(No Model.) 2 Sheets—Sheet 1.

W. A. CROWDUS & H. M. SUTTON.

ELECTRIC ARC LAMP.

No. 358,145. Patented Feb. 22, 1887.

Fig. 1

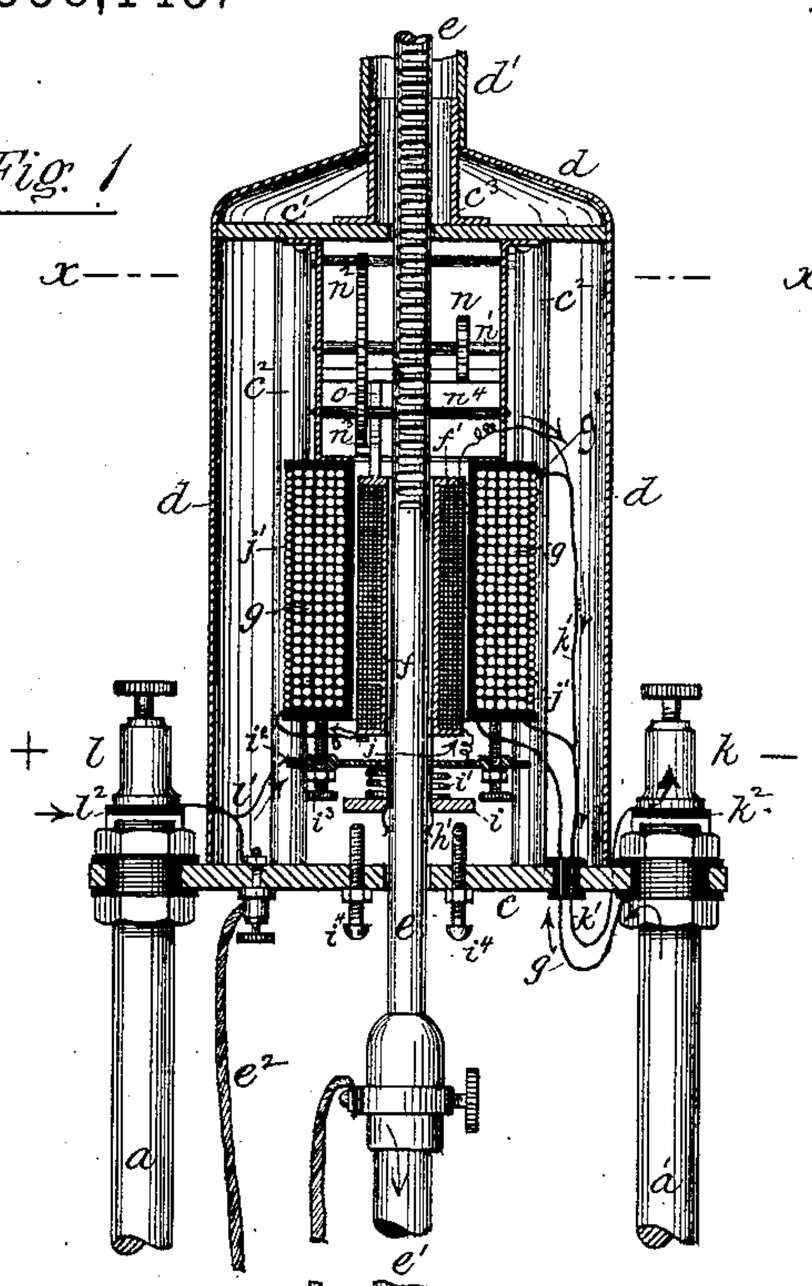
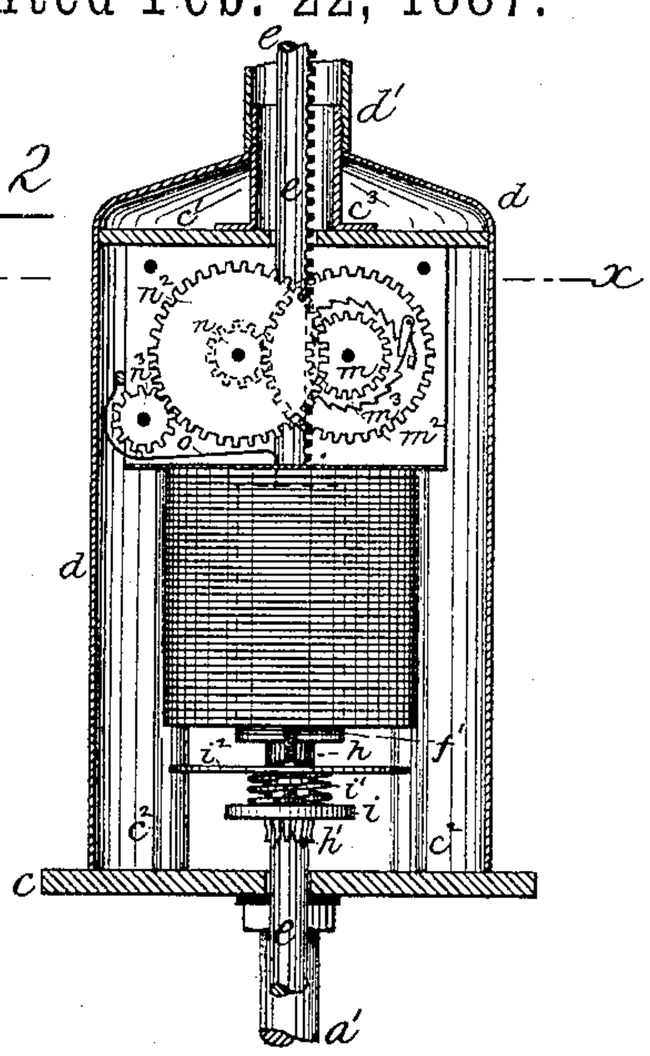
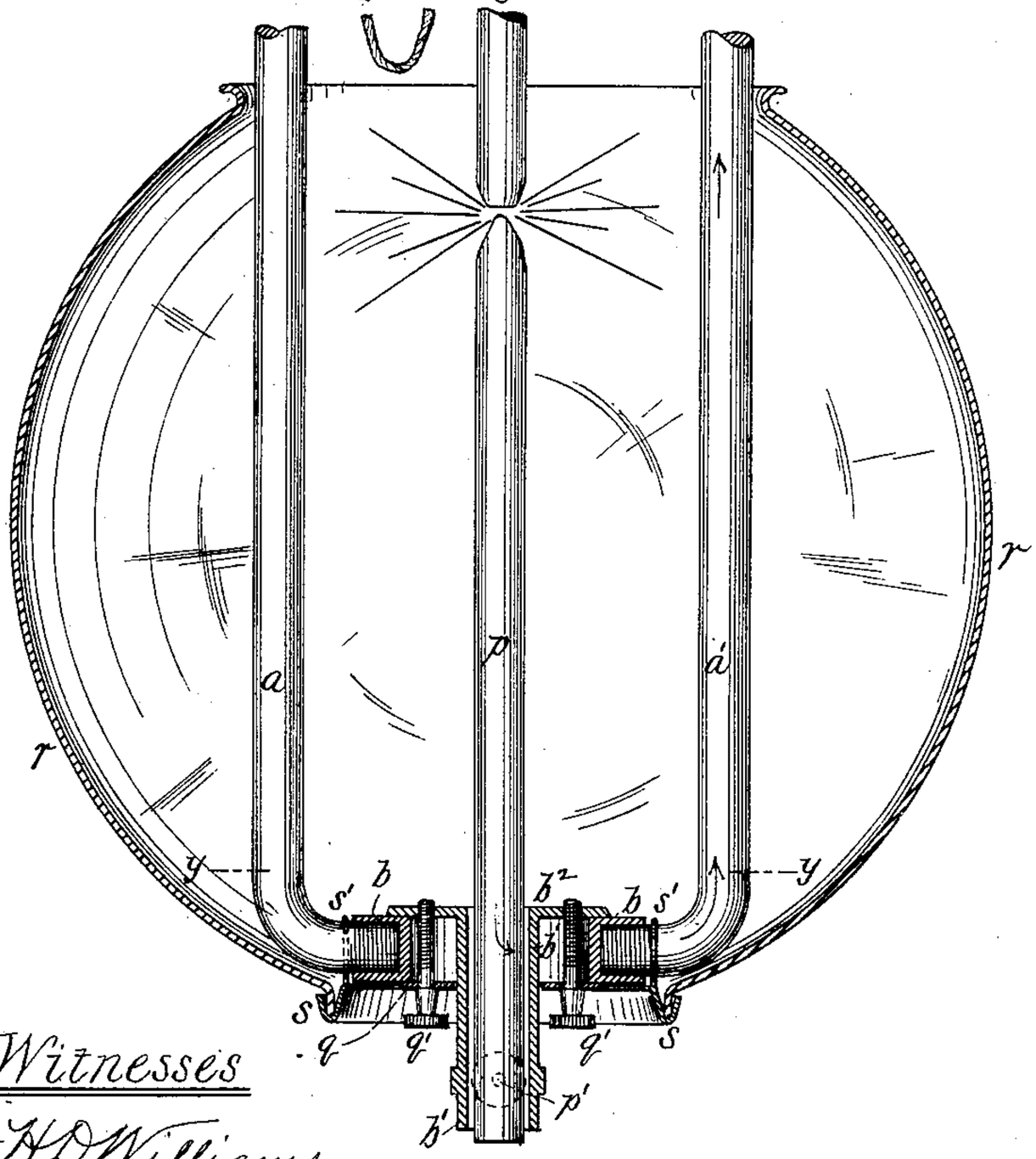


