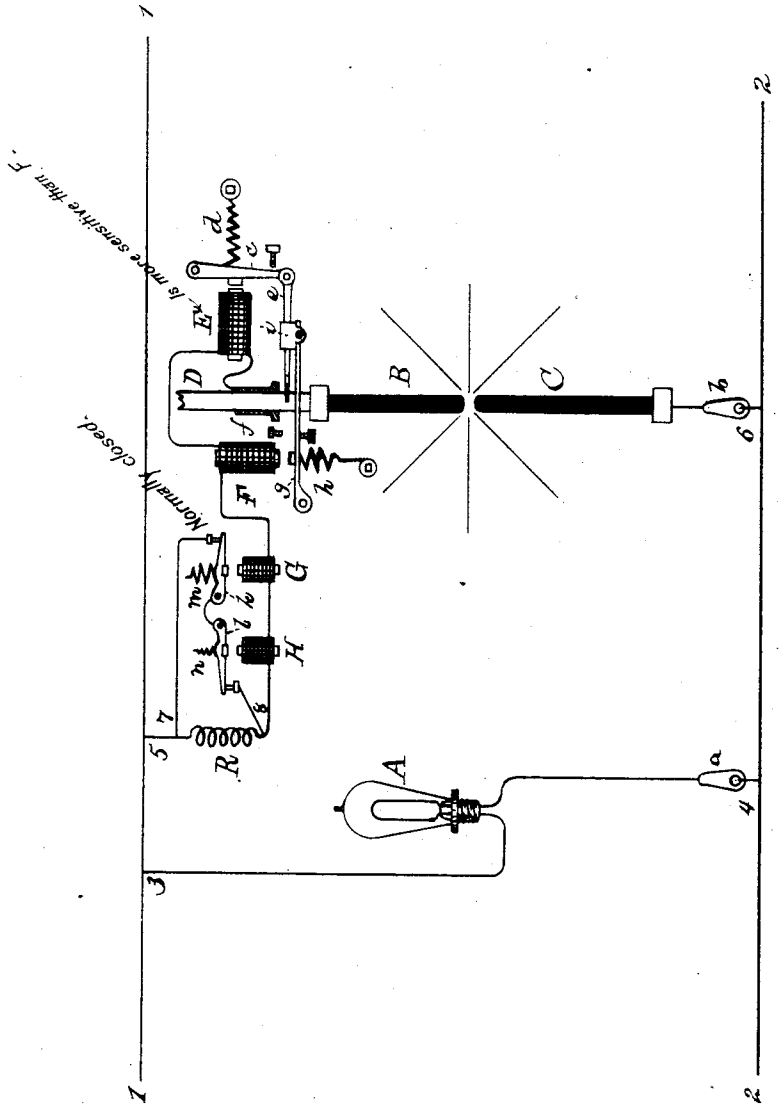
(No Model.)

T. A. EDISON.

ELECTRIC ARC LIGHT.

No. 446,668. Patented Feb. 17, 1891.



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UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF MENLO PARK, NEW JERSEY, ASSIGNOR TO THE EDISON ELECTRIC LIGHT COMPANY, OF NEW YORK, N. Y.

ELECTRIC-ARC LIGHT.

SPECIFICATION forming part of Letters Patent No. 446,668, dated February 17, 1891.

Application filed August 7, 1882. Serial No. 68,651. (No model.) Patented in England August 19, 1882, No. 3,976; in Belgium January 3, 1883, No. 60,002; in Italy January 27, 1883, No. 15,026, and in France April 16, 1883, No. 148,852.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Menlo Park, in the county of Middlesex and State of New Jersey, have invented a new and useful Improvement in Electric Lights, (for which I have obtained Letters Patent in Great Britain, No. 3,976, dated August 19, 1882; in France, No. 148,852, dated April 16, 1883; in Italy, No. 15,026, dated January 27, 1883, and in Belgium, No. 60,002, dated January 3, 1883;) and I do hereby declare that the following is a full and exact description of the same, reference being had to the accompanying drawing, and to the letters and figures of reference marked thereon.

