon electrodes are subjected to the action of a constance force, preferably that of a clock-work mechanism, which tends to bring them into contact with each other. In applying such force I prefer to make use of mechanical devices, whereby it acts to simultaneously depress the positive and elevate the negative electrode.

Second. I employ a novel form of clutch or clamping device actuated by electro-magnetism, so organized as to grasp (through intermediate mechanism) said electrodes at the proper time, and to impart to them the mechanical force exerted by said electro-magnetism, which is sufficient to overcome the constant force acting in the opposite direction, and thereby to maintain said electrodes in the relative position best suited to the development of a maximum intensity of light.

Third. The electro-magnetic force may be created by the independent action of the light-producing current, so that an increase in the strength of said current will produce a separation of the electrodes, while a decrease will cause them to approximate.

Fourth. In order to secure greater efficiency in the operation of the clutch, I prefer to derive the electro-magnetic energy actuating the same from the forces of attraction and repulsion existing between an electro-magnet situated in the main or lighting circuit and an armature which is polarized by that portion of the current traversing a derived circuit which spans both the electric arc and the said electro-magnet. The helices employed are so wound that like magnetic poles are made to confront each other. Accordingly, when there is but little resistance in the light-circuit, the said electro-magnet will be excited to a high degree of magnetization and the said armature to a low degree, and a strong attraction will result; but as the resistance of the light-producing circuit is increased, the strength of the current traversing the shunt-circuit will be augmented, and the said armature will therefore attain to a higher degree of polarity, and a repulsion will be gradually substituted for the previously-existing attraction. Thus the abnormal approach of the electrodes establishes the conditions which are to cause their separation, and vice versa. By these appliances I am enabled to maintain a comparatively uniform length of arc and degree of illumination.

With reference to that part of my invention which provides for the withdrawal of a defective lamp from a circuit in which several lamps are placed in series, and the reintroduction of restored lamps, my method may be described in general as follows:

First. I make use of an armature, which may be the same as that hereinbefore referred to, and in like manner polarized by a derived current. When the electrodes become so far separated as to introduce into the light-circuit an abnormally-great resistance, rendering it de-

sirable that the light should be withdrawn from the circuit, the resulting movement of said polarized armature will cause the closing of a shunt or cut-out circuit of small resistance spanning the electric arc.

Second. The movement of the polarized armature may result from its attraction for a stationary piece of soft iron; but I prefer to substitute therefor an electro-magnet situated in the light-circuit, the polarity of which is opposite to that of the said polarized armature. Its attractive force therefore increases in proportion to the increase of the resistance of the electric arc.

Third. To automatically reintroduce into the circuit an electric lamp after its normal conditions of successful operation have been restored, I avail myself of the pressure of the electrodes upon each other. This pressure (transmitted through intermediate mechanism) is caused to actuate a switch, thereby temporarily introducing into the main circuit an extension or loop, in which is included an electro-magnet of small resistance, operating to immediately interrupt the hereinbefore-mentioned shunt of low resistance, and thereby to permit the lighting-current to again traverse the electrodes and to relight the lamp in the manner described above.

My invention further comprises certain details of mechanism, the particular subject-matter claimed being hereinafter specifically designated.

In the accompanying drawings, Figure 1 is a theoretical diagram, designed to exhibit clearly to the eye the general organization of electric circuits employed in connection with my regulator, as well as some of the mechanical devices which I find it convenient to use. Some of these devices are represented both in plan and elevation. Fig. 2 is a front elevation, and Fig. 3 a plan, of a convenient form of my improved regulator, exhibiting the details of construction.

Referring to the figures, the upper or positive carbon, A', is attached by the clamp B' to the nut B^2, sliding vertically along the guide-rods C' and C^2 as the screw D' is revolved within said nut. The lower or negative carbon, A^2, is carried by the bracket D^2, which is itself supported by a screw, D^3, turning in a revolving nut-block, D^4, and insulated at D^5. The thread of the last-mentioned screw is inclined in a direction opposite to that of the thread of the screw D'. When, therefore, the clock-work mechanism (which is actuated by a spring contained in the drum E', and which comprises the wheels E^2, E^3, E^4, E^5, and E^6) is in operation, the carbon A' will be caused to descend as the wheel E^4 revolves, and the carbon A^2 to ascend as the wheel E^6 revolves. Any force which acts to reverse the direction of the movement of the clock mechanism will, in like manner, cause the carbons to separate.

