(No Model.)

W. M. THOMAS.

ELECTRIC ARC LAMP.

No. 332,971. Patented Dec. 22, 1885.

Fig. 1.

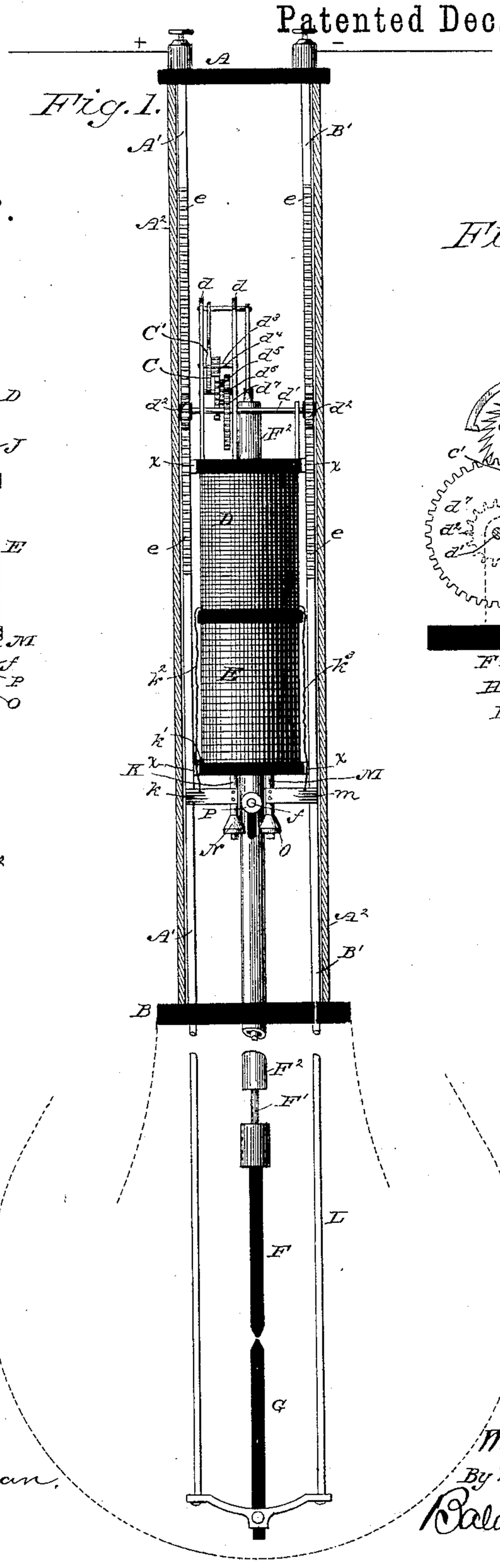


Fig. 2.

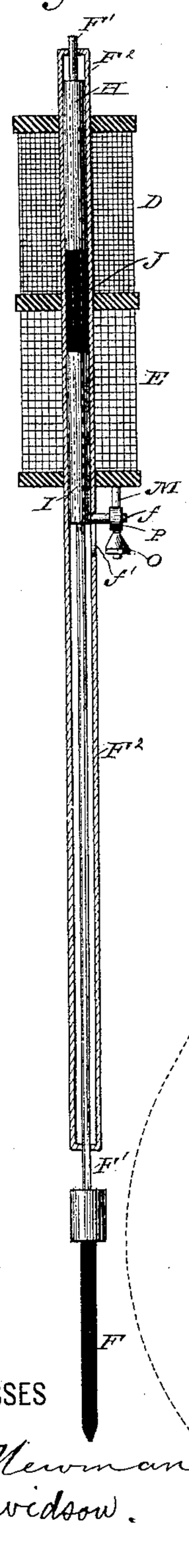
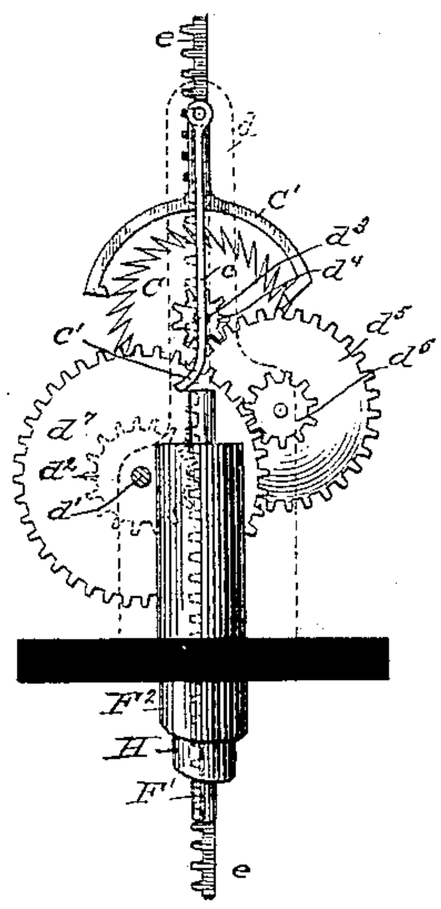


Fig. 3.



