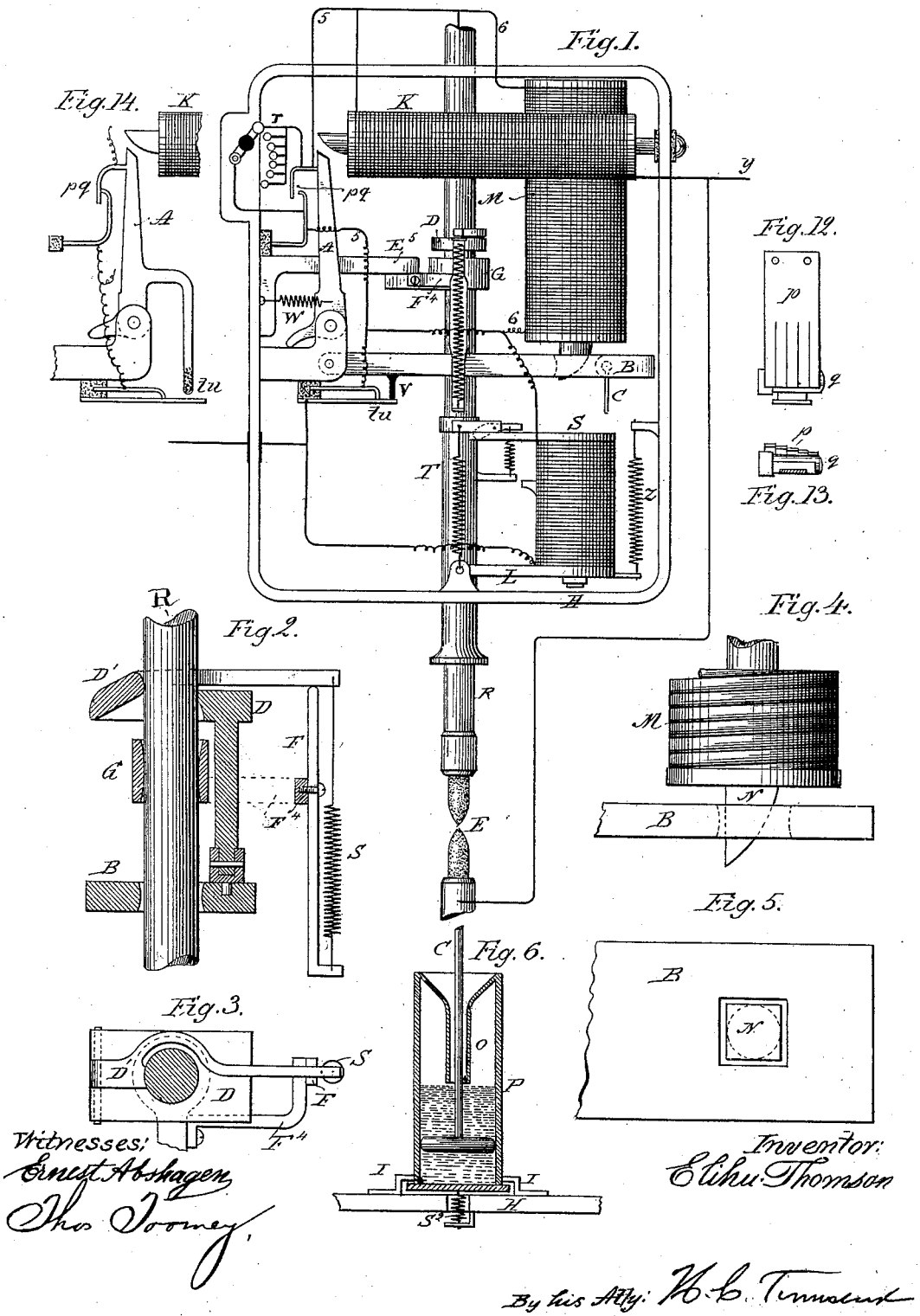
(Model.) 2 Sheets—Sheet 1.

E. THOMSON.

ELECTRIC LAMP MECHANISM.

No. 303,898. Patented Aug. 19, 1884.



Witnesses:
Ernest Hopkagen
Thos Toomey

Inventor:
Elihu Thomson

By his Atty: W. C. Tennant

(Model.)

