(No Model.) 2 Sheets—Sheet 1.

N. McCARTY.

ARC LAMP.

No. 344,188. Patented June 22, 1886.

Fig. 1

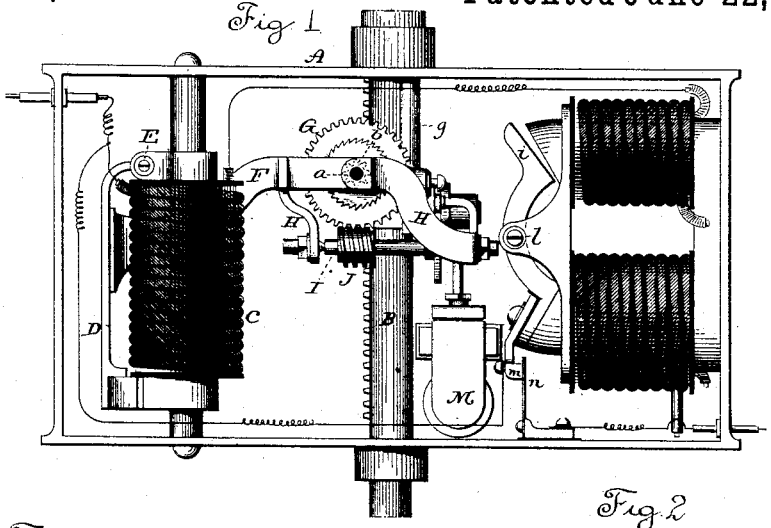


Fig. 2

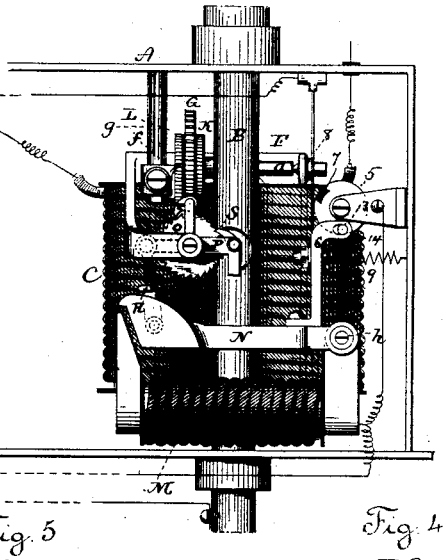


Fig. 3

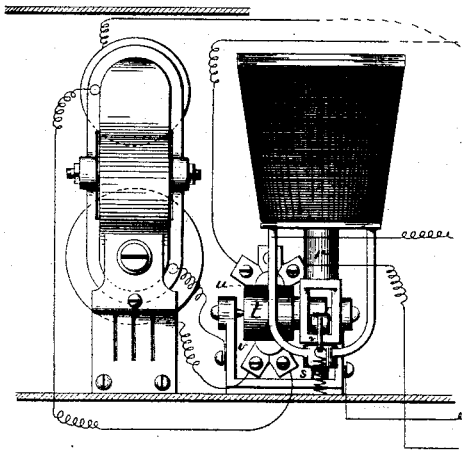


Fig. 6

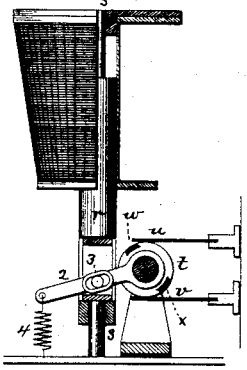


Fig. 5

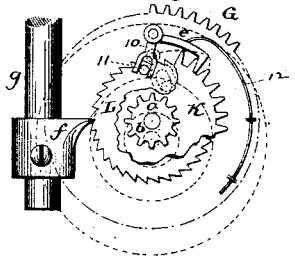
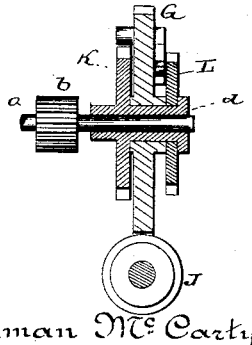


Fig. 4



Witnesses.
J. F. Shumway.
Fred C. Earle

Norman McCarty
Inventor.
By Atty
Wm. C. Earle

(No Model.) 2 Sheets—Sheet 2.