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WILLIAM M. THOMAS, OF GRAND RAPIDS, MICHIGAN, ASSIGNOR OF ONE-HALF TO THE GRAND RAPIDS ELECTRIC LIGHT AND POWER COMPANY, OF SAME PLACE.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 332,971, dated December 22, 1885.

Application filed February 12, 1885. Serial No. 155,705. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM M. THOMAS, of Grand Rapids, in the State of Michigan, have invented certain new and useful Improvements in Automatic Electrode-Feeding Devices for Electric-Arc Lamps, of which the following is a specification.

The object of my invention is to provide an improved apparatus which automatically feeds the carbon electrode and maintains the electric arc, and will cut the electrodes out of circuit in case of any accidental or abnormal condition, and cut them in again upon the restoration of a normal operative condition of the lamp.

In Letters Patent No. 278,293, granted to me May 22, 1883, I have shown an electric lamp having feeding devices in which the controlling prime helix is at intervals caused to descend. A similarly-operating prime helix is shown in the present case, though the invention is not in some respects limited to such a construction.

In the accompanying drawings, Figure 1 is an elevation, partly in section, of my improved lamp; Fig. 3, a detail view of the upper portion thereof, showing the scapement mechanism, and Fig. 2, a sectional view showing the helices, their armatures, and the upper-carbon-carrying rod.

In the present instance, as in my patent before mentioned, the upper movable carbon-carrier is caused to rise and fall to maintain a uniform arc length by the electro-magnetic action of a helix termed the "prime helix," the current traversing which changes with the variations of the arc.

In order to maintain the proper relations between the armature or core and the prime helix, the prime helix is itself at intervals caused to descend as the carbons are consumed.

It will be best to first describe this automatic feeding operation of the lamp before describing the construction and operation of the cut-out and cut-in devices.

A B are two blocks, of suitable insulating-material, connected by vertical conducting rods or bars A′ B′, which may be surrounded by the ordinary enveloping-tube or sheath, A^2, which extends from block to block. The upper block, A, carries positive and negative binding-posts, with which the circuit-wires are connected.

D E are two helices, which are connected so as to move together. From the upper face of the spool of the helix D extend two vertical plates, *d d*, which constitute the scapement-frame, in which a spindle, *d′*, has its bearings. This spindle carries on its ends, but insulated therefrom, small toothed wheels, d^2, which travel in correspondingly-toothed racks, *e*, on the vertical frame bars or conductors A′ B′. A toothed scapement-wheel, C, is fixed on a spindle, d^3, having its bearings in the scapement-frame. A pinion, d^4, on the scapement-spindle gears with a wheel, d^5, on a spindle carrying a pinion, d^6, which gears with a wheel, d^7, on the spindle *d′*. As the helices D and E rise and fall the scapement mechanism will move with it, the wheels d^2 running on the toothed racks *e*. Fingers *x* on the spools of the helices may run loosely on the backs of the bars A′ B′ to hold the pinions and racks in engagement.

C′ is an ordinary pivoted double-toothed scapement-pallet, similar to those used in ordinary pendulum-clocks. A vibrating arm, *c*, extends downwardly from the pallet, as shown in Fig. 3, in line with the axis of the helix D, and is preferably bent or deflected at its end *c′*. If the vibrating pallet-arm *c* is left free to vibrate, the tooth-by-tooth rotation of the scapement-wheel will be permitted, so that the helices D E and the scapement movement will descend, the toothed wheels d^2 running on the racks *e*. Whenever the vibration of the arm *c* is checked, the scapement-movement and helices will be suspended. The vibrating arm is released and checked by the upper end of the carbon-carrying rod F′, as is presently described.

F is the upper positive carbon, and G the lower negative carbon. The carbon F is carried by a brass rod or tube, F′, which extends up through a brass tube, F^2, on which latter the helices D E may be wound, as shown. The rod F′, near its upper end, carries two soft

iron cores, H I, which are preferably separated by a block of non-magnetic material, J. These cores or armatures H I are so related to the helices in the working condition of the lamp as to be in their most effective fields of force. The helix D is included in a high-resistance shunt around the carbons F G, as is presently described, and is so wound that the magnetic effect of the coil upon the core is to draw it down and thus lower the carbon-carrying rod F′. The helix E is included in the main circuit, in which the carbons are connected, and is so wound that its magnetic effect is to raise the armature or core I and elevate the carbon-carrying rod F′.

