(No Model.)

E. F. SMITH.

ELECTRIC ARC LAMP.

No. 476,425. Patented June 7, 1892.

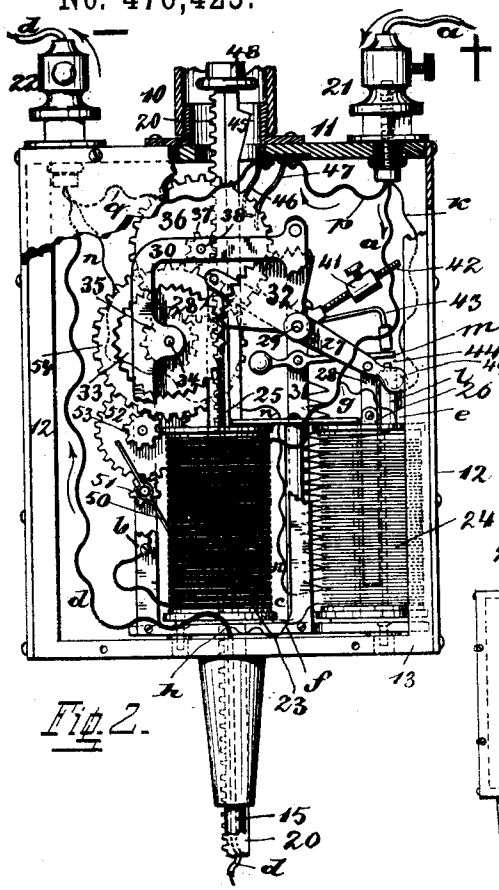

Fig. 2.

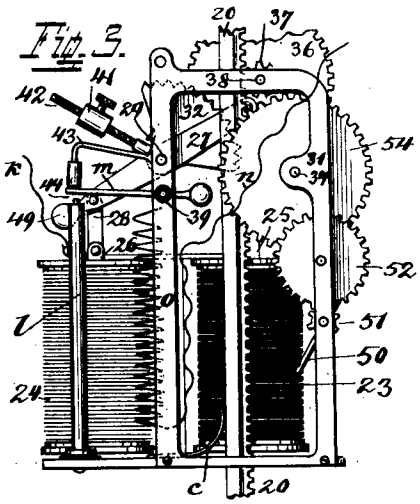

Fig. 3.

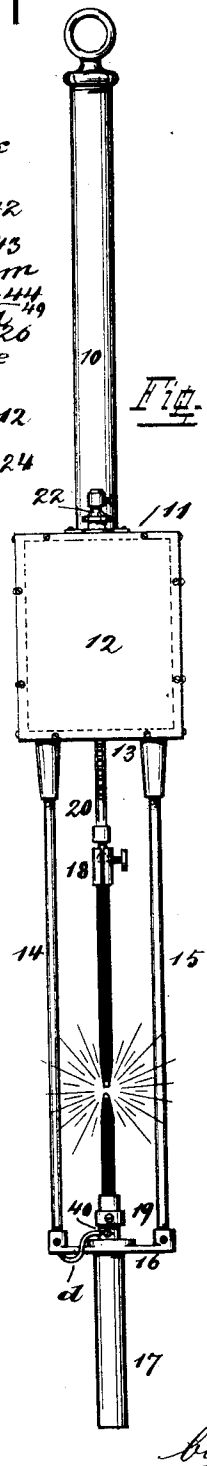

Fig. 1.

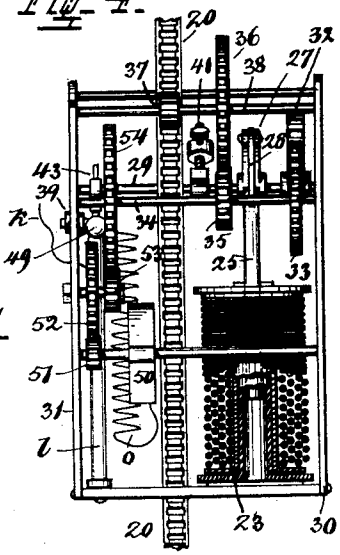

Fig. 4.

