(No Model.) 4 Sheets—Sheet 1.

W. ROBINSON.

ELECTRIC LIGHT REGULATOR.

No. 304,455. Patented Sept. 2, 1884.

Fig. 1.

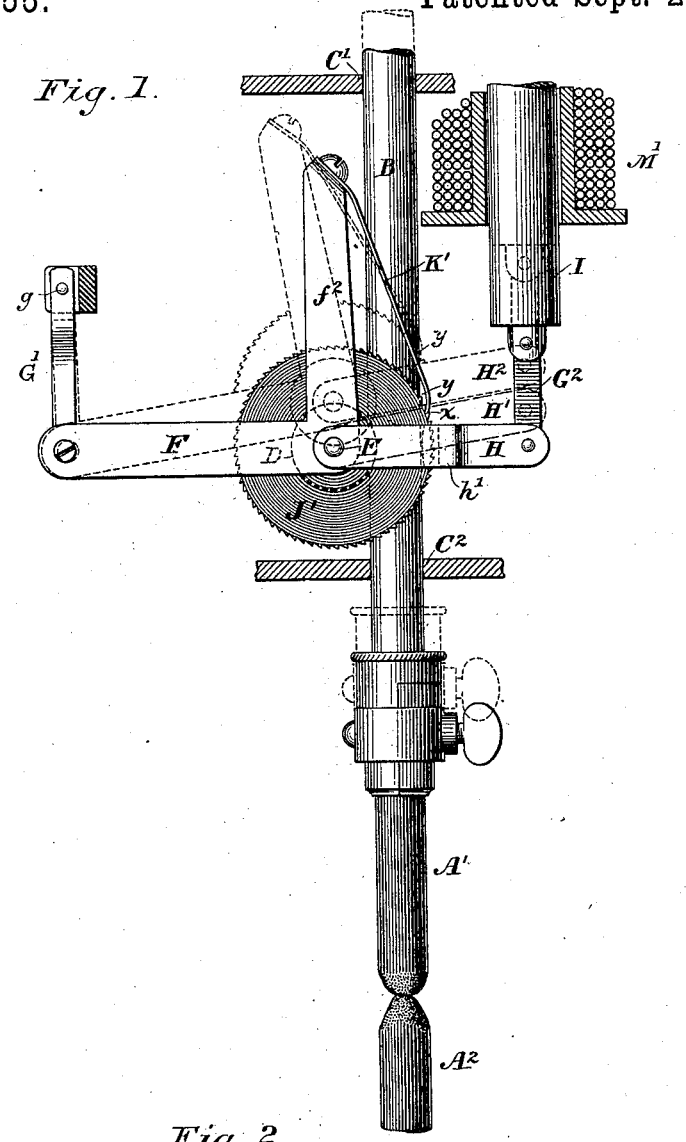
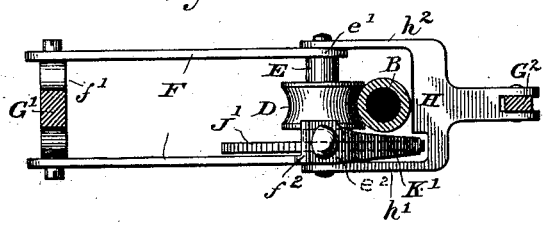


Fig. 2.



WITNESSES

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Fig. 3.