The circuits are as follows: The main line or circuit, in which the lamp is connected in series, enters at the positive binding-post on the block A. The current then passes by way of the upright A′ to a brush or electric rubber, *k*, a further function of which is presently set forth, and then by a wire, *k′*, through the coil of the helix E. The other end of the wire from this helix is soldered to its core or tube F^2, and the current passes from this tube to the carbon-carrying rod or tube F′ through carbons F and G, thence by the frame or bail L, which supports the lower carbon, G, through the upright conductor or frame-bar B′ to the negative binding-post. The high-resistance shunt, in which the coil D is included, is taken from the brush *k* by the shunt-wire k^2. The other end k^3 of this shunt-wire is brought down to a similar brush, *m*, which makes contact with the opposite frame-bar B′. The brushes *k m* just mentioned, which rub against the frame-bars A′ B′, are carried by two insulated conducting-pins, K M, which project downward from the under side of the helix E. The upper end of the carbon-carrying rod is arranged in such relation to the end *c′* of the pallet-arm *c* as, upon an abnormal descent of the rod F′, to pass out of the path of the pallet-arm *c* and let the arm vibrate. This permits the tooth-by tooth rotation of the scapement-wheel and the descent of the helices and scapement movement, as before described.

Commencing the description of the operation of this part of the lamp with the lighting of the lamp, it is assumed that the carbons F G are in contact, and that the upper end of the carbon-carrying rod F′ is in the path of the pallet-arm *c*, so that the scapement-wheel cannot rotate. The low resistance between the two carbons will now permit such an amount of current to pass through the helix E that it will act upon its armature or endwise-moving core I to elevate the carbon-carrying rod F′ and establish the arc between the carbons. This movement will continue until the proper arc length has been reached, when the resistance at the arc will cause such an amount of current to pass through the shunt-coil D that its electro-magnetic effect upon its endwise-moving core H will counterbalance the effect of the helix E upon its core I. Normally now the helices D E remain stationary, and the proper arc length is maintained by the counteracting or counterbalancing effects of the two helices D E. This compensating action takes place within certain limits. When, however, the carbons have been so burned away that a downward movement of greater amplitude of the carbon-carrying rod F′ is necessary to restore or maintain the arc, the rod in its descent passes out of engagement with the vibrating pallet-arm *c*, and the scapement-wheel, being free to revolve tooth by tooth, will permit the toothed wheels d^2 to travel on their racks, and the helices D E will descend until the carbons F and G come in contact or resume their normal condition. When this takes place, a very slight continued descent of the helices D E throws the end of the rod F′ into the path of the vibrating pallet-arm *c* and checks the descent of the helices. The lamp will then be relighted by the re-establishment of the arc by the joint action of the helices D E, as before described.

The improved cut-in and cut-out device may be arranged in the following manner, though the invention is not limited to the specific details of construction: The lower ends of the pins K M are enlarged or provided with caps or nuts N O. An insulated conducting-plug, P, is carried by the rod or tube F′ on a pin, *f*, which projects through a slot, *f′*, in the outer tube, F^2, in such relation to the enlarged ends N O that when the tube F′ descends about the length of the slot *f′*, as hereinafter described, the plug P makes contact with the enlarged ends or nuts N O, and completes a short circuit from the frame-bar A′ through the brushes *k* and *m* to the opposite bar, B′, and cuts out the lamp. When the carbon-carrying rod F′ descends, as has already been described, to restore the arc, or in case of a rupture of either of the carbons or the dropping out of the carbons or any derangement of the electrodes which would cause the rod to drop, the plug P comes in contact with the conductors N O of the short circuit, and the electrodes of the lamp are cut out of the circuit. If the descent of the rod has been due to the rupture of the carbons or any extraordinary derangement, the lamp will remain permanently cut out until repaired. If, however, the cutting out has occurred in the ordinary readjustment of the lamp, to restore the arc the operation is as follows: The carbon-carrying rod having descended sufficiently to release the scapement-wheel, the helices and the scapement-movement will commence to descend, and the plug P, having completed the short circuit just described, the helix E will not act upon its core or armature, so that the rod F′ also descends with the helices D E until the carbons F G come in contact. When this takes place, a very slight continued descent of the helices D E separates the short-circuiting contacts P N O, thus cutting the electrodes in, the circuit having been completed by the contact of the carbons.

The helix E, then acting upon its core I as already described, elevates the carbon-carrying rod, establishes the arc, and throws the end of the rod into engagement with the vibrating pallet-arm, thus causing the suspension of the helices D E in that position.

My improved automatic cut-out and cut-in devices therefore cut the lamp both out and in at each readjustment of the apparatus, and serve also to permanently cut out the lamp in case of any derangement of the lamp. The main-line circuit is therefore always preserved, and the other lamps in the circuit are not disturbed by the readjustment or derangement of the lamp.

I have described my invention as embodied in a simple, practical, and efficient manner, but I do not limit myself to the specific details illustrated, because they may be varied without departing from my invention.