Upon the upper face of the wheel E^3 is formed a rim or annular projection, F'. (Shown both in elevation and plan in Fig. 1.) This rim enters a curved recess, F^2, formed in the clamp F^3. The breadth of this recess is sufficient to freely permit the revolution of the annular projection F', provided that the said clamp F^3 remains in its normal position—that is, in contact with the stop F^4, as shown in Fig. 1. The clamp F^3 is pivoted at F^5 to one end of a link, F^6, which, under the influence of the spring F^7, normally holds the clamp against the adjustable stop F^4. A slight movement of said link in the direction indicated by the arrow will cause the clamp F^3 to impinge angularly upon the rim F', and thus to arrest its revolution. The other end of the link F^6 is provided with a longitudinal slot or fork, F^8, loosely receiving one end of the lever G', which is rigidly connected to the axial core H' of the electro-magnetic coil J'. The core H' is pivoted upon its vertical axis, so as to be capable of revolving thereupon. The helix J' is included in a derived circuit, $K'K^2$, spanning both the luminous arc and the regulating mechanism. A soft-iron extension or pole-piece, G^2, is also rigidly connected to the core H', expanding into an armature, G^3, facing the electro-magnet J^2; or the core may be prolonged to form said armature, which latter plan I prefer. The electro-magnet J^2 is situated in the main circuit of the light, which may be traced from the positive binding-screw L, by wire 1, normally-closed contact $T'T^2$, and wires 2 and 3, to the electro-magnet J^2, which is so wound as to develop a polarity in the pole confronting the armature G^3 similar to that exhibited by said armature. From the electro-magnet J^2 the current passes to the plate M' at the point M^2, thence to the electrodes A' and A^2, bracket D^2, and wire 4, to the negative terminal L^2. It will therefore be understood that when the carbon electrodes are in contact the resistance of the arc will be *nil* and a powerful current will traverse the coils of the electro-magnet J^2, while at the same time the current traversing the shunt-wire $K'K^2$ will be so feeble that the armature G^3 will be but very slightly polarized, and will accordingly be attracted toward instead of repelled from said magnet, thereby causing the lever G' to propel the link F^6 in opposition to the spring F^7, whereby the clamp F^3, impinging upon the rim F', will be caused to grasp said rim and move the train of wheel-work in a direction opposite to that normally caused by its actuating source of power. The electrodes A' and A^2 will be accordingly separated from each other. This separation introduces a resistance into the main circuit, which, as it gradually increases, will, in accordance with the established laws of derived circuits, cause a greater proportion of the current to traverse the shunt-circuit $K'K^2$, thus augmenting the strength of the magnetic polarity of the armature G^3 and establishing a greater degree of repulsive force between said armature and the electro-magnet J^2. We may

thus consider that between the magnet J^2 and its armature an attraction and a repulsion simultaneously exist, the former increasing in strength as the electrodes approximate and the latter as they separate. The armature is also under the influence of the constant force of the spring F', and under the most favorable conditions said armature will assume a normal intermediate position, to one side or the other of which it will vibrate, according as the resistance of the light tends to become abnormally great or small.

I will next describe the mechanism for withdrawing the light from the circuit when, for any reason, it becomes inoperative.