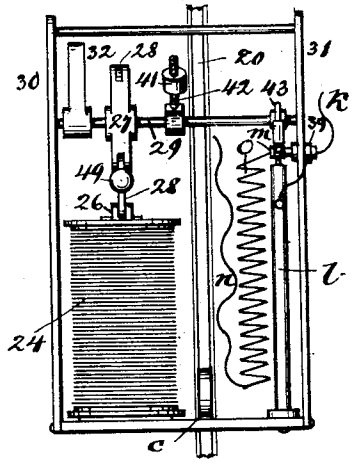

Fig. 5.

Attest
Samuel Mauro
Dan Smith

Inventor
Edward F. Smith
by Carl Spengel Atty

UNITED STATES PATENT OFFICE.

EDWARD F. SMITH, OF CINCINNATI, OHIO.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 476,425, dated June 7, 1892.

Application filed October 5, 1891. Serial No. 407,716. (No model.)

To all whom it may concern:

Be it known that I, EDWARD F. SMITH, a citizen of the United States, residing at Cincinnati, in the county of Hamilton and State of Ohio, have invented certain new and useful Improvements in Electric-Arc Lamps; 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 the letters and figures of reference marked thereon, which form a part of this specification.

This invention relates to electric-arc lamps, and has for its object the combination, with the carbon-feed rod thereof, of new and improved mechanism whereby the former is first lifted to form the arc and then moved toward the point of combustion with a speed equal to the consumption of the carbon, the construction of this mechanism being so designed as to make it very sensitive to the slightest variation of the resistance between the opposing carbon points and instantly responsive to such changes, whereby the feeding of the carbon proceeds constantly and imperceptibly and all flickering and other irregularities of the light are avoided. In combination with such a lamp I have provided an automatic cut-out of special construction by which the lamp is cut out of the series momentarily in cases of accidents or mechanical disturbances in the lamp, which difficulties the mechanism is supposed to overcome unaided, and starts the lamp up again automatically.

My invention is more particularly explained and pointed out in the following specification and claims, and illustrated in the accompanying drawings, in which—

Figure 1 is a general external elevation of my lamp as it appears while burning and in operation. Fig. 2 is a front view of the feed mechanism, parts of the housing of the lamp-frame inclosing it removed and partly shown in section. Fig. 3 shows a view of the mechanism removed from the lamp-frame and in a position reverse to the one shown in the preceding figure. Fig. 4 is a side view of the mechanism as it appears when looking at it from the right of Fig. 3. Fig. 5 is a view similar to the preceding one, with the difference that the point of observation is at the left of Fig. 3 and only parts nearest to the spectator are shown.

10, 11, 12, 13, 14, 15, 16, and 17 constitute the principal elements of the frame and housing of an arc lamp of customary construction and design.

18 is the upper and 19 the lower carbon holder.

20 is the carbon-feed rod, and 21 the positive and 22 the negative binding-post, each insulated from the adjacent part 11 of the lamp-frame.

23 is the series coil, and 24 the shunt-coil, all of well-known construction, both being magnets with movable cores suspended within them and consisting, substantially, of tubes flanged at both ends and wrapped with insulated wire, which latter is also insulated from the tube and its flanges. 25 and 26 are the cores of these magnets or coils, each connected to an end of an oscillating lever 27 by means of links 28. The pivotal point of this lever is formed by a rock-shaft 29, which finds its bearings in the two sections 30 and 31 of the movement-frame. Rigidly secured to this same shaft is a toothed sector 32, capable of engagement with a toothed wheel 33, secured to a shaft 34, also supported in the movement-frame. This shaft carries a pinion 35, meshing into a cog-wheel 36 on a shaft 38, similarly supported like the other shafts and carrying a pinion 37, which engages with the toothed side of the carbon-feed rod 20.

a is the line-wire carrying the current to the positive binding-post 21, from whence it passes to and forms the series coil 23, and then connects to the movement-frame at a suitable point, (in this case at *b*,) where it enters the latter, and, traversing it, passes to the carbon rod through the intervention of a suitable contact piece or brush *c*. From here the current passes through upper and lower carbons to the lower-carbon holder 19 and to the latter's base 40, from whence by insulated wire *d* it passes to and through the hollow rod 14 of the lamp-frame to the negative binding-post 22.

e is the entering and *f* the leaving end of

the fine wire with which the shunt-coil is wrapped. Wire *e* leaves the main wire *a* at *g* and rejoins wire *d* again at *h*.