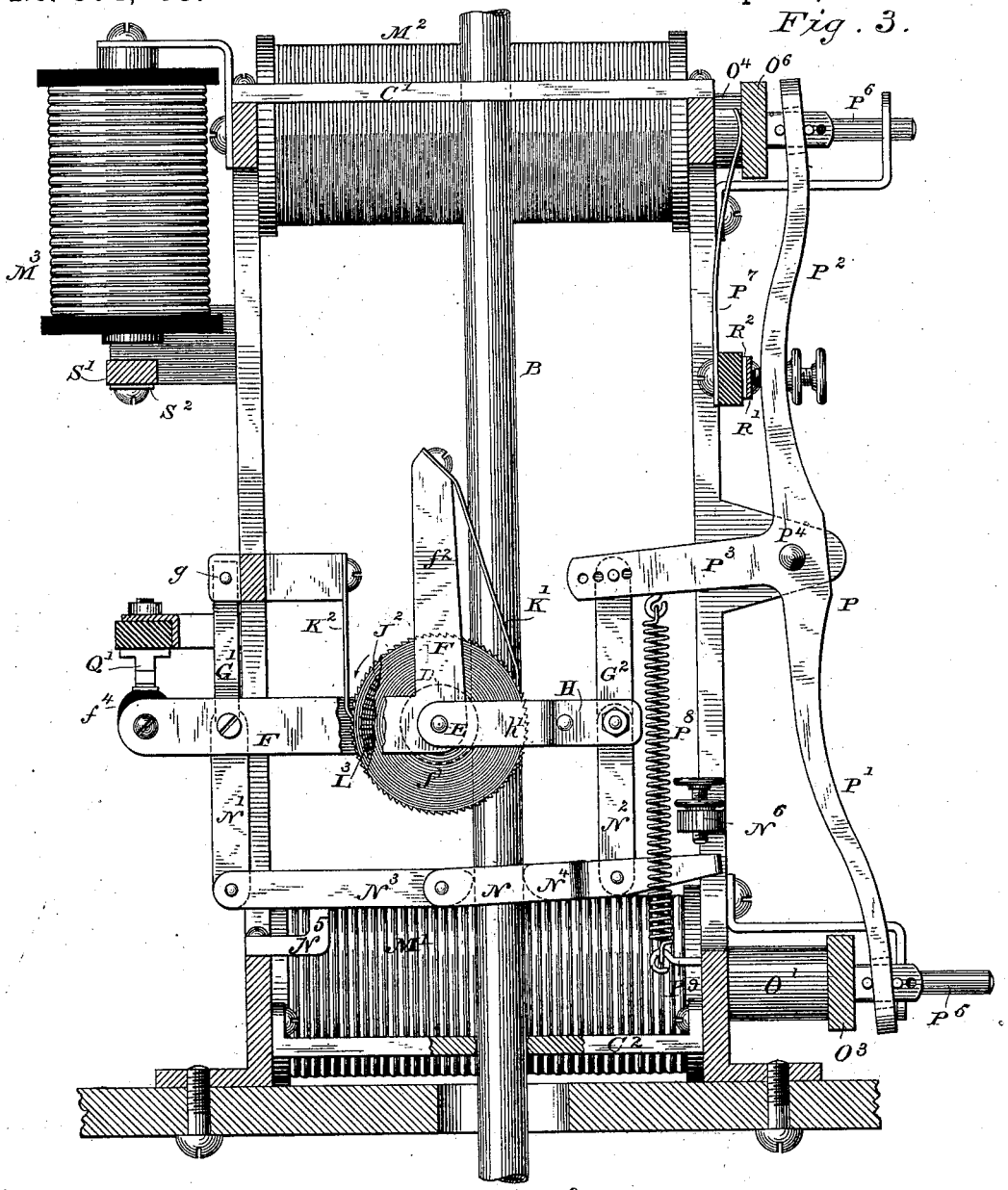

Fig. 4.