Fig. 2





Witnesses

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 3

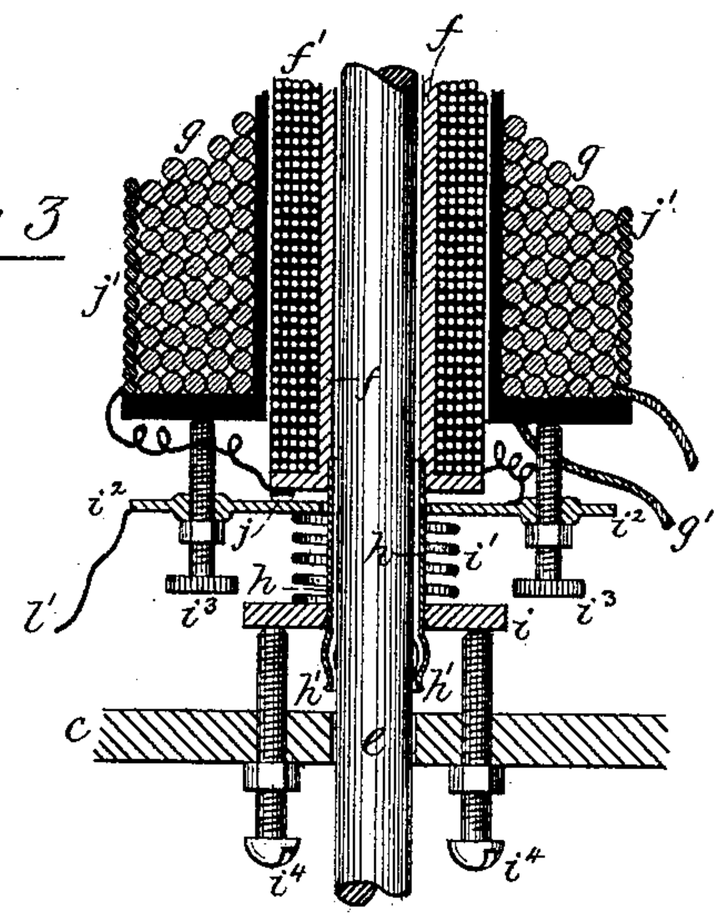


Fig. 5

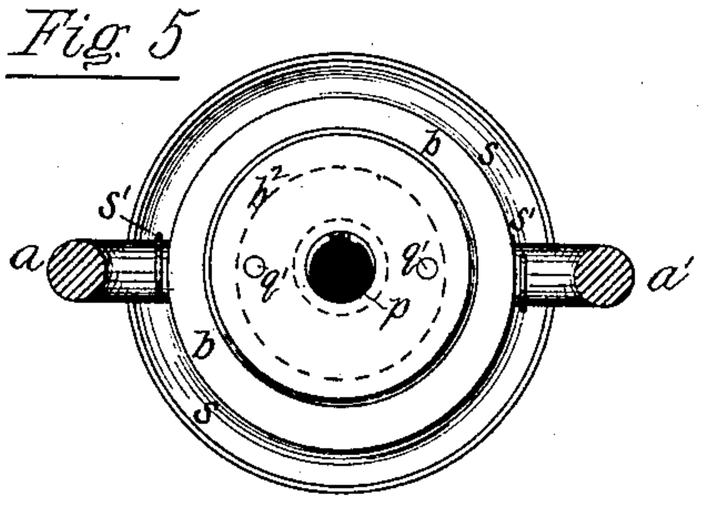
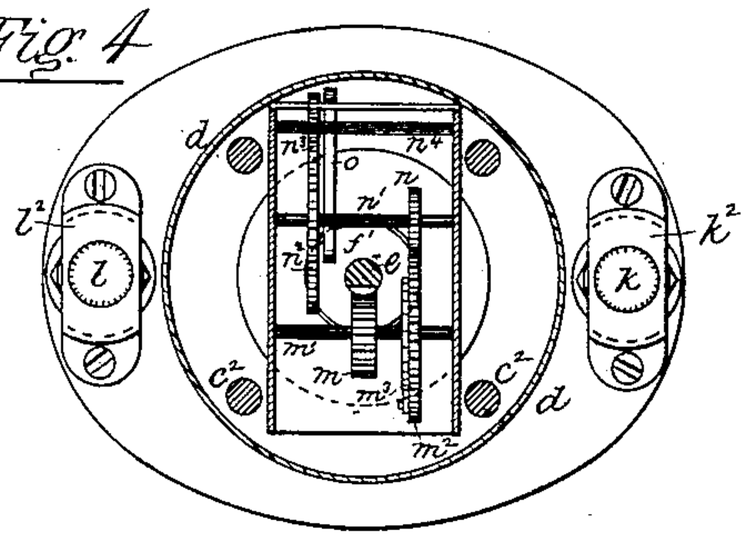


Fig. 4



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UNITED STATES PATENT OFFICE.

WALTER A. CROWDUS AND HENRY M. SUTTON, OF DALLAS, TEXAS.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 358,145, dated February 22, 1887.

Application filed October 1, 1886. Serial No. 215,060. (No model.)

To all whom it may concern:

Be it known that we, WALTER A. CROWDUS and HENRY M. SUTTON, both citizens of the United States, and residents of Dallas, county of Dallas, State of Texas, have invented certain new and useful Improvements in Electric-Arc Lamps, of which the following is a specification.

The improvements in electric-arc lamps forming the subject-matter of this invention comprise the following features: a novel arrangement of a cut-out circuit and the exciting or main coil of a solenoid which is in circuit with the carbons, the circuit-breaker of the cut-out being controlled by a vertically-moving core actuated by the solenoid, whereby the current passing in multiple arc through the exciting or main coil and the cut-out circuit, which is about equal in resistance to the main coil, causes the core to be raised, so as to break the cut-out circuit, and the current, then flowing through the main coil only, further raises the core and forms the arc between the carbon rods by means of a clutch carried by the core; a new form of clutch, which consists of a tube secured to