The movement-frame, as well as the base 40 of the lower-carbon holder, are insulated from the lamp-frame, so that no part of this latter carries any current.

As soon as the current enters the lamp, core 25, which has before been in its highest position with sector 32 and completely disengaged from toothed wheel 33, is drawn within the series coil, causing rock-shaft 29, with sector 32, to partly revolve, turning by means of wheel 33 shaft 34, with pinion 35, which latter through cog-wheel 36 and shaft 38 revolves pinion 37 and lifts the carbon-feed rod. All this occurs instantly, so that with the entering of the current the lamp commences to burn at once. As the progressing consumption of the carbons increases the arc, the resistance to the current, passing between the opposite carbon points, increases also, throwing more current onto the shunt-coil circuit, the increasing magnetic force of which overcomes the force of the series coil and while drawing down core 26 turns rock-shaft 29, with sector 32, toothed wheel 33, and all the intermediate elements and pinion 37 in opposite direction, as before, and permits the feed-rod to descend. If the requisite quantity of carbon has been fed and the distance of the arc between the carbon points has been reduced to the proper length, the decreasing resistance at the arc causes the magnetic force in the series coil to preponderate again over the force of the shunt-coil, the core of the former pulling lever 27 down, causing through the intermediate mechanism the movement of the feed-rod to be arrested for an imperceptibly short time until a renewed supply of carbon becomes necessary. Thus the alternate opposing movement between the two cores continues until the parts have arrived at their normal position, which is about as illustrated in Fig. 2. In this position sector 32 acts like an escapement, holding wheel 33, and, through the connecting mechanism, the upper carbon immovable while in proper position, but releasing it instantly when the carbon becomes too short. The limited engagement between sector 32 and wheel 33, it only being to the extent of one tooth, permits of an instant release of the carbon-feed rod, as well as of a quick arrest of the movement of the same, thus composing the feed motion of the carbon of stops and starts alternating with each other, the duration of these stops and starts being, however, of such an infinitesimal short space of time as to be imperceptible, making for all practical purposes the feeding of the lamp constant, and so producing a light of unvarying intensity and without flickering.

The force which opposes the magnet of the series coil 23 consists of two elements acting in conjunction—namely, the magnet of the shunt-coil 24 and a weight 41, adjustable on an arm 42, extending out from shaft 29. By the movement of this weight the force acting against the series coil may be varied, which again effects the arc and permits its length—that is, the distance between the carbon points—to be adjusted. If, for instance, the weight be moved farther out on arm 42, the power acting on this part of lever 27 is increased, core 25 is held up higher, which causes the mechanism to hold the carbon in a lower position, and as a consequence a shorter arc is produced. The reverse takes place if the weight is screwed farther in on its supporting-arm, and whereby the power aiding and combining with the shunt-coil is reduced.