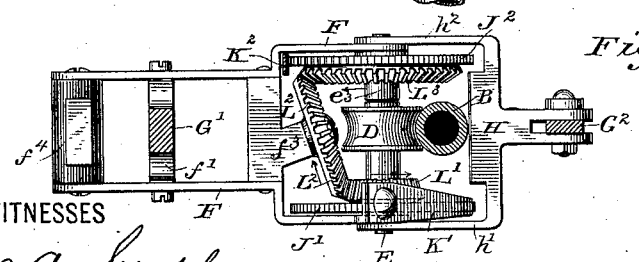

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Fig. 5,

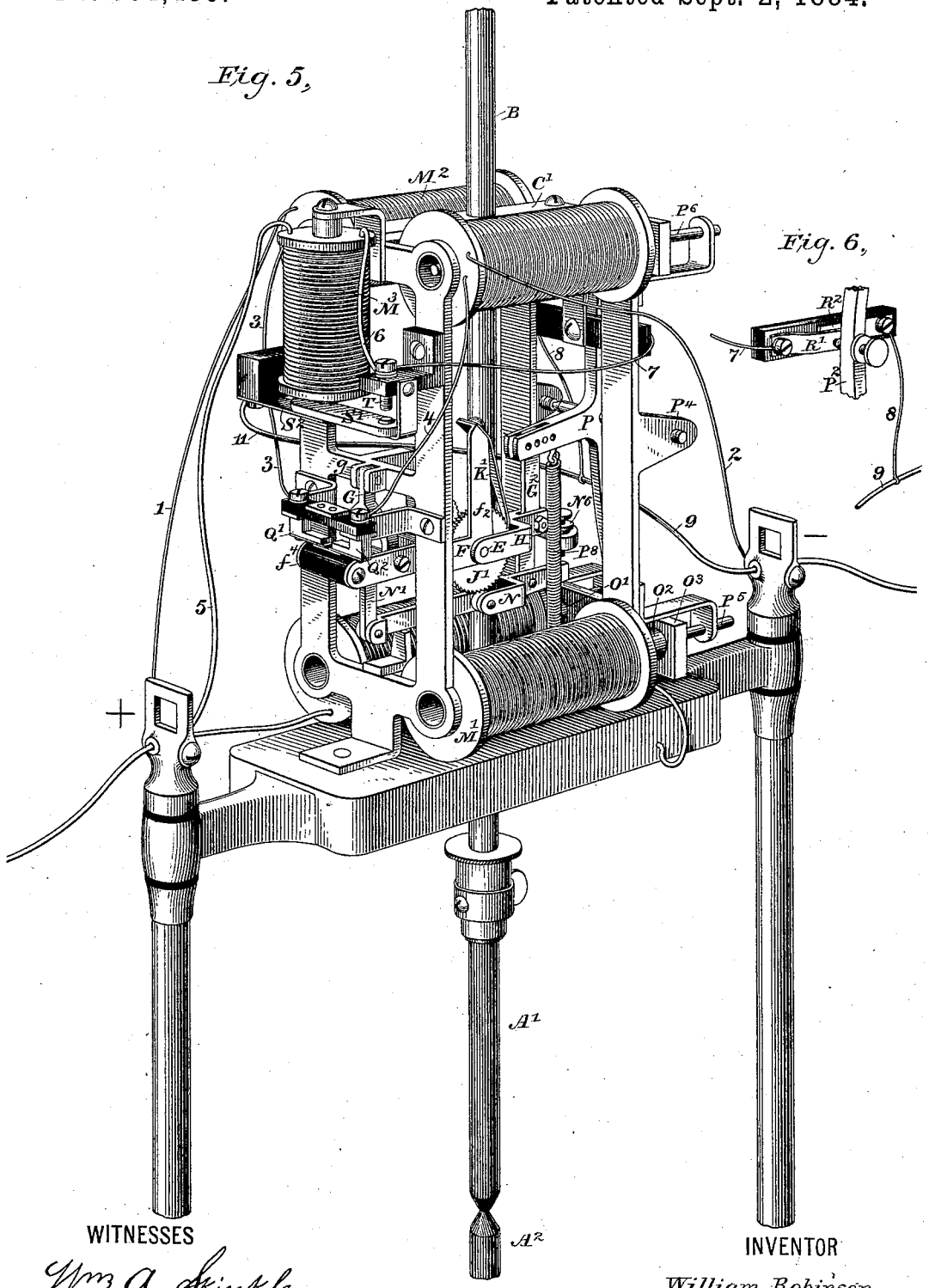

Fig. 6,

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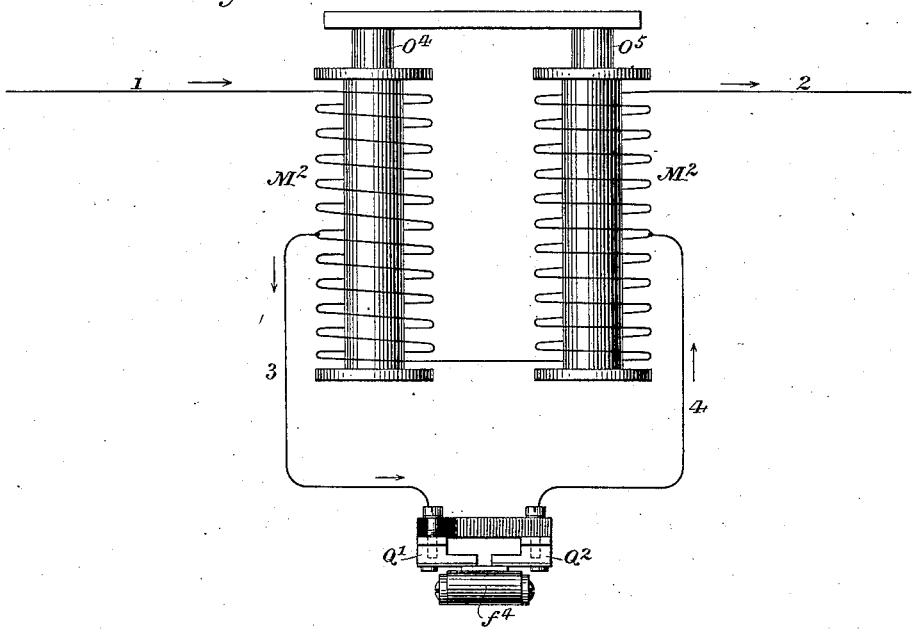
Fig. 7,



