(No Model.)

E. THOMSON & C. E. HARTHAN.

ELECTRIC ARC LAMP.

No. 542,662. Patented July 16, 1895.

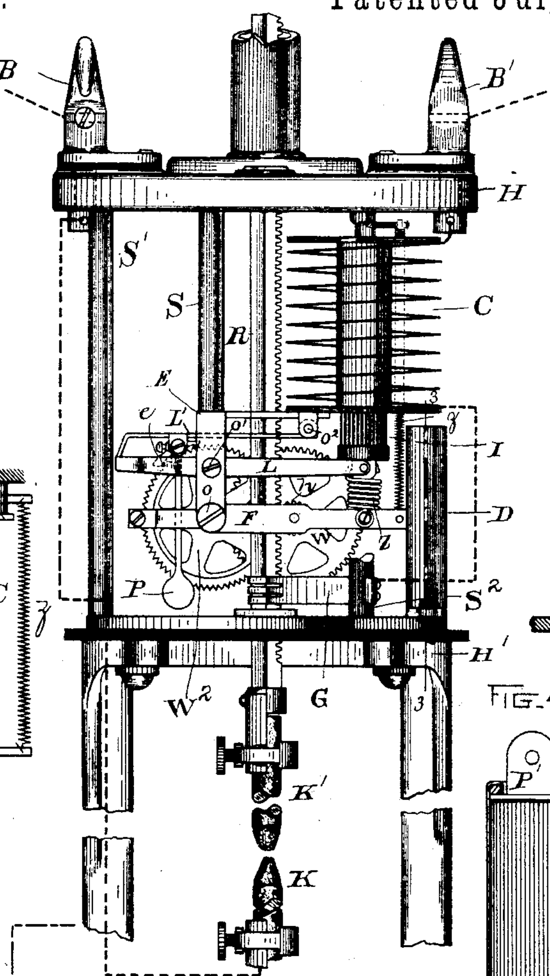

FIG. 1.

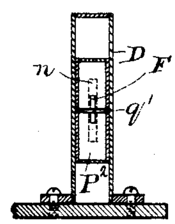

FIG. 3.

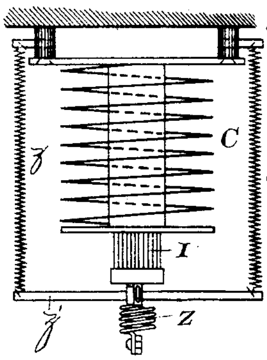

FIG. 7.

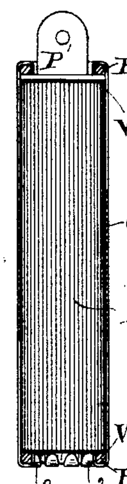

FIG. 4.

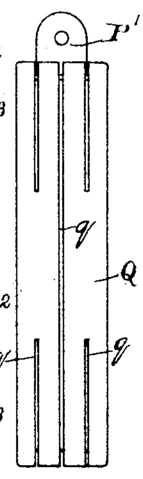

FIG. 5.

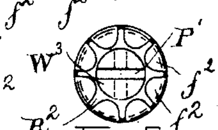

FIG. 6.

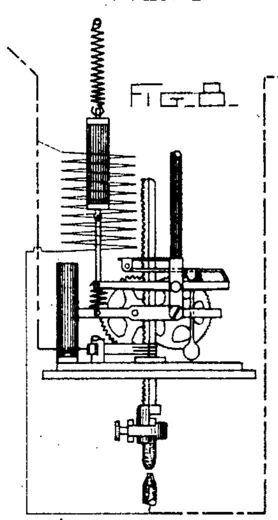

FIG. 8.

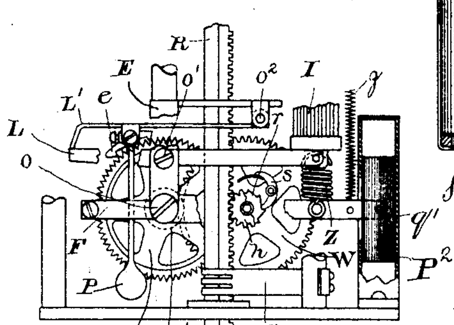

FIG. 2.

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UNITED STATES PATENT OFFICE.

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ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 542,662, dated July 16, 1895.

Application filed June 25, 1894. Serial No. 515,695. (No model.)

To all whom it may concern:

Be it known that we, ELIHU THOMSON, residing at Swampscott, and CHARLES E. HARTHAN, residing at Lynn, county of Essex, State of Massachusetts, citizens of the United States, have invented certain new and useful Improvements in Electric-Arc Lamps, of which the following is a specification.