N. McCARTY.

ARC LAMP.

No. 344,188. Patented June 22, 1886.

Fig. 7

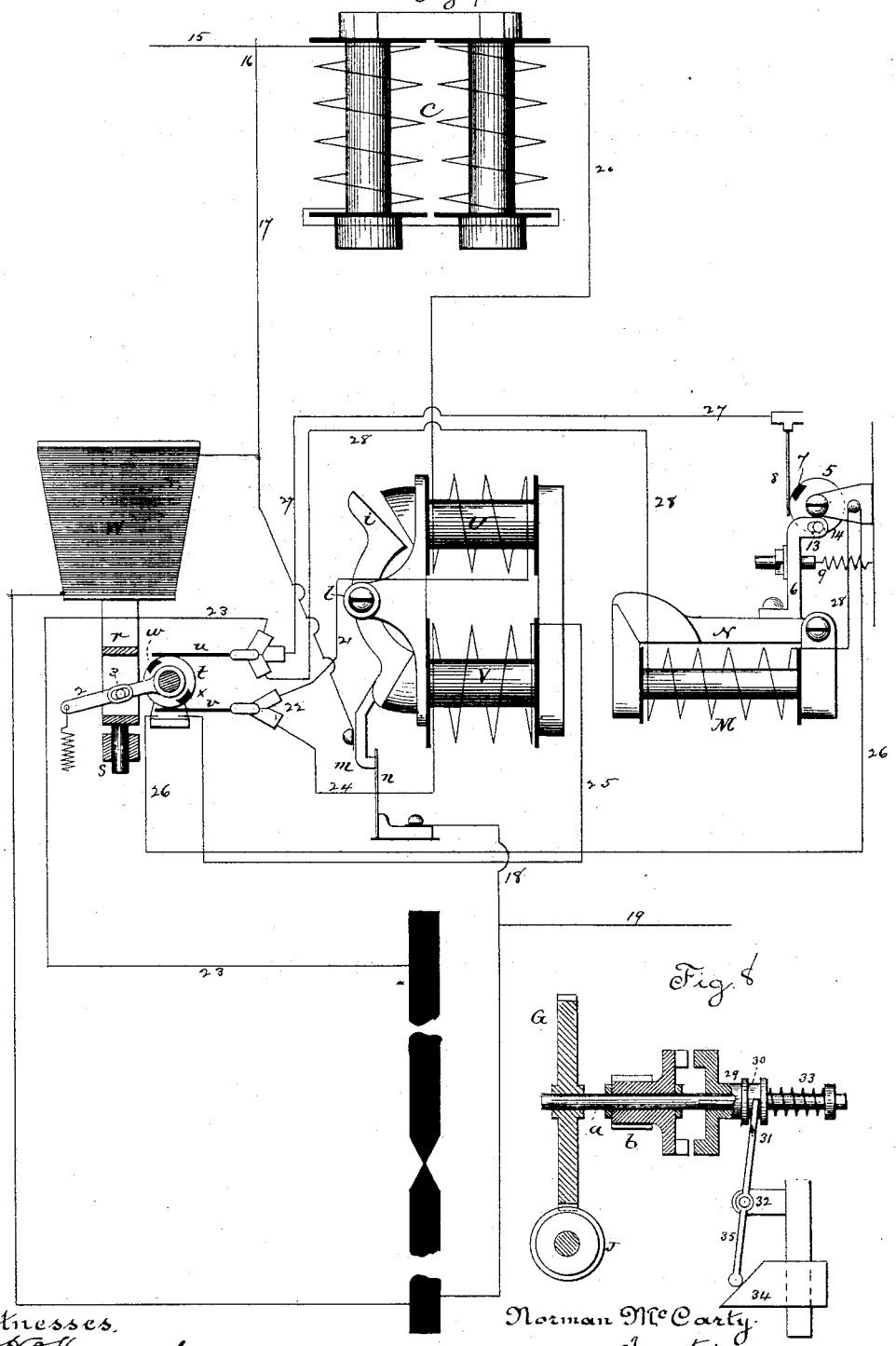


Fig. 8

Witnesses.
J. H. Thumway
Fred C. Earle

Norman McCarty
Inventor.
By Atty
Wm. C. Earle

UNITED STATES PATENT OFFICE.

NORMAN McCARTY, OF HOOSICK, NEW YORK.

ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 344,188, dated June 22, 1886.

Application filed September 7, 1885. Serial No. 176,382. (No model.)

To all whom it may concern:

Be it known that I, NORMAN MCCARTY, of Hoosick, in the county of Rensselaer and State of New York, have invented new Improvements in Arc Lamps; and I do hereby declare the following, when taken in connection with accompanying drawings and the letters of reference marked thereon, to be a full, clear, and exact description of the same, and which said drawings constitute part of this specification, and represent, in—

Figure 1, a side view of the feeding mechanism, all the parts in position as when no current is passing through the lamp; Fig. 2, a transverse sectional view through the frame, looking toward the magnet M; Fig. 3, a transverse section on the same line, looking in the opposite direction, and showing side view of the shunt-magnet; Fig. 4, the shaft *a*, showing vertical section through the wheels arranged thereon; Fig. 5, an end view of the shaft, looking toward the wheels and from the rear of Fig. 1; Fig. 6, a view of the shunt-magnet and its mechanism, looking at right angles to Fig. 3, and in partial section; Fig. 7, a diagram of the several magnetic devices, illustrating the line or wire connections; Fig. 8, a modification.

This invention relates to an improvement in that class of arc lamps commonly known as "positive-feeding" lamps, as distinguished from lamps in which the carbon-holder is moved by gravity, controlled by gearing or a clutch, the object of the invention being to perfect such automatic feed; and it consists in the construction hereinafter described, and particularly recited in the claims.