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UNITED STATES PATENT OFFICE.

WILLIAM ROBINSON, OF BOSTON, MASSACHUSETTS.

ELECTRIC-LIGHT REGULATOR.

SPECIFICATION forming part of Letters Patent No. 304,455, dated September 2, 1884.

Application filed June 21, 1883. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM ROBINSON, a citizen of the United States, residing in Boston, in the county of Suffolk, and State of Massachusetts, have invented certain new and useful Improvements in Electric-Light Regulators, of which the following is a specification.

My invention relates to that class of electric lights in which the so-called "electric arc" is maintained between two carbon electrodes.

It particularly relates to a class of devices or appliances commonly denominated "regulators," the function of which is to automatically maintain said electrodes in that relation to each other which is essential to the production of a uniform and maximum degree of illumination.

The objects of my invention are to maintain the proper separation of the electrodes conditioned upon the strength of current, to compensate for their consumption by feeding one toward the other, to steady the light by preventing all useless motion of the movable electrode, and to provide devices which will render it practicable to operate a number of light-regulators simultaneously upon a single circuit.

The important features of my invention are a device for feeding forward the movable electrode, a device for permitting the feed mechanism to be raised without increasing the length of the arc, and a device for cutting the lamp from the circuit when out of order. The especial merit of my improved feeding mechanism is that it never releases the electrode to the action of gravity while the lamp is in operation, and by maintaining a constant grasp upon the holder of the electrode it prevents all lateral and rotary movements of the electrode. With regulators in which one of the electrodes is allowed at times to fall, the light is subject to frequent and decided changes of intensity. Side movements of the electrodes are apt to occur during the fall, which change the length of the arc more than does the fall itself; and if, in falling, the electrode should be slightly turned upon its own axis, a change in the intensity of the light would probably result. This latter change might be due to the fact that the cavity of the positive and the point of the negative were not at the time in the same vertical line, or more frequently it results from the fact that the movable electrode and its holder are not in the same direct line, so that the twisting of the holder causes the point of the electrode to make a considerable sweep. It is therefore a matter of great importance that the positive electrode should be held firmly at all times, and be free from all movements except such as are in the direction of its feed.

The invention also includes certain details of construction, the exact subject-matter claimed being hereinafter particularly designated.

In the accompanying drawings, Figure 1 is a vertical elevation, and Fig. 2 a plan view, of a form of feeding device involving one of the principles of this invention. Fig. 3 is an elevation, and Fig. 4 a plan, of the compound clutch mechanism. Fig. 5 is a perspective view of the complete lamp, and Fig. 6 a detached view of certain circuit-closing devices. Fig. 7 is a diagram showing in detail the organization of a shunting device applied to a portion of the coils of one of the electro-magnets.

Similar letters of reference are applied throughout the figures to corresponding parts.