the lower end of the core, slit and bent at its ends, so as to form gripping-jaws to embrace the upper-carbon-holding rod, two disks fitted freely over the tube, and a spring located between the disks. The lower disk is supported on adjusting-screws, and acts on the bent jaws of the tube to cause them to grip the carbon-holding rod when the core is raised sufficiently to lift the disk off from its adjusting-screws. The upper disk is provided with adjustable stop-screws bearing against the bottom of the solenoid, by which the amount of free play of the gripping-jaws when the lower disk is at rest and the closing of the cut-out circuit after the jaws have released the rod are determined, and the resisting action of the spring between the disks is regulated.

A brake arrangement is provided to insure a steady and regular feed to the upper carbon when its rod is released by the clutch, which consists of a system of gears actuated from a rack formed in the side of the carbon-holding rod, and a brake-lever caused to act on the last wheel of the system of gears, and which is released therefrom by the core when it falls sufficiently to allow the rod to slide through the clutch.

The invention also embraces an improved lower-carbon holder, whereby the lower carbon may be readily adjusted longitudinally and to bring it in alignment with the upper carbon from the outside of the lamp without disturbing the protecting globe, and a globe-holder consisting of a ring adapted to embrace and hold the globe at its lower opening, and spring-clamps on the ring arranged to catch over the side bars of the lamp.