A represents the frame in which the mechanism is supported vertically in the frame and in suitable bearings. The carbon-holder B is arranged so as to be moved up and down therein for the adjustment of the carbon.

C is the principal or lifting magnet, the sole purpose of which is to establish the arc; D, its armature-lever, hung upon a fulcrum, E, and so as to swing in the usual manner for such armatures.

To the armature-arm a frame, F, is attached and extends toward the carbon-holder, and so as to receive an up-and-down vibratory movement under the swinging movement of the armature-lever D. In this frame, at right angles to the axis of the carbon-holder, a shaft, *a*, is arranged, to which a pinion, *b*, is fixed, corresponding to and working into the teeth in the carbon-holder, as indicated in broken lines, Fig. 1, also seen in Fig. 4. On the same shaft *a* is a worm gear-wheel, G, but loose upon the shaft, so as to revolve independent of it. From the frame F hangers H H extend downward and carry a shaft, I, on which is a worm, J, working into the worm-gear G.

K is a toothed wheel fixed to the shaft *a*, the teeth of which are preferably of gear-shape, in contradistinction to ratchet-teeth. Its hub *d* extends through the wheel G, and so that the wheel takes its bearing thereon loosely, and is, therefore, as before stated, substantially loose on the shaft. On the hub *d*, upon the opposite side of the wheel G, is a ratchet-wheel, L, loosely arranged and so as to rotate independent of the wheel G.

e is a pawl hung to the wheel G, its nose adapted to work into the teeth of the wheel K, and so as to positively engage the wheels K and G when free so to do.

f is a pawl fixed and stationary in the frame. It is best adjustably secured to a stud, *g*, extending down from the frame, and so that the nose of the pawl may engage the teeth of the wheel L, as seen in Figs. 2 and 5.