The object I have in view is to produce simple and efficient means for regulating the feed of the upper or positive carbons of arc lamps, more especially designed and adapted for such lamps when arranged in separate multiple-arc circuits and having the cross or multiple-arc circuits completed only through the electrodes of the lamps. These lamps are run from the same conductors as incandescent electric lamps, the regulating mechanism being constructed and arranged to separate the carbon electrodes the proper distance to give the desired resistance at the arc. With a multiple-arc arrangement a constant difference of potential is maintained in the main conductors or those from which the lamp-circuits are taken. When two opposing electro-magnets or solenoids are used for the regulating mechanism located one in a main conductor and the other in the cross or lamp circuit, the former acts simply as a constant force opposing the action of the latter. I have found that the constant opposing force can be efficiently produced by a retracting spring or weight. While a single electro-magnet or solenoid located in the lamp-circuit and an armature or core and retractor might be used to regulate an arc lamp arranged in a multiple-arc circuit by the employment of a gripping-lug or similar device, still I prefer to use for the purpose two electro-magnets or solenoids, both located in the lamp-circuit and acting together to regulate the feed of the upper or positive carbon and to raise it in establishing the arc. Electro-magnets are preferably used for the purpose, but solenoids may be employed. The term "electro-magnets," when hereinafter used, will be understood as including solenoids as equivalent devices. One electro-magnet operates a locking device which locks and releases the holding-rod of the upper carbon electrode. The other electro-magnet works through this locking device to raise the carbon electrode in establishing the arc and in enlarging the distance between the electrodes, if need be, during the burning of the lamp. The armature-lever of the locking electro-magnet has a forked or notched arm pivoted thereto and pressed by the electro-magnet against the carbon-holding rod. The armature-lever and the forked arm are drawn back by a retracting-spring, which is nicely adjusted, so that when the arc is normal the arm will press against the holding-rod with just sufficient force to prevent the further descent of the carbon, and when the arc increases a definite small extent the holding-rod will be released and again instantly locked. The movement of this locking-arm is limited by a stop, and the retracting-spring of the armature-lever is provided with means for permitting adjustment of its tension. The other or lifting electro-magnet has an armature-lever retracted by an adjustable spring and carrying a sleeve box or lock, through which the forked arm of the locking armature-lever works. This magnet may be made less sensitive than the locking-magnet by giving it fewer turns of wire, a more sluggish core, or in any well-known or suitable manner. The lifting electro-magnet is not as sensitive as the locking electro-magnet, the retracting-spring of its armature-lever being adjusted to overcome the magnetic attraction, except when there is a marked increase in the current. Both electro-magnets being in the cross or multiple-arc circuit in which the carbon electrodes are located, they will both be strongly energized when the circuit to the lamp is first completed. The locking-magnet, acting first, will force the notched arm against the holding-rod of the upper or positive carbon, when the lifting-magnet will raise said

arm and the upper carbon, establishing the arc. As the arc increases, the armature-lever of the lifting-magnet drops until it rests on the back contact. The locking-magnet then controls the further downward feeding of the carbon. It being very sensitive and its action being exceedingly quick, it will release and lock the carbon-holding rod with a short and rapid movement, making a regular feed and preventing flicker in the light. To prevent a too rapid descent of the carbon electrode, a retarding device may be employed, such as a ratchet-wheel and reed or pendulum or other form of escapement. A circuit-controller is placed in each arc-lamp circuit, and also in the circuit of each incandescing lamp operated from the same conductors, so that every lamp in the system, whether arc or incandescing, is independent of all the others and can be lighted and extinguished without affecting other lamps.

The object of this invention is, further, to provide a safety device to be used with arc lamps arranged in multiple-arc circuits for preventing a dangerous flow of current when the carbon electrodes touch each other. The touching of the carbon electrodes would form a short circuit and the conductors would be heated by the abnormal flow of current, destroying insulation and setting fire to woodwork with which such conductors may be in contact. The other lamps would also be affected by this short circuit. The means for preventing the formation of this short circuit consists of a resistance which is cut out of circuit when the arc is normal, but which is thrown into series with the carbon electrodes when the flow of current increases to a definite extent by means of an electro-magnet. Another electro-magnet is provided to throw such resistance into series with the carbon electrodes when the circuit is broken. The resistance may be arranged in series with the carbon electrodes, and the electro-magnets be also placed in the lamp-circuit in series with such electrodes. A shunt-circuit is formed around the resistance passing to the back contact of one armature-lever of such electro-magnets and to the front contact of the other lever. The two levers are connected electrically together and form part of the shunt-circuit. The retracting-springs of these levers are so adjusted that the lever making its back contact normally will be drawn away from such contact by the magnet when there is a definite increase in the flow of the current, and the lever making its front contact normally will break contact when the circuit is broken. The movement of either lever away from its normal contact opens the shunt and throws the resistance into series with the carbon electrodes.