If for any reason—accidents to the carbon or imperfect working of the mechanism—the carbon-feed rod fails to feed properly, the increasing resistance at the separating carbon points, reacting on the series coil, will greatly increase the magnetic force of the shunt-coil, which latter will completely draw its core down, and thereby turn shaft 29 to such an extent that a weighted lever 43, bent and insulated at its end, is enabled to complete an electric contact at 44, whereby shaft 29 brings sector 32 completely out of engagement with wheel 33. Sector 32, having heretofore acted as an escapement and check to wheel 33 and through this latter regulated the movement of the whole mechanism, is unable to do so any further, owing to its disengagement, as already mentioned, and there not being anything else in the way to check the mechanism the combined weight of the upper carbon, carbon-holder, and feed-rod is generally sufficient to overcome any obstruction in the lamp, like a sticking of the mechanism, for instance, and the feeding down will proceed by gravity only, or if the disturbance has been caused by the breaking of one of the carbons, causing a wide separation, the feeding by gravity will continue until the carbons have approached each other again. When as a consequence to such a disturbance the electric contact has been established at 44, then the current passes from the lower inner end of binding-post 21 through wire *k*, post *l*, which is insulated from the movement-frame, next through lever *m*, held against post *l* by lever 43 and also insulated from the movement-frame by a sleeve 39, then through a wire *n*, connected to the pivot of lever *m*, and finally out through this wire to the negative binding-post. As soon as the dropping carbon-feed rod has descended far enough to bring the carbon points together the resistance caused by their former separation is removed and the current through the series coil fully re-established and magnetized, causing core 25 and lever 27 to be pulled down and throwing sector 32 again in contact with the balance of the mechanism, whereby the lamp is started up again and relights as at the original beginning. In order to induce the current at this time to leave the shorter circuit *k l* 44 *m n* and follow the normal circuit, a resist-

ance-coil *o* is incorporated into the former circuit. In all of these cases it is of course supposed that the first sudden drop of the carbon-feed rod caused by the released mechanism is able to overcome the temporary obstruction or disturbance. Where this disturbance relates to broken carbons only, this cut-out is always reliable. There is also a dead cut-out provided, which works automatically in cases when the carbon is completely consumed and the lamp cannot start up again unaided, as in the former case, but must be supplied with carbon first. This cut-out is constructed as follows: Near the upper end of the feed-rod is an inclined projection 45, which when sufficiently low comes in contact with a spring 46 and presses the same against another spring 47, both springs being insulated from the lamp-frame and connected by wires *p* and *q*, which in turn again connect to positive and negative binding-posts, through which when these springs come in contact a short circuit 21 *p* 47 46 *q* 22 is formed, which takes all the current out of the lamp. The feed-rod and connecting mechanism being freed from the check imposed by sector 32, which latter is pulled over by the preponderating weight on one side of lever 27, are solely following the law of gravity now and the feed-rod settles down until it comes to a final rest on a button 48 at its upper extremity. This button is of insulating material and of a size which prevents it from passing through the opening in part 11 of the lamp-frame. The lamp is unable to light itself now, and the feed-rod remains in this position until raised by the lamp-trimmer for the purpose of supplying new carbon.

49 is a weight at one end of lever 27, which compensates for the weight of sector 32, extending to the opposite side from shaft 29. The two coils may be held in position in any suitable way. In this case I use a post rising between them from the bottom of the movement-frame and having a bridge-piece secured at its top, which reaches also over the tops of the coils.

In order to still more equalize the feed-movement of the lamp, a fan 50, driven by suitable gear connection 51 52 53 54, with power taken from the shaft 34, may be added. The resistance of the air encountered by this fan lessens the abruptness between the succeeding starts and stops of the mechanism.

The advantages inherent to this construction are numerous. As will be observed, the use of springs has been entirely dispensed with. The connection between feed-rod and movement mechanism is positive, providing thus a direct electrical control of the carbon-supply. The light is perfect and even, owing to the interposition of the mechanism between the series coil and the carbon-feed rod, whereby the spasmodic movements of the magnet are converted to a slow and constant motion of the feed-rod, and for the further reason that this mechanism is constantly controlled by the always active force of the magnets. This lamp cannot go out unless the carbons are consumed, taking care of itself in all other emergencies.

Owing to the great simplicity of the mechanism of this lamp and material reduction in its weight, due principally to the fact that only two coils are used, its manufacturing cost is greatly lessened without impairing the efficiency of the device. By dispensing with the use of any part of the lamp-frame for the purpose of carrying the current great security against accidents and fire is attained.

Where great evenness of the light is no particular object, the connection between the parts directly affected by the magnet of the series coil and the carbon-feed rod might be more direct. So, for instance, all the elements intervening between wheel 33 and pinion 37 may be left out. A pulley may be substituted for lever 27 and the cores connected to it by means of chains.