Referring to Figs. 1 and 2, A′ is the positive and preferably the movable electrode; A^2, the negative and fixed electrode. The movable electrode is supported by the holder B, a brass rod running through guide-openings C′ and C^2 in the frame of the instrument. A roller, D, Fig. 2, is carried on a pivotal shaft, E, revolving in bearings e' and e^2 in the side pieces of a frame-work, F. This frame-work is hung from the pivot g by a link, G′, attached to the transverse end piece, f'. Upon the shaft E there is also arbored a forked-shaped clutch, H, consisting of a shoulder with side projections, h' h^2, attached by means of the link G^2 to the core I of an axial electro-magnet M′. The pivotal shaft E also carries rigidly a ratchet-wheel, J′, with the teeth of which the blade-spring K′ engages. This spring is fastened to a vertical projection or arm, f^2, of the frame-work F. When the clamp is not in action, it remains in the position shown at H, Fig. 1; but when the magnet is vitalized the clamp is drawn into the position H′, Fig. 1,

so that it binds the rod B by pressing it against that point on the roller D which it then happens to confront. If the magnetic force is sufficient, the clamp will then be elevated to a position such as H^2, thus raising the rod B, which is still held rigidly between the clamp and the roller. In the form shown in Figs. 1 and 2 the roller D does not during the ascent revolve with reference to the rod B, said rod being continually pressed against the same point upon said roller; but the roller D and pivotal shaft E turn slightly in the bearings *e* during such ascent. The ratchet-wheel J′ is also rigidly connected to the pivotal shaft E, and accordingly, during an upward movement of the clamp, the ratchet-spring K′ will be drawn over one or more teeth from its original point of engagement, *x*, to a point determined by the extent of the upward movement of the clamp—as, for example, *y*. This upward movement of the clamp may be employed to establish the arc; but in practice I prefer to provide an additional device for that purpose, which will be explained hereinafter. When, by reason of the consumption of the electrodes, the resistance of the arc increases and the magnetic force is lessened, the clamp begins to descend and the spring K′ moves toward its former position to an extent determined by the amout of the descending movement. It will therefore revolve the ratchet-wheel J′, and with it the roller D, which will now turn with reference to the holder B, and hence feed forward the movable electrode at a rate of speed somewhat greater than that of the descending movement of the clamp. This increase of speed secures the required relative advancement of the upper electrode, to compensate for the consumption of the carbon points. I have thought best thus to illustrate this feature of my lamp separately from the other mechanisms with which it is preferably combined, in order that it may be more easily understood.

In Figs. 3 and 4 I have shown a compound clutch mechanism in which the devices shown in Figs. 1 and 2 are employed, together with additional devices for establishing the arc and for preventing any increase of the arc when the clutch removes its hold to a more elevated point upon the holder. To the pivotal shaft E there is rigidly attached, in addition to the roller D and ratchet-wheel J′, a beveled gear-wheel, L′. The gear-wheel L′ works into the teeth of a second beveled gear-wheel, L^2, (see Fig. 4,) axled upon a transverse brace, f^3. The teeth of the wheel L^2 take into the teeth of the beveled gear-wheel L^3, to which a second ratchet-wheel, J^2, is attached. The wheel L^3 and ratchet-wheel J^2 are secured upon a sleeve, e^3, loosely mounted on the shaft E. A blade-spring, K^2, attached to the frame-work of the instrument, takes into the teeth of the ratchet-wheel J^2. If, now, the forked clutch H be elevated, the spring K^2 will act to revolve the wheel L^3 in the direction of the arrow. Wheels L^2 and L′ and roller D will accordingly revolve in the direction indicated by the arrows assigned, respectively, to each. The gearing is so dimensioned that the roller D will revolve at a speed such as will offset the upward movement of the clamp and make the effect upon the holder B *nil*—in other words, a point on the periphery of the roller will revolve through an arc the length of which is equal to the distance through which the roller is elevated. The weight of the carbon holder will be sufficient to overcome any tendency on the part of the same to move upward with the clamp, by reason of the friction between the holder and the upwardly-moving jaw or shoulder of the clamp. On the descending of the clamp under a decrease of magnetic force, the rapid feeding will again be renewed by the action of spring K′ and ratchet-wheel J′, as described with reference to Figs. 1 and 2. In connection with this mechanism I also employ a second clamping mechanism, N, depending from the clutch H, just described, and comprising the links N′ and N^2, the tongue N^3, and forked shoulder N^4. I also provide stops N^5 and N^6. The action of this depending clutch is as follows: The electrodes being together, if a current be caused to traverse the coils of the magnet M′, the link N^2 and forked shoulder N^4 are elevated, thus binding the rod B between the tongue N^3 and forked shoulder N^4, and carrying it up through a distance equal to the length of the required arc. The action of the stop N^6 is then to open the clutch N, as will be understood by inspecting the shape of the said tongue and shoulder, as indicated by dotted lines in the drawings; but prior to such opening the clutch H comes into action, and the holder B is upheld thereby. Further pull of the magnet M′ will, as heretofore explained, produce no further separation of the electrodes, but merely remove the hold of the clutch H to a higher point. When the action of the magnet is reversed, the rapid feeding action, as already explained, will be established. The sole office of the lower clutch is thus to establish the arc, the length of which is regulated by adjusting the screw N^5. Having performed this function, it delivers over, as it were, the holder B to the upper clutch, and is not again called into action during the continued service of the lamp, as will be hereinafter explained.