The safety device may be used to adapt any arc lamp for a multiple-arc arrangement.

The foregoing will be better understood from the drawing, which is a view, partly diagrammatic, of an arc lamp embodying the invention and showing a multiple-arc arrangement of both arc and incandescing lamps in the same system.

1 2 represent main conductors, which are shown as connected by cross or multiple-arc circuits 3 4 and 5 6. In 3 4 is located an incandescing electric lamp A of any suitable pattern, the circuit being made and broken by a circuit-controller *a*. In the multiple-arc circuit 5 6 are arranged the carbon electrodes B C of an arc lamp. This circuit is made and broken by the circuit-controller *b*. The upper or positive carbon is carried by a sliding rod D, and is fed downwardly by its own weight and that of the rod. The locking and lifting electro-magnets are represented at E F, and are located in the circuit 5 6 in series with the carbon electrodes, such circuit being completed through the electrodes only. The armature-lever *c* of the locking-magnet is retracted by the adjustable spring *d*, and has pivoted thereto an arm *e*, which is provided with a forked or notched end pressed by the magnet against the carbon-holding rod D, close to the long stationary bearing *f*, or between two bearings. The armature-lever *g* of the lifting-magnet is retracted by an adjustable spring *h*. It has a box, sleeve, or loop *i*, through which the arm *e* works loosely. The escapement for retarding the downward movement of the carbon is not shown. By the combined action of the two electro-magnets, as before explained, the upper carbon electrode is lifted to form the arc, and is given a regular downward feed.

It is evident that the locking and lifting electro-magnets may have a multiple-arc relation to each other instead of being in series, as shown, and still be located in series with the carbon electrodes of the arc lamp.

The safety device is composed of a resistance R, located in the arc-lamp circuit 5 6, around which resistance is a shunt 7 8, passing to the back and front contacts of armature-levers *k l* and through such levers. The electro-magnets G H, working such armature-levers, are also in the lamp-circuit. The magnets and armatures, with their back stops, constitute circuit-controllers to render the resistance ineffective or effective, according to the position of the armatures. Lever *k* is retracted by a heavy spring *m*, while *l* is retracted by a weak spring *n*. Lever *k* closes the shunt 7 8 at its back contact, except when there is an abnormal flow of current, while *l* closes such shunt at its front contact, except when the lamp-circuit is broken. The breaking of contact of either lever opens the shunt and throws the resistance into series with the carbon electrodes, such resistance being sufficient to prevent a dangerous flow of current, but allowing the regulating mechanism to act and re-establish the arc.

I do not claim, broadly, in this application the combination of a main circuit, incandescent lamps in multiple-arc branch circuits,

arc lamps in other multiple-arc branches from the same circuit, and resistances in the separate arc lamp branches to reduce the difference of potential effective at the electrodes of the arc lamp, since that is embodied in my application Serial No. 68,659, dated August 2, 1882. The present application embraces a specific arrangement of apparatus and certain combinations relating to a sytem of the character described.

What I claim is—

1. The combination, with the electrodes of an arc lamp, of two electro-magnets or solenoids acting one to lift and the other to lock the upper electrode, such locking magnet or solenoid being more sensitive than the lifting magnet or solenoid, and both said magnets or solenoids being located in series with the electrodes of the lamp and controlling the arc by their combined action, substantially as set forth.

2. The combination, with an arc lamp adapted to be located in a multiple-arc circuit, of a magnet in series with the lamp, an armature for the magnet adjusted to maintain a definite position while the arc is of the desired length and to move when the carbons come together, thus increasing the flow of current, a circuit-controller operated by said magnet, and a resistance made effective in series with said lamp by the circuit-controller, substantially as described.

3. The combination, with an arc lamp located in a multiple-arc circuit, of a resistance in the lamp-circuit, and two electro-magnets, also in the lamp-circuit, having armature-levers closing a shunt around such resistance at their back and front contacts, respectively, substantially as set forth.

4. The combination, with an arc lamp located or adapted to be located in a multiple-arc circuit, of two magnets in series with the lamp, an armature for each magnet, one armature operating on an increase and another on a decrease of current, and a resistance made effective in the multiple-arc circuit by movement of either armature, substantially as described.

This specification signed and witnessed this 3d day of June, 1882.

THOS. A. EDISON.

Witnesses:

RICHD. N. DYER,

EDWARD C. ROWLAND.