I have shown a lever, G^4, rigidly connected to the core H′, which latter, as hereinbefore explained, is capable of revolution upon its vertical axis. This lever is provided within its elbow G^5 with a longitudinal slot, into which one end of the lever N′ enters. The lever N′ is fulcrumed at N^2, and carries an armature, N^3, which plays between the contact-stops O′ O^2, and is retained in either of its extreme positions by some suitable device, such as a roller, P′, mounted upon a spring, P^2. The armature G^3 is rigidly attached to the core H′, as heretofore explained. When, therefore, an abnormal resistance is from any cause created in the light-circuit, it will tend to increase the strength of current traversing the coils of the electro-magnet J′, and hence the armature G^3 will become more highly polarized. This polarity will be such as to cause the armature to be repelled from the magnet J^2 and to exert an attraction for the soft-iron core H^3. In practice I prefer to envelop this core in a coil, J^3, and to include said coil in the main or light circuit in such manner as to develop therein an opposite polarity to that manifested by the armature G^3. When this attraction exceeds a predetermined maximum strength, the extent of which is capable of regulation or adjustment by means of the set-screw H^4, which moves the core to and fro in the direction of its length, the armature G^3 will move over to the core H^3, the lever N′ will be moved so as to bring the armature N^3 against the contact-stop O^2, and a shunt-circuit of small resistance will be closed, which will practically withdraw the lamp and its electro-magnets from the main circuit. The circuit in such case passes from the terminal L′, by wire 1, to contact-stop T′ T^2, wires 2 and 5, armature-lever N^3, contact-stop O^2, and thence to terminal L^2. Upon the removal of the disturbing cause, so that the clock mechanism again causes the approach of the electrodes, the light will be automatically re-established in the following manner: Referring to Fig. 2, the lower carbon is sustained by a curved holder, D^2, rigidly extending from the screw D^3, which works within the revolving nut D^4. The holder D^2 runs between the guide-rollers R′ R^2. These direct the vertical motion of the holder D^2, and also serve as a fulcrum, so that the pressure of the upper electrode upon the lower causes the holder D^2 to turn or twist within the rollers—that is, so that the screw D^3 moves in the direction indicated by the arrow D^4, while the lower end of the holder D^2 moves in the opposite direction. The threads of the screw D^3 fit loosely within those of the nut D^4, and the barrel D^6, sustaining said nut, has more or less freedom of motion within its collar in the frame-work M′. The action of the pressure of the electrode is therefore to strain the nut D^4 in the direction indicated by the arrow, thereby pressing the lower end, S^2, of the lever S′, (which normally presses against said nut,) and causing the upper end of said lever S′ to press the lever T′ away from its contact-point T^2. The spring T^3 acts to return the lever T′ to its normal position when the pressure of said lever S′ is withdrawn. The lamp is now in condition to continue its normal operation in the manner already described. By means of this apparatus I am enabled to automatically remove the defective lights from a circuit and to reintroduce them when the cause of the difficulty is withdrawn.

I find in practice that the helices of the magnet J′ in the shunt-circuit K′ K^2 should be composed of thin wire presenting considerable resistance; but the said helices should not include all of the resistance of the said shunt-circuit, for were such the case the polarization of the armature G^3 would be too great. It is therefore advisable to introduce into said shunt-circuit an additional adjustable resistance, U′; or, having empirically determined the proper proportion between the resistances of said shunt-line and the coils of said electro-magnet for a given light and strength of current, the lamps may be constructed in accordance therewith, and the artificial resistance will in such case be unnecessary. When the carbon electrodes have been consumed to such extent that it is desirable to extinguish the light, a contact-point, V′, will have descended with the positive carbon, so as to impinge upon a contact-point, V^2, which is connected by wire 4 to the binding-post L^2. This will establish a shunt which will extinguish the light, and thus prevent injury to the metallic portions of the apparatus.

In Fig. 2 I have shown in elevation the details of construction of a practical working apparatus. The same appears in Fig. 3 in plan somewhat enlarged. The apparatus is attached to a base of metal, M′, which supports on its upper surface the clock-work mechanism, the clamp-levers F^5, F^6, and G′, and the cut-out devices, including the magnet J^4.

The electro-magnets J′ J^2 J^3, the armature G^3, the screws D′ and D^3, the guide-rods C′ C^2, and the lever S′ are supported from the under surface of the plate.

As corresponding parts are designated by similar letters of reference, a detailed description of the several parts is deemed unnecessary.

I claim as my invention—

1. The combination, substantially as hereinbefore set forth, of the electrodes of an arc-lamp, the mechanical clamping mechanism, a helix situated in a shunt-circuit spanning said electrodes, a core revolved within said helix upon its central longitudinal axis, and means, substantially such as described, co-operating with said core, to operate said clamping mechanism.

2. The combination, substantially as hereinbefore set forth, of the electrodes of an arc-lamp, mechanism for producing a constant force tending to diminish the distance between said electrodes, a grasping mechanism, a helix situated in a shunt-circuit spanning said electrodes, an electro-magnetic core within said helix revolving upon its central longitudinal axis, and means, substantially such as described, co-operating with said core, to operate said grasping mechanism and separate said electrodes.