Other minor improvements are shown, which, with the foregoing improved devices, will be fully understood by reference had to the accompanying drawings, in which—

Figure 1, Sheet 1, is a vertical sectional view of our improved arc-lamp. Fig. 2, Sheet 1, is a side elevation of the upper part of the same, partly in section. Fig. 3, Sheet 2, is an enlarged sectional view of the clutch. Fig. 4, Sheet 2, is a plan of the upper part of the lamp, taken on the line *x x;* and Fig. 5, Sheet 2, is a plan of the lower-carbon holder, taken on the line *y y*, Fig. 1.

The frame of the lamp consists of the two side bars, *a a'*, bent at their lower ends and screwed into the ring *b*, the plate *c*, to which the rods *a a'* are secured by insulated connections, and the upper plate, *c'*, connected to the plates *c* by the rods c^2. The upper works are protected by the cylindrical case *d*, resting at its lower edge on the plate *c*, and having a hole formed in its upper end, through which passes the tubular neck c^3, attached to or forming a part of the plate *c'*, said case *d* being held in position by the tube *d'*, into which the upper-carbon holding rod *e* passes, and which, by means of a screw-thread, is attached to a tubular neck, c^3, its end bearing on the top of the case *d*.

The rod *e*, carrying, by means of a suitable clamp, the upper carbon, *e'*, is fitted to slide freely through central guide-holes in the plates *c* and *c'*. This rod *e* is electrically connected to the plate *c* by the flexible wire e^2. The iron spool *f*, wound with fine insulated wire *f'*, and constituting the core or armature of the solenoid *g*, surrounds this rod *e*. From the lower end of this core *f* depends the tubular clutch

h, consisting of a piece of tube or pipe with its lower end slit and bent so as to form gripping-jaws *h'*, as shown in the enlarged view, Fig 3. These jaws when normally free allow the carbon-rod *e* to slide through them, but are closed so as to grip the rod by the ring or disk *i*, which is pressed down by the spiral spring *i'*, located between the disks *i* and i^2. The position of the disk i^2 is regulated by means of the thumb-screws i^3 i^3, passing through tapped holes therein and abutting against the lower end of the solenoid. Screws i^4 i^4, passing through the plate *c*, support the disk *i* when the core *f* falls, and thus allow the jaws to open and free the rod, the adjustment of the screws i^4 i^4 determining the vertical amount of play of the jaws and core without gripping action on the rod.

The disk i^2, with the insulated block *j*, carried by the core *f*, constitutes the circuit-breaker of the cut-out, one end of the coil *j'*, which is placed over the wire of the solenoid *g*, being connected to the block *j* and the other end to the binding-post *k* by the wire *k'*. This coil *j'* is about equal in resistance to the solenoid coil *g*. Branches from this wire *k'* also go to one end of the solenoid *g* and the fine wire coil *f'*. The other end of the solenoid *g*, by the line *g'*, joins the side post *a'*, and the other end of the fine wire coil, *f'*, is electrically connected to the disk i^2. The binding-post *l* is connected to the plate *c* and to the disk i^2 by the line *l'*.

The binding-posts *k* and *l* are supported on bridge-pieces k^2 l^2, extending over the fastenings of the upper ends of the rods *a a'*. Both of these bridge-pieces are shown as made of insulating material. The one l^2 may be made of metal to form the electrical connection between the post *l* and the plate *c*. The wire *l'* is shown as forming this connection in Fig. 1, to clearly indicate the circuit connections.

Between the top of the solenoid *g* and the plate *c'* is a train of gear-wheels, consisting of a pinion, *m*, secured to the shaft *m'*, and arranged to mesh into rack-teeth cut in the rod *e*, a wheel, m^2, running loosely on the shaft *m'*, but connected so as to rotate therewith when the rod *e* is moving downwardly, by a spring-pawl on its side catching in the ratchet-wheel m^3, secured to the shaft *m'*, a pinion, *n*, on the shaft *n'* meshing into the wheel m^2, a wheel, n^2, also on this shaft, and a pinion, n^3, on the shaft n^4 meshing into the wheel n^2. By reason of the ratchet-wheel m^3 the carbon-holding rod *e* may be moved upwardly without actuating the system of gear-wheels, and said rod is held up by the spring brake-lever *o* locking the last wheel, n^3, of the system. The free end of this lever *o* rests on the top of the moving core *f*, and is freed from the wheel n^3 after the clutch carried by the core has released the rod *e* by the downward motion of the core.