Referring to Figs. 3 and 5, the magnet M′ is composed of double hollow coils lying longitudinally, and entered by a brace of cylindrical cores, O′ O^2, which are connected by a yoke-piece, O^3, secured to the arm P′ of a branched armature-lever, P, fulcrumed to the frame of the instrument at P^4. Guide-rods P^5 and P^6 are employed to direct the movements of these cores, which rest within the perforations of the electro-magnet M′. An electro-magnet, M^2, the coils of which are wound with fine wire, is included in a shunt-circuit, 1 2, passing from the binding-post (+) to the binding-post (—.) The magnet M^2 is secured to the upper part of the frame-work in a hori-

zontal position, and provided with cores O^4 O^5, similar to those of the magnet M′. These cores are attached to the arm P^2 of the branched armature-lever P. A spring, P^8, fastened at one end to the frame of the instrument at P^9 and at the other to the branch P^3 of the lever P, serves to maintain the latter in the position shown in Fig. 3. A less powerful spring-blade, P^7, acts in the contrary direction by pressing against the yoke-piece O^6 of the upper magnet-cores. The branched lever P, therefore, responds to changes in the intensity of the magnets by turning upon its pivot P^4.

From points about the center of the winding of each of the coils of magnets M^2, conductors 3 and 4 are led to the contact-points Q′ and Q^2, respectively. A metallic bridge for joining these points is carried upon an insulating cross-piece, f^4, between the extreme outer ends of the side pieces of the framework F. During the advancement of the upper carbon by virtue of the movement of the feeding-clutch, it is evident that the bridge carried upon the cross-piece f^4 will gradually approach the contact-points Q′ and Q^2. When the feeding has continued until near the point at which the lower clamp, N, would renew its hold, this bridge comes into action and completes, the circuit-connection between the two, thereby causing the withdrawal from the shunt-circuit 1 2 of half of each of the coils of the magnet M^2, as more clearly shown in Fig. 7, thus materially weakening the attractive force of that magnet. The superior energy of the magnet M′ will then cause the lever P to turn on its pivot P^4 and elevate the clutch mechanisms, thus opening wider the lower clutch, and causing the upper clutch to assume a more elevated grasp upon the holder B. As the action of this bridge takes place before the release of the holder by the upper clutch, it will be understood that so long as the light remains in action the holder B is never liberated to the force of gravity, but continues to be tightly held in the grasp of the upper clutch.

I will next describe that portion of my invention which refers to the cutting out of the lamp when, for any reason, it interferes with the operation of other lamps in the same circuit. The device by which this effected is brought into action when the resistance of the arc is rendered excessive for any cause—as, for example, the breaking of an electrode or the sticking of the holder. In such an event the branch P^2 of the lever P will, under the increased attractive force of the magnet M^2, and at a point near the terminus of its forward stroke, engage with the spring R′ (see Fig. 6) and bring it into contact with the spring R^2, thereby closing an electric circuit between the binding-posts (+) and (—,) which may be traced as follows: by conductor 5, electro-magnet M^3, (which is wound with coarse wire capable of carrying the line-current,) conductors 6 and 7, springs R′ and R^2, and conductors 8 and 9. The closing of this circuit instantly vitalizes the magnet M^3, causing it to attract its armature S′, carried upon the flexible spring S^2, and bring said armature into contact with the stop T, thereby establishing a circuit through conductor 5, magnet M^3, conductor 6, armature S′, spring S^2, and conductors 11 and 9. A channel of low resistance is thus afforded to the main current, and in consequence the magnets M′ and M^2 are practically demagnetized. The lever P therefore reassumes at once its normal position of equilibrium under the influence of springs P^7 and P^8. Although this opens the circuit of the springs R′ and R^2, the lamp will nevertheless remain cut out of circuit so long as sufficient current traverses the coils of the magnet M^3 to prevent the fall of its armature. The tension of the spring S^2 is made such that if the lamp subsequently comes into working order, the contact of the carbon electrodes will divert enough current from the magnet M^3 to cause it to let fall its armature, thus opening the shunt-circuit at the contact-point T and throwing the whole current through the lamp. Means are thus afforded for reintroducing a restored lamp, as well as for cutting out one which has become deranged.