Our invention relates to electric-arc lamps, and particularly to those adapted for use upon constant-potential or incandescent-lighting circuits, though also adapted for use upon constant-current circuits with suitable modifications, and is especially useful where a single lamp is to be connected up in a constant-potential circuit. We can also run the lamp either by alternating or continuous current with equal efficiency and success.

Our invention has for its object to secure delicacy of regulation and consequent perfection of feed, so that the control of the feeding shall be directly dependent upon the action of the controlling-magnet irrespective of its adjustment for the arc length.

Our invention enables us to make a lamp which can be used singly on alternating potentials of, say, thirty volts between terminals, and also on circuits in which the potentials are constant, the lamps in such case being run in multiple; also by a modification in the winding of the controlling-magnet it can be made a differential lamp of great delicacy of feed, having in all other respects the properties of a good differential lamp. To attain these ends pointed out, we construct our lamp so that its entire regulation, both in striking the arc and in regulating its length, is obtained by means of the electromagnetic effect of a coil which may be a plain series coil or, in a differential lamp, may be wound with shunt and series coils, respectively, or, by proper modifications, a derived-circuit magnet only may be used; and though we illustrate a particular form of gearing which we prefer to employ we do not mean to limit ourselves to this particular feature; but various modified forms of gear may be employed in place of the one shown, it being our object to claim particularly the method of regulating an arc lamp, which consists in performing the regulation by means of the current in the electromagnetic coil alone working upon an escapement-feed which is in a measure independent in its actions of the motions of the arc striking or regulating movement which sets the length of the arc.

In the accompanying drawings we illustrate one embodiment of our invention adaptable to use as single lamps on a circuit, such as an alternating-current circuit, of, say, thirty volts potential difference, and therein—

Figure 1 is an elevation of our improved lamp, showing the working parts. Fig. 2 is a detail with parts of the mechanism broken away to illustrate the operation of the lamp. Fig. 3 is a section upon the line 3 3 of Fig. 1 of the special dash-pot used. Figs. 4, 5, and 6 are respectively a section, a side elevation, and a plan of the improved core for the magnet-coil for alternating currents. Fig. 7 is an end elevation showing a modified arrangement of the gear-frame and springs by which the adjustment of the lamp is effected, and Fig. 8 shows an adaptation of the invention to a shunt-lamp.

H is the upper part of the frame of the lamp; H', its lower part. These two parts are, as usual, of cast metal and are united by the usual supports or standards S S' S^2.

A coil C in series with the carbon or arc is attached to any suitable part of the lamp-frame, preferably to the upper part H.

K is the lower carbon with its holder, and K' the upper carbon, also in its holder, attached to the rack-rod R, meshing with a small pinion *h*, (shown also in Fig. 2,) which is secured to the gear-wheel W by a ratchet *r* and pawl *s*, allowing the free upward motion of the rod R by preventing its descent. This gear-wheel W meshes with a small pinion W' attached to the escapement-wheel W^2. The shafts of all these wheels have their bearings in a frame F pivoted at *o* to a supporting-piece E extending from the frame to the lamp. This frame F is connected to the iron core I of the coil and projects in the other direction a short distance beyond its pivot *o*. The connection between the core and the frame is by means of a spring Z, the purpose of which will be hereinafter explained, while the end of the frame is attached to the piston of the dash-pot D. A lever L, also pivoted in the piece E, is attached at one end directly to the iron core I and also projects beyond its pivot o' in the other direction. To assist the action of the coil upon the frame F, springs z z are provided, the tension of which may be adjusted so as to get just such a balance as is best for the feeding of the lamp between the weight of the frame F and its contained gearing and the pull of the coil C upon the core.

The escapement-wheel W^2 is held against rotation by the pawl e, which is double, as usually constructed, so that the teeth may escape singly, though it may be adjusted to feed with more rapidity if desired. This pawl is pivoted in a movable lever L′, which itself is pivoted at o^2, and its extreme end beyond the pawl e is engaged by the lever L in its movement. A pendulum P, for which may be substituted a suitable spring, is provided to prevent the oscillation of the pawl except when the feed should take place.

The circuit through the lamp is from the binding-post B through the lower part of the lamp-frame to the lower carbon K, the upper carbon K′, through the rack-rod R, which is insulated from the lamp-frame, thence to the brush G through the series coil C, and out at the other binding-post B′.