The lower carbon, *p*, is held in the tube *b'*, having a flange, b^2, of sufficient size to rest on the ring *b*. As the tube *b'* is considerably smaller than the opening in the ring *b*, it may be moved in any direction horizontally to set the carbon *p* directly under the carbon *e*. The carbon *p* is held in the tube *b'* by the thumb-screw *p'*, passing through the side of the tube below the frame of the lamp. A plate or disk, *q*, surrounds the tube *b'*, and set-screws *q' q'* clamp this plate and the flange b^2 firmly to the ring *b* after the carbon *p* has been properly set.

The globe *r* surrounds the side bars, *a a'*, and is held up by a V-flange on the ring *s*, fitting around the lower opening of the globe, said ring *s* being provided with spring-hooks *s' s'*, arranged to catch over the lower bent ends of the rods *a a'*. By this arrangement the globe *s* is firmly held in position, and is readily removed from and replaced on the lamp, and the means for adjusting the lower carbon, *p*, are accessible without having to remove the globe.

The circuit-wire *j'* of the cut-out may be placed in any other position than around the solenoid-coil *g*.

In normal inactive condition the arc forming and regulating devices occupy the position shown in Fig. 3, the upper carbon then resting upon the lower one. Upon putting the lamp in circuit the current entering the post *l* has three paths, one comprising the carbon-rods *e'* and *p*, side rod, *a'*, wire *g'*, the main coil or solenoid *g*, wire *k'*, and post *k*. The second circuit comprises the disk i^2, the fine-wire coil *f'* of the core, wire *k'*, and post *k*, and is always closed; and we would here mention that we are enabled, by the construction of our lamp, to make this coil *f'* of such high resistance that danger of burning the same is avoided. The third circuit comprises the disk i^2, contact-block *j*, resistance-coil *j'*, wire *k'*, and post *k*. The coils *g*, *f'*, and *g'* are so wound and connected that similar magnetic polarity is induced at their adjacent ends by the action of the current flowing through them, the coils *g* and *f'* acting differentially to control the arc in the manner well understood. The current initially passes mainly through the coils *g* and *j'* in multiple arc, and induces sufficient magnetism to cause the core *f* to be raised. This it is free to do without raising the rod *e*, by reason of the play given to the clutch below the disk *i;* but during the first part of its upward movement the cut-out circuit is broken at *j*, thus leaving the coil *g* as the main path of the current. The magnetic influence now due to the solenoid, in causing the core to be further raised, lifts the disk *i* off the screws i^4 i^4, thereby causing the jaws *h'* to grip the rod *e*, so that it travels up with the core, and the electric arc is formed between the carbon-rods *e* and *p*. When the arc increases beyond its normal working length, the current then flowing through the fine-wire coil *f'* demagnetizes the core *f* to oppose the attractive action of the solenoid *g* thereon, thus allowing the core and carbon to fall until the disk *i* is again supported by the screws i^4 i^4, and the clutch-jaws are allowed by their resilience to leave the rod *e*. The spring brake-

lever *o* is now, by the downward movement of the core, freed from the wheel n^3 of the retarding or speed-controlling system of gears, and the carbon-rod allowed to gradually fall, to maintain the arc constant. This freeing of the clutch and brake-lever occurs before the cut-out circuit is closed, and as the feed of the carbon is controlled by the gears independently of the clutch-jaws, which are used only to form the arc, the weight of the core and its coil is the only opposing force to the lifting power of the magnetism differentially controlled by the solenoid *g* and its coil *f'* when it becomes necessary for the upper carbon to feed to maintain the length of the arc constant, so that the feeding operation is under perfect control, its sensitiveness being such as to avoid any apparent variations in the length of the arc.

Should the arc become broken from any cause, or any derangement of the arc-circuit occur, the cut-out circuit would be immediately closed, affording a free path for the current, so that other lamps in circuit would be in nowise affected thereby; and it will be observed from the foregoing that the cut-out is perfectly automatic in its operation, its circuit being broken as soon as the arc-circuit is complete, and before the establishment of the arc takes place, by means of the moving core or armature which forms and controls the arc.