The forked shoulder H, which I have described, may be variously modified without in any way changing its functions. Thus that part of the shoulder which engages with or presses against the holder B may be provided with one or more rollers of any convenient form, for the purpose of reducing the friction developed between it and said holder. Again, the point of articulation of the shoulder with the frame F may be placed at various points. Thus the frame F may be extended beyond the holder and the point of articulation placed on the side other than that shown. I have preferred, however, to employ the forked-shaped form, in order to bring the points of articulation into line with the axis of the roller D, thereby enabling me to use a common shaft or arbor, E.

I claim as my invention—

1. The combination, substantially as hereinbefore set forth, of the holder of the movable electrode of an arc lamp, the clamping device consisting of the roller and articulated shoulder, between which said holder is clamped, a ratchet-wheel moving with said roller, and a spring sliding over the teeth of said ratchet-wheel during the upward movement of the clamp and revolving said ratchet-wheel and roller during the downward movement thereof, for the purpose of increasing the rapidity of the feed of the electrode.

2. The combination, substantially as hereinbefore set forth, of the electrode-holder, the clamp consisting of the roller and clamping-shoulder, a magnet for moving said clamp vertically, and a mechanism for causing the revolution of said roller during the descent of the clamp, for the purpose of hastening the forward feed of said holder.

3. The combination, substantially as here-

inbefore set forth, of an axial electro-magnet, its cylindrical core, a clamping-shoulder moving with said core, the suspended clamp frame-work, the pivotal shaft whereby said clamping-shoulder articulates with said clamp frame-work, a roller mounted upon said pivotal shaft, and an electrode-holder grasped between said roller and said shoulder by the action of said axial magnet.

4. The combination, substantially as hereinbefore set forth, of an axial magnet, its core, the clamping-shoulder, the suspended clamp frame-work, the pivotal shaft upon which both said frame-work and clamping-shoulder are arbored, the roller thereon, and mechanism for causing the revolution of said roller during the descent of said clamp.

5. The combination, substantially as hereinbefore set forth, of the electrode-holder, the clamp consisting of the roller and the articulating-shoulder, and mechanism for enabling the clamp to remove its grasp to a higher point upon said holder without causing any elevation thereof.

6. The combination, substantially as hereinbefore set forth, of an electrode-holder, a clamping mechanism constantly grasping said holder and ascending and descending in the line of said holder, mechanism for feeding forward said holder during the descent of the clamp, and mechanism for preventing the retrograde movement of said holder during the upward movements of said clamping mechanism.

7. The combination, substantially as hereinbefore set forth, of an electrode-holder, a feed-roller constantly pressed against said holder, mechanism for causing said roller, in ascending, to roll in the direction necessary to prevent upward movements of said holder, and mechanism for causing said roller, in descending, to revolve in the direction necessary to feed forward said holder.

8. The combination, substantially as hereinbefore set forth, of the electrode-holder, the roller mounted on the pivotal shaft, the ratchet-wheel mounted loosely on said shaft, the spring projecting from the frame-work of the lamp and engaging with the teeth of said ratchet-wheel for the purpose of revolving the same when elevated, and mechanism for communicating the rotary movements of said ratchet-wheel to said roller.

9. The combination, substantially as hereinbefore set forth, of the pivotal shaft, the roller mounted rigidly thereupon, the ratchet-wheel mounted upon the loose sleeve upon said pivotal shaft, the spring projecting from the frame of the lamp and engaging with the teeth of said ratchet-wheel, and gearing whereby movements of said ratchet-wheel in one direction cause reverse movements of said roller.