Under the swinging movement of the armature-lever D the shaft *a*, the wheels it carries, and the worm J will be moved up and down, as indicated in broken lines, Fig. 5. When the armature-lever D is in its closed position, the shaft *a* and the parts in connection therewith stand in the up position. As the armature-lever D swings from its pole, it brings the shaft *a* down with all it carries. In such downward movement the ratchet-wheel L, being engaged with the fixed pawl *f*, will be forced to revolve to the extent of such downward movement, and as indicated in Fig. 5.

From the pawl *e* an arm, 10, extends inward alongside the ratchet-wheel L, and in the wheel L is a stud, 11, which works in a corresponding slot in the arm 10 of the pawl *e*, and so that as the ratchet-wheel L rotates, as before described, it will turn the pawl *e* from its engagement with the wheel L, as indicated in broken lines, Fig. 5, and thereby disengage the wheel G from its connection with the shaft. Then, when the shaft *a* rises

under the movement of the armature-lever D, the spring 12 of the pawl *e* will force its nose into engagement with the wheel K, to again connect the wheel G with the shaft *a*, and such movement of the pawl *e* returns the wheel L to the same relative position to the wheel G that it before held. The downward swinging movement of the frame F and the shaft *a* permits a corresponding descent of the carbon-holder B with the frame.

M is a magnet in the main circuit; N, its armature lever, hinged at *h*, and, as here represented, the magnet and the armature-lever stand in a horizontal plane, and so that the lever works up and down.

Fixed to the shaft I, on which is the worm J, is a toothed ratchet, O, and hung upon the same shaft I is a lever, P. One arm extends to one side of the shaft I, and is joined to the armature-lever N by a connecting-rod, R, (see Fig. 2,) and so that the vibratory movement of the armature-lever N will be imparted to the lever P. The other arm of the lever P extends to the opposite side of the shaft I, and is there provided with a pawl, S, to work into the teeth of the ratchet-wheel O, and so that as the armature-lever N moves to the open position it will withdraw the pawl one or more teeth, as the case may be. Then on the return or closing movement the pawl will engage the wheel O, and correspondingly turn the shaft I and the worm J, which movement will be imparted to the worm-wheel G, and the relation of the worm to the wheel G is such, as shown, that the rotation of the wheel G is in the direction that if communicated to the shaft *a* it will revolve the shaft in the direction to drop the carbon holder. A stop-dog, T, is arranged to engage the ratchet-wheel O and prevent its return.

U V are two legs of a magnet traversed by the current passing through the arc. The armature is hung between the two, as at *l*, and so as to rock toward or from the pole of either. At one end, *i*, the armature is adapted to engage the pole of the leg U and the other end of like shape adapted to work with the pole of the other leg, V. The said other end carries a block, *m*, which, under the rocking movement of the armature, makes and breaks contact with the brush *n*.

W is a solenoid or electro-magnet, whose current is derived or shunted from that traversing the arc. Its armature *r* is guided through a bearing, *s*, above and *s* below.

t is a commutator, upon which bear the brushes *u v*, and the said commutator *t* is in metallic connection with the frame in which it revolves. From the commutator-cylinder a lever, 2, extends, and is connected with the armature *r* by a stud, 3, on the armature, working in a corresponding slot in the lever 2, (see Fig. 6,) the lever extending beyond the armature, where a spring, 4, is arranged, the tendency of which is to yieldingly hold the lever 2 in its down position. The movement of the armature *r* therefore serves to impart an oscillatory movement to the commutator *t*. The commutator is provided with insulating-surfaces *w* and *x*, to make or break contact with the respective brushes *u v*.

5 is a second commutator, to which oscillation is imparted through an arm, 6, attached to the armature-lever N of the magnet M, as seen in Figs. 2 and 7. This commutator 5 is provided with an insulating-surface, 7, and upon the commutator rides the brush 8. The armature-lever N is provided with an adjusting-spring, 9. The connection between the commutator cylinder 5 and the arm 6 is by a slot, 13, in the arm, working upon a stud, 14, in the end of the cylinder, so as to permit a little over motion, for the purpose hereinafter described.