Instead of having the connection between sector 32 and wheel 33 accomplished by teeth, this connection might be frictional, which, however, would form only an inferior equivalent.

Having described my invention, I claim as new—

1. In an electric-arc lamp, the construction whereby the arc is established, consisting of the combination, with the magnet of the series coil and the carbon-feed rod of such a lamp, of mechanism capable of raising the carbon-feed rod, a lever actuated by this magnet, a rock shaft deriving its motion from the magnet through the medium of the lever, which is rigidly mounted upon the former, and a lateral extension also rigidly connected to and moving with the rock-shaft and capable of engaging with and actuating, for the purpose of starting the lamp, the mechanism which raises the feed-rod, all as substantially shown and described.

2. In an electric-arc lamp, the construction whereby the arc is established and maintained, and which construction consists of the combination, with the magnet of a series and shunt coil, of an oscillating lever 27, connected with its ends to each one of the magnets, a rock-shaft deriving its motion from the magnets through the medium of this lever, which is rigidly mounted upon the former, a lateral extension also rigidly connected to and moving with the rock-shaft, and mechanism capable of raising and supporting the carbon-feed rod and electrically controlled by the rotary reciprocatory motion of the rock-shaft, which is imparted to it through the medium of the extension mentioned before, which engages with said mechanism, all as substantially shown and described.

3. In an electric-arc lamp, the combination, with the toothed carbon-feed rod thereof, of a movement mechanism consisting of a train of gear-wheels whereby the feed-rod is moved and an electrically-controlled toothed sector

capable of intermeshing with the train of gear-wheels and thereby regulating its movement, all as substantially shown and described.

4. In an electric lamp, the combination, with the toothed carbon-feed rod thereof, of a train of gear-wheels whereby this feed-rod is moved, a toothed sector intermeshing with this train of gear-wheels, regulating its motion, an oscillating lever turning a rock-shaft upon which this sector is rigidly secured, and two magnets controlling the movements of this lever, all as substantially shown and described.

5. In an electric lamp, the combination, with the toothed carbon-feed rod thereof, of a movement mechanism consisting of a train of gear-wheels whereby the feed-rod is moved, an electrically-controlled toothed sector capable of intermeshing with this train of gear-wheels, thereby regulating its movement, and an electrically-controlled cut-out consisting of levers 43 *m*, wires *k* and *n*, and resistance-coil *o*, all as substantially shown, and for the purposes described.

6. In an electric lamp, the combination, with the main circuit thereof, of the cut-out circuit *k* 44 *o n*, connecting binding-posts 21 and 22, which circuit contains a resistance-coil of higher resistance than is produced by the carbon points when in their normal position, all as substantially shown and described.

7. In an electric lamp, the combination, with the toothed feed-rod thereof, of a train of gear-wheels whereby this feed-rod is moved, an escapement engaging with this train of gear-wheels and regulating its motion, an oscillating lever turning a rock-shaft to which this escapement is rigidly secured, and two magnets controlling the movements of this escapement, all as substantially shown and described.

8. In an electric-arc lamp, the means to shunt the current from the lamp in case of accidents and establish electrical connection between binding-posts 21 and 22, and which means consist in the combination, with resistance-coil 24, of a lever 27, a contact-piece *m*, operated by it, post *l*, and wires *k* and *n*, connecting piece *m* and post *l* with the binding-posts, all as substantially shown and described.

9. In an electric-arc lamp, the means to shunt the current from the lamp in case of accidents and establish electrical connection between binding-posts 21 and 22 and the means to revert the current again to its normal path through coil 23, and which means consist in the combination, with resistance-coil 24, of a lever 27, a contact-piece *m*, operated by it, post *l*, wires *k* and *n*, connecting piece *m* and post *l* with the binding-posts, and resistance-coil *o*, of higher resistance than coil 23, all as substantially shown and described.

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

EDWARD F. SMITH.

Witnesses:
SAMUEL M. QUINN,
CARL SPENGEL.