Having now described our invention, what we claim, and desire to secure by Letters Patent, is—

1. In an electric-arc lamp, the combination, with a solenoid included in the arc-circuit and a core actuated thereby, provided with means for establishing the arc, of a cut-out circuit arranged in multiple series with the arc-circuit and provided with a circuit-breaker actuated by the core, whereby the electric current is initially divided between the arc-circuit and the cut-out circuit, the cut-out circuit is then broken by the inductive action of both parts of the divided current on the core, and the core is further raised and the arc formed by the entire current flowing through the solenoid in the arc-circuit.

2. In an electric-arc lamp, in combination, a fixed solenoid included in the arc-circuit, a core wound with fine wire connected in circuit around the solenoid and arc differentially arranged with the solenoid and provided with means for establishing the arc, a cut-out circuit about equal in resistance to the arc-circuit solenoid in multiple series with the arc-circuit, and combined therewith so as to induce magnetic action in a similar manner, and a circuit-breaker in the cut-out circuit actuated by the core, substantially as and for the purpose set forth.

3. In an electric-arc lamp, in combination, a fixed solenoid in the arc-circuit, a moving core actuated thereby and provided with a clutch, a carbon-holding rod passing through the core and clutch, a train of gear-wheels actuated by the rod, and a brake-lever actuated by the core and applied to one of the wheels of the system when the core is raised and before the carbon-holding rod is lifted by the core and released therefrom by the downward movement of the core after the carbon-holding rod has been freed by the clutch, substantially as set forth.

4. In an electric-arc lamp, in combination, a hollow vertically-moving core or armature actuated by a solenoid or magnet included in the arc-circuit, a carbon-holding rod located within the core, a clutch surrounding the rod and carried by the core, consisting of a tube split and bent at its end to form spring-jaws, two disks loosely fitted on the same, and a spiral spring located between the disks, substantially as and for the purpose set forth.

5. In an electric-arc lamp, in combination, a fixed solenoid included in the arc-circuit, a hollow core located therein, a carbon-holding rod sliding freely within the core, a tubular spring-clutch attached to the lower end of the core, a disk arranged to slide on the tubular clutch and close the clutch-jaws upon the carbon-holding rod, a spring on the disk, and another disk resting on the spring, provided with stop-screws arranged to abut against the bottom of the solenoid and electrically connected to one of the terminals of the lamp, and a resistance one end of which is joined to an insulated block carried by the core and the other end to the other terminal of the lamp, substantially as and for the purpose set forth.

6. In an electric-arc lamp, in combination, a fixed solenoid included in the arc-circuit, a hollow core located therein, a carbon-holding rod sliding freely within the core, a tubular spring-clutch attached to the lower end of the core, a disk arranged to slide on the tubular clutch and close the clutch-jaws upon the carbon-holding rod, a spring on the disk, and another disk resting on the spring, provided with stop-screws arranged to abut against the bottom of the solenoid and electrically connected to one of the terminals of the lamp, a resistance one end of which is joined to an insulated block carried by the core and the other end to the other terminal of the lamp, and a fine-wire coil connected at one end to the upper disk of the clutch device and its other end to the second terminal of the lamp, substantially as and for the purpose set forth.

7. In an electric arc lamp, in combination, the upper frame, *c c'*, the cover *d*, fitted over the tubular neck c^3, and the tube *d'*, screwed on the neck c^2 and bearing against the cover *d*, substantially as and for the purpose set forth.

8. In an electric-arc lamp, the combination, with the globe and the frame of the lamp, of a ring having a V-shaped groove, in which the lower end of the globe rests, and provided

with spring-hooks arranged to catch over the lower part of the frame, substantially as and for the purpose set forth.

Signed at Franklin, county of Simpson, State of Kentucky, this 17th day of September, 1886.

WALTER A. CROWDUS.

Witnesses:
A. T. BRADLEY,
W. BEALL.

Signed at Dallas, county of Dallas, State of Texas, this 13th day of September, 1886.

HENRY M. SUTTON.

Witnesses:
C. F. CRUTCHER,
L. R. WRIGHT.