In Fig. 7 I illustrate the several parts of the apparatus in diagram form, to conveniently show the connections and currents. The current enters at 15, divides at 16, part flowing through the wire 17 to the block *m*, thence through the brush *n* to the wire 18, to the wire 19, thence out to the next lamp. The balance from the division at 16 flows through the magnet C, through line 20 to the leg U of that magnet, thence through line 21 to brush *v* of commutator *t*. This portion of the current before it reaches the brush divides at 22. The principal portion flows through the commutator *t* to the brush *u*, thence through the line 23 to the carbon, while the less portion of the current flows from the division 22 through the wire 24, around the leg V of that magnet, through the line 25 to the commutator *t*, thence through the commutator-brush *u* and line 23 to the carbon. The major portion of the current flowing around the leg U causes a strong north pole to form at that leg and a corresponding weak south pole at the leg V, the armature at the same time forming a south pole at the leg U and a north pole at the leg V. At the same time the current flowing around the leg V forms a north pole at that leg, but does not materially affect the leg U. The result of this obstruction of the currents is to produce a strong attraction between the end *i* of the armature and the leg U, and a weak repulsion between the leg V and the other end of the armature, which causes the armature to close upon the leg U and open the armature from the leg V. This separation of the armature from the leg V takes the block *m* from contact with the brush *n*, which causes the entire current to flow through the magnet C, line 20, magnet U, commutator *t*, thence through line 23 to the carbon. Under these conditions the armature of the magnet C will be attracted to its pole, and will raise the frame F, together with the shaft *a* and all thereto connected, as indicated in Fig. 5, broken lines in that figure indicating the down position of the shaft *a* and the wheels it carries, and from which the said shaft and its wheels are moved by the closing movement of the armature of the magnet C. This upward movement of the shaft *a* will leave the ratchet L free to rotate toward

its pawl—that is to say, the tooth with which the pawl *f* is engaged, resting upon the pawl while the shaft *a* and the ratchet rise, will permit the ratchet to rotate to the extent that the shaft is raised. Such rotation of the wheel and shaft is induced by the spring of the pawl *e*, acting through the arm *n*. The pawl *e*, under such movement of the ratchet-wheel L, is forced into engagement with the teeth of the wheel K, at the same time causing the wheel L to stand in engagement with its pawl *f* and impart to the wheel substantially a return movement, thus coupling the wheel G with the shaft *a*, then, as the armature-lever D completes is closing movement, and the completion of the upward movement of the shaft *a*, will engage the pinion *b* with the teeth of the carbon-holder, so that the carbon-holder will be lifted through that portion of the upward movement in which the wheel G is engaged with the shaft. The shaft *a* cannot revolve under the engagement with the ratchet, because of the interlocking of the wheels and the worm; hence the pinion will make a positive lifting engagement with the carbon-holder.

As the arc increases in length, a portion of the current is shunted through the magnet W in the usual manner. The armature *r* of that magnet will be consequently drawn upward, imparting a rotation to the commutator *t*, until the brush *u* comes to a bearing on the insulation *w*, thus breaking the short circuit through the brush *u* and the line 23, which causes the current to flow through the line 26 to the second commutator, 5. At this point the current can flow two ways: first, through the commutator and the brush 8 to line 27, thence through line 23 to the carbon; second, around the magnet M, through line 28 to line 23, and thence to the carbons; but the current through the carbon is never broken, for the reason that the commutator *t* is in metallic connection with the frame in which it revolves, and the wire 26 is also in connection with the same frame, so that a portion of the current is always going that way, but not enough to draw down the armature of the magnet M as the principal portion is going across the brush *u* to line 23, because of its low resistance; but as soon as it has been revolved so that the brush *u* bears on the insulation *w* the whole current must flow through the line 26. The action of the spring 9 causes the brush 8 to lie on the insulation 7 on the commutator-cylinder, thus breaking the short circuit and forcing all the current through the magnet M, which draws its armature to its pole, which movement of the armature, through the connecting-rod R and pawl S, causes a slight rotation of the ratchet-wheel O and the worm J on the same shaft, and this rotation of the worm J causes a corresponding rotation of the wheel G, and the wheel G being engaged, as before described, with the shaft *a*, communicates its rotation to the pinion *b*, thence to the carbon-holder, to impart a feed to the holder corresponding to such rotation of the ratchet-wheel O. The slot 13 in the arm 6 allows the magnet M to continue under the action of the current until just before the armature-lever N comes to its pole. Then, during the completion of the closing movement of the lever N, the commutator is reversed, completing the short circuit through its brush 8. When this is done, the armature-lever N will again leave its pole and assume its original position, breaking the short circuit and again approach its pole. Each time the armature is drawn down an impulse is given to shorten the arc, which in time will lessen the resistance and allow the armature of the shunt-magnet W to fall until the normal position is reached, when the brush *u* will again bear on the commutator, and the magnet M will be again short-circuited.