Instead of attaching the springs z directly to the frame F we may, and preferably do, attach these springs to the bar z', with which the lever L connects. As already explained, the office of these springs is to assist in drawing up the frame F against the weight of the parts supported by it. This arrangement is illustrated in end elevation in Fig. 7.

Referring to Fig. 3, we illustrate the construction of the dash-pot which we prefer, the outside elevation being shown in Fig. 1, and a partial section upon a line at right angles to the one shown in Fig. 3 being illustrated in Fig. 2. Therein D is the outer cylinder. B^2 is a double-ended piston forming a close working fit in the cylinder D. A slot n in the sides of the cylinder and a similar one in the piston permit the entrance of the end of the frame F, and the pin q' secures the frame in place in the piston. This arrangement provides a perfect protection against dirt, the piston being double-ended and forming a hollow shell, so that any dirt that may gain access to it is deposited on the inside of this shell and cannot interfere with its motion in the cylinder D.

Referring now to Figs. 4, 5, and 6, we illustrate the improved core for the coil when used with alternating currents. To construct this we assemble a bundle of soft-iron wire of the proper length, and on each end of this we place insulating-washers of asbestos or fiber. Over the washers we put rings of insulating material. These three parts are lettered respectively B^2, W^3, and R^2. For the washers we prefer insulating material of some strength, such as steatite or "lava," as it is commonly called. The core is preferably wrapped with paper or some other thin insulating material, and we then insert it into a shell of metal, preferably magnetic, and upon the ends of the shell we form fingers f^2 f^2. These fingers are then crimped down over the ring and the whole forms a strong construction, within which eddy currents cannot circulate to any great extent. The outer shell Q is slotted at q q to further prevent the circulation of such currents. In one end of the core we insert before bending over the fingers f^2 an eye-plate P′ between the insulating-washer and the ring of insulating material, which forms an attachment for the lever L, as shown in Figs. 1 and 2. The core thus described is quickly and easily assembled and when so assembled is as strong as if made in one piece, so far as any strain in action is concerned.

The operation of the lamp is as follows: The carbons K K′ are in contact and when the current is turned on the series coil becomes energized and draws up core I. This raises the tripping-lever L′ and puts pawl e and wheel W^2 into engagement, locking the wheelwork in position. The further movement of the core I then so far extends the spring Z that the frame F is lifted and as the wheel W and pinion h are locked the rack-rod and upper carbon are lifted and the arc is struck. The dash-pot D insures the simple and gradual separation of the carbons by its attachment to the frame F, while the strength of the series coil C and the adjustment of the springs z z determine the length of the arc. As the resistance of the arc increases by the consumption of the carbon the current passing through the coil is diminished and the core I begins to descend. The lever L is first let down by the descent of the core I and its farther end raises the lever L′, carrying the pawl e, allowing one or more teeth of the wheel W^2 to escape and permitting the carbon to feed. If there is a slight overfeeding, diminishing the resistance at the arc, the coil is strengthened and the upper carbon is lifted slightly to establish the proper length of the arc.

It will be seen that by the employment of the escapement-regulating lever L for receiving the delicate movements of the core in response to the minor fluctuations of current, the condition of the escapement is one of readiness for delicate action at any time, while the frame F, which carries the wheelwork whereby the length of the arc itself is regulated, being checked by the dash-pot, does not respond so quickly to the fluctuations of current and maintains, therefore, an average position during these fluctuations. Hence the feeding action is in a measure independent of the drawing of the arc or its lengthening or shortening by a general movement of the frame up and down. So, also, the continued descent of the core drops the lever controlling the escapement and also the frame carrying the gearwork in such a way that the escapement is lifted clear of the train of gears, and the gears, therefore, are perfectly free to revolve. This action will occur in case of the failure of the escapement to do its duty in letting the teeth go by, as might happen if it were sticky or not offering to move, and this action also occurs when the lamp is out of action, so that the wheelwork is entirely free for movement in either direction when the carbon rod is raised or lowered rapidly and is independent of any check put upon it by the escapement. These features constitute the chief differences in our present lamp from former constructions, and on them depend the accuracy and evenness of the operation.

While there has been shown simply a single winding on the coil C, it will be understood that such coil might be wound for special uses, as when two or more lamps are to be placed in series with each other, with the usual differential coils, one in series with the arc and the other in derived circuit thereto, opposing each other's magnetic effects, while the mechanism for feeding and regulating the arc would remain as in the construction shown. It will also be understood that should the feeding and action of the lamp be required to depend only on the derived circuit, the modification which would be made would be such as is indicated in Fig. 8, where C is in derived circuit and has its core or armature pulled in the reverse direction to that of Fig. 1, while the other parts may remain as before. In this case, if a certain potential be put upon the terminals of the lamp, the coil C is energized and pulls down the core I, thereby running the carbons together. The establishment of the arc causes a drop of potential, as the arc is in shunt to the coil C, and the core I is relieved and pulled upward by the spring z', separating the carbons and forming the arc, while the minor fluctuations of the action of said coil C and core I are, as before, used to influence the feeding-lever or escapement-controlling lever L, while the frame F, as before, takes the major fluctuations in regulating the arc length, as in starting the arc, &c.