10. The combination, substantially as hereinbefore set forth, of the pivotal shaft, the sleeve-mounted ratchet-wheel, the rigidly-mounted roller, and the communicating gearing, consisting of three beveled wheels proportioned to cause the rolling of any point on the periphery of the roller through an arc approximately equal in length to the upward movements of said roller.

11. The combination, substantially as hereinbefore set forth, of the clamp frame-work depending from the lamp-frame, the forked shoulder articulating with said clamp frame-work, the pivotal shaft, the sleeve thereupon, the ratchet-wheels upon said shaft and said sleeve, respectively, the spring on the clamp frame-work engaging with one ratchet-wheel, the spring from the lamp-frame engaging with the other wheel, and the gearing mechanism arranged as described, whereby the holder remains at rest during ascending movements of said roller, and is fed rapidly forward during descending movements thereof.

12. The combination, substantially as hereinbefore set forth, of the electrodes of an arc light, a clamp mechanism for normally feeding one of the electrodes downward gradually, but which moves upward without influencing the arc, and a second clamp for causing the separation of the electrodes for the purpose of establishing the arc.

13. In combination, substantially as hereinbefore set forth, with the upper clamp, as described, the depending clamp for causing the separation of the electrodes, and thereby establishing the arc, and the adjustable stop for determining the length of arc.

14. The combination, substantially as hereinbefore set forth, of the upper and lower clamping mechanisms, the stop for determining the length of arc, and a spring assisting in the downward feeding of the upper electrode.

15. The combination, substantially as hereinbefore set forth, of the upper clamping mechanism, the lower clamping mechanism, the stop, the spring for assisting in the downward feeding, and mechanism for causing the re-elevation of the clamps in opposition to said spring just before reaching that point at which the lower clamp would renew its hold upon the electrode-holder.

16. The combination, substantially as hereinbefore set forth, of a clamp feeding forward on the downward movement, mechanism for preventing disturbances of the arc on the upward movement, and mechanism for re-elevating the clamp before it releases the electrode-holder.

17. The combination, substantially as hereinbefore set forth, of the main-line magnetizing-helix, a shunt-circuit magnetizing-helix, clamping mechanism acting under the joint magnetic influence developed by the currents traversing said helices, and mechanism for short-circuiting a part of said shunt-circuit magnetizing-helix for the purpose of modifying said joint magnetic influence.

18. The combination, substantially as hereinbefore set forth, of the upper clamp, the two horizontal axial magnets, a common branched armature-lever responding to the resultant of the attractive forces of said magnets, a shunt-

circuit spanning a fraction of the coils of one of said magnets, and mechanism for closing said shunt-circuit, for the purpose of imparting a movement to said common armature-lever.

19. The combination, substantially as hereinbefore set forth, of the main-line magnet, the shunt-circuit magnet, their common armature-lever, mechanism for cutting out part of the shunt-circuit magnet-coils, and thus diminishing the action of said shunt-circuit magnet, and thereby causing a movement of said common armature-lever, and clamp mechanism elevated by said movement.

20. The combination, substantially as hereinbefore set forth, of the regulating electro-magnets of an electric lamp, a circuit closed by the action of one of said electro-magnets in bringing two contact-points together, a second electro-magnet included in said circuit, and having less resistance than the first-named electro-magnet, and a shunt-circuit spanning said contact-points, closed by the action of said second electro-magnet.

21. The combination, substantially as hereinbefore set forth, of the main and shunt magnets, the armature-lever moving under their joint influence, and a cut-out circuit closed by said lever at a definite point of its excursion, for the purpose of removing an electric lamp from a circuit including other lamps.

22. The combination, substantially as hereinbefore set forth, of the main and shunt magnets, the common armature-lever, a shunt-circuit closed at a definite point in the excursion of said common armature-lever, an electro-magnet situated in said shunt-circuit, the armature of said electro-magnet, and a second shunt-circuit closed by the forward movement of said armature.

23. The combination, substantially as hereinbefore set forth, of the horizontal magnets, main and shunt, their horizontal axial cores, guiding mechanism for said cores, a common armature-lever attached to the cores of both of said magnets, a system of springs for steadying the movements of said cores, and clamp mechanisms actuated by the movements of said common armature.

In testimony whereof I have hereunto subscribed my name this 18th day of June, A. D. 1883.

WILLIAM ROBINSON.

Witnesses:
FRANCIS S. DYER,
GEO. T. ANGELL.