2 Sheets—Sheet 2.

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Fig. 7

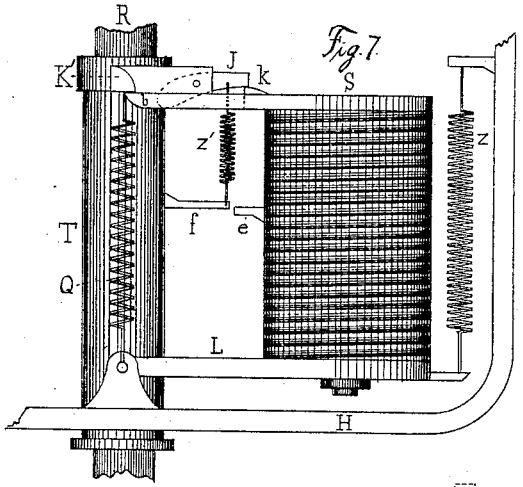


Fig. 9

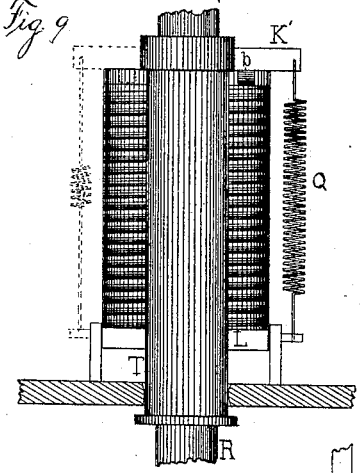


Fig. 8

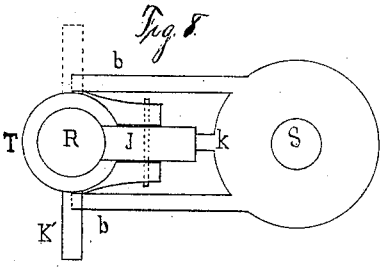


Fig. 10

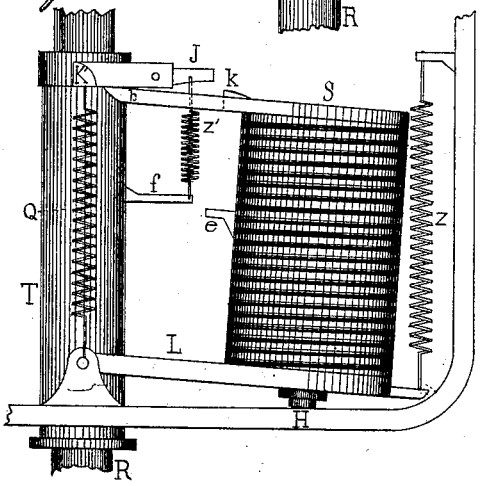
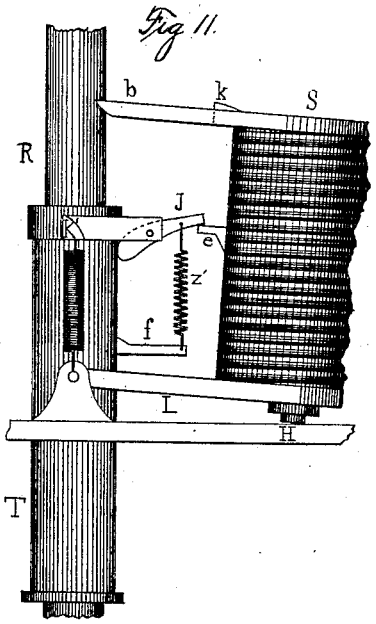


Fig. 11.



Witnesses:
W. B. Thomson
E. Wilbur Rice.

Inventor:
Elihu Thomson.

UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF NEW BRITAIN, CONNECTICUT, ASSIGNOR TO THE THOMSON-HOUSTON ELECTRIC COMPANY.

ELECTRIC-LAMP MECHANISM.

SPECIFICATION forming part of Letters Patent No. 303,838, dated August 19, 1884.

Application filed June 8, 1881. (Model.)

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, residing in the city of New Britain, county of Hartford, State of Connecticut, have invented certain Improvements in Electric-Lamp Mechanism; and I do hereby declare that the following is a description thereof.