In practice there will be a balance formed between the strength of the shunt-magnet W or the resistance of the arc and the spring or detractor attached to the lever 2, which will cause the armature of the magnet M to give an occasional movement to the ratchet-wheel O, keeping up a practically constant feed, and maintain a constant resistance in the arc. It will be noticed that the feeding is done by a magnet in main circuit, the power of which can be made sufficient to overcome all ordinary obstacles to feeding, while the shunt has nothing to do but make and break circuit, and may be made of high resistance, thus increasing the percentage of useful current in the lamp. This action will be kept up during the normal working condition of the lamp; but should the carbon stick so as to prevent feeding, or from any other cause the proper working of the lamp should be prevented, the armature of the shunt-magnet W will be drawn up still farther, and the other brush, *v*, will be made to bear on the insulation *x*, and the short circuit around the leg V will be broken, causing the current to pass that way. Under this condition the leg V is considerably stronger than the leg U, and is wound to neutralize the action of U. As before stated, the north pole of V will be strengthened, and that of U correspondingly weakened, while a second north pole will be established on the armature at the leg U, thus giving attraction between the other end of the armature and the leg V and repulsion between U and the armature at that leg. The armature will therefore be drawn to the leg V, thereby closing the contacts *m n*, and thus cut the lamp out of circuit.

It will be apparent that the cutting out of the lamp occurs before the arc has become sufficiently great to actually break the circuit; but it can be made to take place at any length of arc, accordingly as the brush *v* is nearer to or farther from the insulating-surface *x*.

If, after the cut out has taken place, the obstruction to the feed should be removed, the carbon rod will fall until the ratchet-wheel L again strikes its fixed pawl *f*, when the continued movement of the armature or falling of the rod will cause the ratchet-wheel to turn backward and the pawl *e* to disengage the

wheel K, as indicated in broken lines, Fig. 5, thus releasing the rod, and leave it free to be lifted for the purpose of replacing the carbon. The parts have now all assumed their normal position, and the passage of the current through the lamp causes the cut-out to break the contact between *m* and *n*, and the lamp immediately relights. The cut-out mechanism is therefore not only capable of automatically cutting out the lamp when the arc becomes abnormally long, or the main circuit through the lamp is broken, but also automatically cuts in the lamp when these obstructions have been removed.

I do not wish to be understood as limiting my invention to the specific device which I have shown and described for the purpose of mechanically locking and unlocking the worm-gear or pinion which works into the rack in the carbon-holder, as other devices for accomplishing the same result will present themselves to those skilled in the art to which this invention pertains. One of numerous devices which will readily suggest themselves as a modification of this device is seen in Fig. 8.