We have found the feeding action of the lamp, when properly adjusted, to be very delicate and precise, so that the normal length of arc is maintained and uniform intensity of illumination secured.

Many changes might be made in the general arrangement of the parts necessary in the construction of our invention. The action of the springs might be reversed or the path of the current might be changed, if desired, or a different form of dash-pot or of the core substituted without affecting the operation of the lamp as a whole, and all such modifications we aim to embrace.

What we claim as new, and desire to secure by Letters Patent of the United States, is—

1. In an electric arc lamp, an arc-striking mechanism, a feeding mechanism, and electro-magnetic means for actuating the two devices, arranged to operate the arc-striking mechanism by its major movements, and to operate by its minor downward movements the feeding mechanism without moving the arc-striking device.

2. In an electric arc lamp, an arc-striking mechanism, a feeding mechanism, a lost motion connection between the two, and suitable electro-magnetic means for actuating the two devices, such means responding to varying electro-motive forces by movements of greater or less extent; the greater movements actuating the arc-striking mechanism and the lesser downward movements actuating only the feeding mechanism.

3. In an electric arc lamp, a series coil, a core therefor, an arc-striking mechanism operated by the coil and core, and a feeding mechanism having an elastic connection with the arc-striking device, and thus adapted to respond to movements of the core not sufficient to operate the arc-striking device.

4. In an electric arc lamp, an arc-striking mechanism, a feeding mechanism, a solenoid and a core operated thereby and actuating the feeding and arc-striking devices, and means for causing the major upward movements of the core to strike the arc, and its minor downward movements to feed the carbon, while its minor upward movements have no effect.

5. In an electric lamp a feed carrying train or support attached elastically to the core or armature of the electro-magnet, said feed controlling frame being pivoted at a point which permits the raising or lowering of the carbon rod or holder by the movements of said frame, a direct connection from said controlling core to a movable escapement whereby the escapement with relation to the feed wheel is adjusted automatically from the position of entire engagement and cessation of feeding to the position of entire clearance and free feeding, on movements of said core or armature to its extreme positions, and whereby in the intermediate positions and slight movements of said core such movements may determine the feeding of the teeth of the gear individually by the escapement.

6. In an electric arc lamp, a series coil, a core therefor, a lever connected to the core, a frame carrying gearing having an escapement, a second lever actuated by the first and controlling the escapement, and a spring, as Z, permitting a slight lost motion between the frame and the first lever, substantially as described.

7. In an electric arc lamp, a series coil, a core therefor, a lever connected to the core, a frame carrying gearing having an escapement, a second lever actuated by the first and controlling the escapement, a spring, as Z, permitting a slight lost motion between the frame and the first lever, and a dash-pot connected to the frame, substantially as described.

8. In an electric arc lamp a dash-pot composed of the following elements; a cylindrical case closed at both ends, a piston reciprocating

therein, and a lateral attachment to the piston engaging with a frame carrying the feed mechanism.

9. In an electric arc lamp, a dash-pot comprising a cylinder, as D, a second cylinder within the first and acting as a piston, as P^2, the two cylinders provided with registering slots n and a pin q' extending through the piston and arranged to form an attachment for the feeding mechanism of the lamp.

10. In an electric arc lamp, a core for the series coil composed of a body of subdivided magnetic material having an insulating washer upon each end, and wrapped in insulating material, an insulating ring over each washer and a sheathing of iron having its ends crimped over the insulating rings and itself slotted to prevent the circulation of eddy currents.

11. In an electric arc lamp, a core for the series coil composed of a body of subdivided magnetic material having an insulating washer upon each end and wrapped in insulating material, an insulating ring over each washer, and a sheathing of sheet-iron having its ends crimped over the insulating rings and itself slotted to prevent the circulation of eddy currents, and an eye-plate, as P', secured in one end of the core between the insulating washer and the insulating ring.

In witness whereof we have hereunto set our hands this 22d day of June, 1894.

ELIHU THOMSON.
CHARLES E. HARTHAN.

Witnesses:
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HENRY O. WESTENDARP.