3. The combination, substantially as hereinbefore set forth, of the electrodes of an arc-lamp, a mechanical clamping device, mechanism for producing a constant force tending to detain said clamping device in a non-clamping position, a cylindrical core revolving on its vertical longitudinal axis under reciprocal changes in the strengths of the main and branch currents, operating to bring said clamping mechanism into action when turning in one direction, and to return said clamping device to said non-clamping position when turning in the other direction.

4. The combination, substantially as hereinbefore set forth, of a central electro-magnetic core revolving upon its vertical longitudinal axis, and polarized by the current which traverses a derived circuit spanning an electric arc, a right-angled extension to said core, an electro-magnet polarized by the light-producing current to a similar polarity to that of said extension, but of greater intensity, for actuating said extension, and a clamping mechanism of an electric-arc light actuated by the rotary movements of said core.

5. The combination, substantially as hereinbefore set forth, of the electrodes of an arc light, supported, respectively, by a screw revolving in a nut and a nut revolving upon a screw, mechanism actuated by a spring-power for approximating said electrodes, a clamping mechanism actuated by the movements of a polarized armature for grasping through intermediate mechanism said electrodes and subjecting them to the action of said polarized armature.

6. The combination, substantially as hereinbefore set forth, of the electrodes of an arc-lamp, screw and nut bearings for supporting the same and allowing their vertical motion, mechanism actuated by a spring-power for approximating said electrodes, a core revolving on its central longitudinal axis under simultaneous increases in the strength of current traversing the main circuit and decreases in the strength of current traversing the shunt-circuit, and vice versa, and clamping mechanism actuated correlatively with said movements.

7. The combination, substantially as hereinbefore set forth, of the electrodes of an arc-lamp, a clamping mechanism, a shunt-circuit spanning said electrodes, a helix in said shunt-circuit, a core revolving on its vertical longitudinal axis within said helix, means, substantially such as described, for causing the revolution of said core, and intermediate mechanism whereby the motions of said core are communicated to said clamping mechanism.

8. The combination, substantially as hereinbefore set forth, of the electrodes of an arc-lamp, nut and screw bearings substantially such as described, a train of mechanism actuated by a spring-power for advancing said electrodes toward each other, a shaft, a clamping mechanism by which said shaft may be attached to the said advancing mechanism, a revolving core for impelling said shaft in such direction as to reverse the approximating action of said advancing mechanism, a helix in a shunt-circuit spanning the electric arc surrounding said core, an extension of said core, and an electro-magnet situated in the main circuit for attracting said extension.

9. The combination, substantially as hereinbefore set forth, of an armature polarized by the current which traverses a derived circuit spanning an electric arc, a soft-iron core polarized by the light-producing current to a polarity opposite to that of the said armature, and mechanism operated by the movements of said armature to close a shunt spanning the electric arc.

10. The combination, substantially as hereinbefore set forth, of a core rotated upon its vertical longitudinal axis, and polarized by a current traversing a derived circuit spanning an electric arc, a soft-iron attracting-piece polarized by the light-producing current to a polarity opposite to that of said core, and mechanism operated by the movements of said core upon its axis to close a shunt-circuit spanning the electric arc.

11. The combination, substantially as hereinbefore set forth, of a core situated in the helix of a shunt-circuit spanning an electric arc, an extension-piece of said core, whereby the same may be revolved by virtue of the attraction of said extension-piece for a piece of soft iron polarized by the light-producing current, a second extension of said core, a subsidiary lever operated by the movements of said second extension, and contact-points carried by said subsidiary lever for closing a cut-out shunt-circuit spanning said electric arc.

12. The combination, substantially as hereinbefore set forth, of an extension to a core revolving upon its central vertical axis, two fixed attraction-pieces polarized by the light-producing current for determining the direction in which said core shall turn, mechanisms by which a movement in one direction separates the electrodes, mechanisms by which

given motion in the opposite direction allows their approximation, and mechanisms by which further motion in this latter direction operates a shunting device for short-circuiting said light.

13. The combination, substantially as hereinbefore set forth, of the electrodes of an arc-lamp, one or more co-operating levers slightly turned upon their fulcrums by the pressure of said electrodes one upon the other, contact-points normally together, but separated by the turning of said levers, and a shunt-circuit spanning said arc-lamp thereby opened.

In testimony whereof I have hereunto set my hand this 30th day of June, A. D. 1880.

ROBERT J. SHEEHY.

Witnesses:

DANIEL W. EDGECOMB,

CHARLES A. TERRY.