Instead of making the worm-wheel G loose on the shaft *a*, as before described, in this construction it is made fast to the shaft, and the pinion *b* is loose upon the shaft. On the shaft a sleeve, 29, is arranged loose for longitudinal movement, but splined to the shaft, so as to couple the two that they must revolve together. The adjacent faces of the sleeve 29 and the pinion *b* are constructed to engage or disengage in the usual manner of machinery-clutches. The sleeve is constructed with an annular groove, 30, in which stands one arm, 31, of a lever, hung below upon a fulcrum, 32. On the shaft is a spring, 33, the tendency of which is to force the sleeve 29 toward the pinion.

34 represents a stationary inclined plane corresponding substantially to the stationary pawl *f*, before described. The second arm, 35, of the lever is adapted to ride upon the incline 34. When the armature-lever D stands in its open position, and the shaft *a* down, as before described, the lower end of the arm 35 has passed down upon the incline 34 to such an extent as to withdraw the sleeve 29 from its clutch engagement with the pinion *b*, thus leaving the pinion free; but when the shaft *a* is raised under the closing movement of the armature-lever D the spring 33 reacts and forces the sleeve 29 toward and into engagement with the pinion *b*, so that in that condition the pinion *b* will be engaged with the shaft, so as to revolve with it, and then the continued upward movement of the frame causes the carbons to separate, as before. Other mechanical equivalents might be described for accomplishing this same result; but this modification will be sufficient for the information of those skilled in the art, the gist of this part of my invention being to automatically disengage the worm from the rack on the carbon-rod by the outward or opening movement of the armature controlling the separating device.

As to the system of short-circuiting at the commutator *t*, I do not limit myself to the commutator device, as many equivalents known to those skilled in the art may be attached to the armature of the shunt-magnet, which will cause the necessary distribution of the currents; neither do I wish to be understood as limiting my invention to the particular automatic cut-out, the gist of my invention being the employment of an electro-magnetic device having its two poles acting on a single armature hinged so as to approach one pole and recede from the other pole, the legs of which magnet are wound so as to always form like poles at their free ends, the one being stronger than the other and changing from strong to weak or weak to strong by the action of a magnet in shunt-circuit, which changing in strength makes and breaks the short-circuit around the carbons.

The magnet U V, which is traversed by the current passing through the arc and the shunt-magnet and their connections, may be employed with other automatic feeds than that which I have described as a means for cutting out the lamp.

I claim—

1. In a feeding mechanism for an arc lamp, the combination of the carbon-holder and the three electro-magnets with the mechanism, substantially such as described, connecting the said magnets, the first of said magnets traversed by a current derived or shunted from the arc, the increase or decrease of the strength of which makes or breaks the electric contact completing a branch around the second electro-magnet, the said second electro-magnet traversed by the direct current or a portion thereof, which said second magnet with the third magnet separates the carbons, and also adjusts the position of the carbons during the normal operation, substantially as described.

2. In a feeding mechanism for an arc lamp, the combination of an electro-magnet consisting of two legs, both wound to form like poles at their free ends, but the one stronger than the other, an armature hung between said legs and adapted to approach the one as it recedes from the other, with a shunt-magnet, substantially such as described, whereby the said legs will be changed, respectively, from strong to weak and from weak to strong, thereby making and breaking a short circuit around the carbons.

3. In a feeding mechanism for arc lamps, the combination of the carbon-holder B, the lifting magnet C, its armature-lever D, carrying the frame F, the shaft *a*, arranged in said frame at right angles to the axis of the carbon-holder, and carrying a pinion, *b*, corresponding to the toothed rack on said holder, a worm-wheel, G, on said shaft, a worm, J, also carried by said frame adapted to work into said wheel G, with a second magnet, M, in the main circuit, and its armature-lever, the connections

between the said armature-lever and the worm J, with mechanism, substantially such as described, between the worm-wheel G and the pinion *b* to couple the said wheel and pinion, and a shunt-magnet with line or wire connections, substantially as and for the purpose described.