So far as the combination of my improved cut-out and cut-in devices, with the particular kind of lamp shown, is concerned, other details of construction may be used—as, for instance, those illustrated in my previous patent, above mentioned.

I am aware of English Patent No. 1,670 of 1881. This patent shows an arrangement somewhat like that of English Patent No. 2,539 of 1883, above mentioned—that is, the short-circuiting contact is on the bracket or frame which supports and accomplishes the feeding of the carbon rod, and the short circuit is not completed by the fall of the carbon rod itself, irrespective of the action of the carbon-rod carrying the feeding devices.

I am aware that an upper-carbon carrier has been provided with a cut-out contact arranged at its upper end, which short-circuits the lamp when the carbons have been completely consumed. I am also aware that the clamping or feed mechanism which regulates the descent of the carbon-carrier has been arranged with cut-out contacts—as shown, for instance, in German Patent No. 8,900 of 1879, and English Patent No. 2,539 of 1883—and I do not therefore claim such broad ground.

In my arrangement the cut-out contact is on the carbon-carrier, so that the short-circuiting of the carbons occurs upon an abnormal drop of the carbon-carrier irrespective of the action of the feed devices. If therefore the feed devices should become deranged and fail to act, the descent of the carbon rod would effect the cutting out of the lamp.

I claim as my invention—

1. The combination of the electrodes of an arc lamp, a vertically rising and falling carbon-carrying rod, feeding mechanism for supporting and feeding said carbon-carrying rod, cut-out contacts arranged in suitable relation to the carbon-carrying rod, and another cut-out contact carried by the carbon-carrying rod in proximity to the first-mentioned contacts, said contacts being normally arranged in close proximity during the entire consumption of the carbons, whereby the lamp may be cut out of circuit by the descent of the rod should a slight fall of said rod occur independently of the action of the feeding devices during the working of the lamp.

2. The combination of the electrodes, the rising and falling carbon-carrier, feed-regulating devices or helices which are caused to descend bodily in the adjustment of the lamp, and short-circuiting contacts arranged in proximity to each other which are completed to short-circuit the lamp upon an abnormal descent of the carbon-carrier to effect the readjustment of the electrodes, and are separated when the carbon-carrier is caused to rise to re-establish the arc.

3. The combination of the two descending helices arranged in a fixed relation to each other, the tube on which they are mounted, the rising and falling carbon-carrier arranged concentrically within said tube, and the core or cores carried thereby on which the helices act.

4. The combination of the electrodes, a vertically rising and falling carbon-carrier, feed-regulating devices or helices which are caused to descend bodily in the adjustment of the lamp, short-circuiting or cut-out cont carried by said descending feed-regulating devices, and a contact on the carbon-carrier for automatically completing the cut-out circuit between the contacts on the descending feed-regulating devices upon the abnormal descent of the carbon-carrier.

5. The combination of the reversely-acting helices, the carbon-carrying rod or support, the scapement mechanism, and the automatic cut-out and cut-in devices, for the purpose set forth.

6. The combination of the rising and falling carbon-carrying rod, the prime helix, the high-resistance helix, means substantially such as described for permitting the descent of the helices at intervals, and short-circuiting or cut-out devices which are thrown into action upon the abnormal descent of the carbon-carrying rod, for the purpose set forth.

7. The combination of the prime helix and the high-resistance helix which move together, the scapement or clutch devices, the armatures or cores of said helices, the carbon-carrying rod which is raised and lowered by the action of said helices on their cores, and short-circuiting or cut-out devices which are automatically thrown into operation upon an abnormal descent of the carbon-carrying rod, for the purpose set forth.

8. The combination of the carbon-carrying rod, the prime helix which causes the elevation of said rod to establish the arc, the secondary or high-resistance helix which causes the descent of the rod to maintain the normal arc length, mechanism substantially such as described which permits the descent of the prime helix when the carbons are shortened or consumed, and cut-out devices which short-circuit the carbons when the carbon-carrying rod and prime helix descend to accomplish

the adjustment of the apparatus, for the purpose set forth.

9. The combination of the electrodes, the rising and falling carbon-carrying rod, the prime helix and high-resistance helix which descend to readjust the arc between the electrodes, cut-out devices for short-circuiting the electrodes when the helices and carbon-carrying rod make an abnormal descent and bring the electrodes in contact, and means for opening the short-circuit, arresting the descent of the helices when the carbons come in contact, and re-establishing the arc.

10. The combination of the parallel frame-bars, the traveling toothed-wheels d^2, the helices which rise and fall with said toothed wheels, the scapement, and the rising and falling carbon-carrying bar.

In testimony whereof I have hereunto subscribed my name.

W. M. THOMAS.

Witnesses:
JOSEPH H. WALKER,
WM. H. POWERS.