My invention relates to an electric lamp in which carbon electrodes are used for producing an arc; and it consists of combinations of devices for securing certainty of operation, regularity of arc length, and the prevention of open-circuiting when several lamps are arranged in series. I make use of an electro-magnet and armature imparting movement to a clamp for lifting the upper carbon and establishing the arc. I also employ a shunt or derived circuit magnet to close a set of contacts forming a shunt of small resistance around the lifting-magnet coils, or a portion thereof, and arranged so as to cause a very delicate feeding of the electrodes as consumed. I also employ a very effective device for forcing the approach of the carbon electrodes in case of the failure of said carbon electrodes to feed.

I will proceed to describe my invention by reference to the accompanying drawings.

Figure 1 is a front view of the regulating mechanism of an electric lamp embodying the substantial features of my invention; Fig. 2, a figure partly in section showing the devices for lifting the carbon-rod R in detail; Fig. 3, a top view or plan of the clamp D D′, Fig. 1. Fig. 4 shows the relation between the lifting-magnet and its armature. Fig. 5 is a plan of said armature and magnet-pole. Fig. 6 is a peculiar arrangement of dash-pot for checking the movement of the lifting-armature. Figs. 7, 8, 9, 10, and 11 are views of an improved safety device for forcing the approach of the electrodes when the arc resistance becomes abnormally great.

In Fig. 1 the parts are shown supported in the interior of an iron frame or box, the carbon-rod R passing vertically through its center. An electro-magnet, M, traversed by the circuit current or direct current is arranged so as to attract an armature, B, pivoted as shown. The magnet and armature are shaped, as will be described in connection with Figs. 4 and 5, though this construction is not essential to the operation of the lamp, a plain flat armature and flat pole of the magnet M being also suitable. By the upward and downward movements of the armature B a clamp, D D′, is lifted or lowered. This clamp serves to seize the carbon-rod R and establish an arc when lifted, and to allow said rod to slip through it when lowered. Figs. 2 and 3 show the preferred construction of the lifting-clamp D D′. An arm, C, Fig. 1, connects the armature B to a dash-pot or other check-motions, as may be preferred. The electro-magnet K of high resistance is a shunt or derived circuit around the arc, and the variations of its power, acting in opposition to a spring, W, upon its armature A, serve to close or open a set of contacts, *p q*, which constitute a shunt of small resistance around coils of M, so as by shunting current from such coils to weaken the magnet's power.

The magnets *p q* may be simply a single pair of contacts, or may be constructed as described in my Patent No. 261,790, and constitute a variable-resistance shunt. The construction of the contacts whereby this result may be effected is shown in Figs. 12 and 13, where the contact *p* is divided like a comb or brush, and has its teeth so arranged as to come successively into contact with a block, *q*, of carbon. The shunt-wire around magnet M is indicated by the numeral 5, Fig. 1, and the wire which includes magnet M and is shunted is indicated by the numeral 6. The action of the derived-circuit magnet K and contacts *p q* in shunting the feed-magnet M is substantially the same as in my patent before referred to. A small resistance-coil or resistance, *r*, is provided partly as a preventive of spark during the closing and opening of said contacts *p q*. This resistance is connected to the branch 5 at the points indicated, so as to form a circuit for the current in 5 around said contacts. When the contacts are open, the branch 5 is a shunt of high resistance around 6 and the magnet M; but when the contacts are closed the resistance is cut out. I also make use of

this resistance r for a novel purpose. By changing its amount, as by changing its length or size of wire composing the coil, or the material of the coil, or by otherwise changing the resistance of r in any manner, I am enabled to adapt the power of the lifting-magnet to varying strengths of current used to operate the lamp without changing the winding of the magnet M as to size of wire, convolutions, &c. The device for adjusting the resistance, as here shown, consists of the well-known arrangement of a switch moving over a series of contacts connected to the resistances at various points, whereby a greater or less length of the resistance may be included in the circuit 5 around the magnet M. Where a current of large volume or strength is used the resistance r is made less, so as to permanently divert more current from the magnet, and thus adjust its lifting-power to the proper amount, and where a current of small volume or strength is employed, the resistance r is made great, so as to force the current through the magnet and thus give it the proper power. It is thus, without otherwise changing the construction of the lamp, I adapt it to run upon greater or less current strength by merely changing the amount of the resistance r.