4. The combination of the carbon-holder B, principal lifting-magnet C, its armature lever D, carrying the frame F, the shaft *a*, arranged in said frame at right angles to the axis of the carbon-holder and carrying a pinion, *b*, corresponding to the toothed rack on said holder, a worm-wheel, G, on said shaft, a worm, J, also carried by said frame and adapted to work into said wheel G, with a second magnet, M, in the main circuit, and its armature-lever, the connection between the said armature-lever and the worm J, with mechanism, substantially such as described, between the worm-wheel G and the pinion *b*, to couple the said wheel and pinion, a shunt-magnet, the commutator *t*, actuated by said shunt-magnet, and the wire or line connections, substantially as described.

5. The combination of the carbon-holder B, principal lifting-magnet C, its armature-lever D, carrying the frame F, the shaft *a*, arranged in said frame at right angles to the axis of the carbon-holder and carrying a pinion, *b*, corresponding to the toothed rack on said holder, a worm-wheel, G, on said shaft, a worm, J, also carried by said frame and adapted to work into said wheel G, with a second magnet, M, in the main circuit, and its armature-lever, the connection between the said armature-lever and the worm J, with mechanism, substantially such as described, between the worm-wheel G and the pinion *b*, to couple the said wheel and pinion, a shunt-magnet, the commutator 5, in connection with and so as to be actuated by the armature-lever of the said magnet M, and the wire or line connections, substantially as described.

6. The combination of the carbon-holder B, principal lifting-magnet C, its armature lever D, carrying the frame F, the shaft *a*, arranged in said frame at right angles to the axis of the carbon-holder and carrying a pinion, *b*, corresponding to the toothed rack on said holder, a worm-wheel, G, on said shaft, a worm, J, also carried by said frame and adapted to work into said wheel G, with a second magnet, M, in the main circuit, and its armature-lever, the connection between the said armature-lever and the worm J, with mechanism, substantially such as described, between the worm-wheel G and the pinion *b*, to couple the said wheel and pinion, a shunt-magnet, the commutator *t*, actuated by said shunt-magnet, and a second commutator. 5, in connection with and so as to be actuated by the armature-lever of the magnet M, and the wire or line connections, substantially as described.

7. In a feeding mechanism for arc lamps, the combination of the carbon-holder B, the lifting-magnet C, its armature lever D, carrying the frame F, the shaft *a*, arranged in said frame at right angles to the axis of the carbon-holder and carrying a pinion, *b*, corresponding to the toothed rack on said holder, a worm-wheel, G, on said shaft, a worm, J, also carried by said frame, adapted to work into said wheel G, with a second magnet, M, on the main circuit, and its armature-lever, the connections between the said armature-lever and the worm J, with mechanism, substantially such as described, between the worm-wheel G and the pinion *b*, to couple the said wheel and pinion, a magnet traversed by the current which passes through the arc, the armature of the said magnet hung between the two legs and so as to rock from the pole of one to the pole of the other, and a shunt-magnet, with the line or wire connections, substantially as described.

8. The combination of the carbon-holder, magnet C, its armature-lever D, carrying the frame F, the shaft *a*, supported in said frame at right angles to the axis of the carbon-holder, pinion *b*, fixed to said shaft and adapted to engage a corresponding rack on the carbon-holder, the worm-wheel G, loose on said shaft *a*, the ratchet-wheel L, loose on said shaft, stationary pawl *f*, adapted to engage the teeth of said ratchet-wheel, a toothed wheel, K, loose on said shaft, a spring pawl, *e*, hung to said worm-wheel G, provided with an arm, 10, arranged to engage said ratchet-wheel L, the nose of said pawl adapted to engage the teeth of said wheel K. and whereby the said worm-wheel G is coupled with said shaft *a*, a worm, J, arranged in said frame and working into the said worm-wheel G, a ratchet, O, on the shaft of said worm, a second magnet, M, its armature-lever N, a pawl in connection with said armature-lever N and adapted to work into the teeth of said wheel O, the third magnet traversed by the current passing through the arc, and a shunt-magnet, with the wire or line connections, substantially as described.

NORMAN McCARTY.

Witnesses:
JOHN E. EARLE,
FRED C. EARLE.