I do not limit myself as to the manner or means of varying the resistance r. It may be applied to any kind of lifting or regulating magnet in an electric lamp, no matter whether the variations of power in said magnet for producing a feed are brought about by the automatic shunt herein described, or by other and well-known arrangements of said magnet itself in the circuit. The resistance r constitutes in any case a permanent derivation around the coils of the regulating-magnet through which the direct current passes, and acts to divert current from said magnet and to modify its power, so as to adapt it for use in any circuit.

The poles of the magnet K are shaped with respect to the armature A, moving near thereto, so as to give a nearly uniform attractive force in various positions when a constant current is circulating through the coils of the magnet K. This result is accomplished by the tapering of the poles, as shown in Fig. 1. A second set of contacts, $t u$, which remain closed during normal operation of the lamp, constitute a shunt or short circuit around an electro-magnet, S, which latter acts to bring into operation a safety device, fully described in connection with Figs. 7, 8, 9, 10, 11. The contacts $t u$ are opened when the armature B fully retires from its limits of position during normal feeding of the carbon electrodes. A stop or projection, V, is provided for opening the contacts $t u$.

The general circuits are as follows: Entering at X, the circuit is to and through contacts $t u$ when armature B is raised or when said contacts are broken through the magnet S. After passing through contacts $t u$ or magnet S the circuit divides, as shown, one path being through the main-circuit magnet M to the carbon-rod, the arc, and out at Y, the other being to one side of the set of contacts p and q, and, when the latter are closed, through the same to the upper carbon, or through the magnet K to the point Y, magnet K being, as indicated and as usual, in a derived circuit around the carbons. The resistance r is in a branch around the contacts $p q$, and forms the whole or a portion of the path for the current in the branch from $t u$ around magnet M, according as the contacts $p q$ are open or closed. On establishing a current the armature B is lifted and the contacts $t u$ closed. The clamp D D′ lifts the rod R and establishes the arc at E. When the arc has elongated slightly, the contacts $p q$ are closed by the increased attraction of the shunt magnet or coil K upon its armature A, thus diverting sufficient current from the magnet M, releasing the armature B, which descending opens the clamp D D′ and allows the carbon-rod to feed downward. The contacts $p q$ and $t u$ may be both operated directly by the armature A of the shunt-magnet K, as indicated in Fig. 14. In this latter case the contacts $p q$ are first closed, after which closure the contacts $t u$ are opened by a further movement of the shunt-armature A, so that the first action of the shunt is to feed the electrodes, the second action being to bring into operation the magnet S to insure their approach if the feeding otherwise fails.

In Fig. 2, B is the lifting-armature, to or by which the clamp-body D is pivoted or supported. The movable toe or clamp D′, pivoted as shown, rests against the rod R, and has an elongated portion, to which one end of a spring, S′, is attached, while the other end of the spring is attached to a fixed support. G is a fixed bushing through which the rod R is guided. Bushing G is supported by an arm, F^5, secured to the lamp frame or casing. Bushing G also bears a stop, F, secured to a curved arm, F^4, projecting from F^5, arranged to open the clamp-jaw D′, when the armature B and part D are lowered to the position as in the figure. The rod R then slides gradually through the clamp D.

It will be seen that the view of the parts D G B, Fig. 2, is at right angles to that in Fig. 1. The spring S′ is seen in front of Fig. 1. The stop F is merely a projection from the bushing G, secured to the lamp box and frame. The clamp-body D, as shown, is pivoted to the armature B, which is perforated for the free admission of the carbon-holding rod R. The clamp D therefore moves with the armature B up and down, while the spring S′ holds the toe D′ against the rod R, when said toe is not in contact with the stop F, as when the clamp D is lifted by the armature B.

In Fig. 3 the relations of the parts D and D′ of the clamp are more fully shown, the toe or jaw D′ occupying a portion of the opening in the clamp-body D, through which the rod R passes.

In order to equalize the magnetic effect of

the magnet M upon its armature B in different positions, its pole N is preferably allowed to project through the armature B, and it has a curved face made upon it, as shown. The pole is shown as square in horizontal cross-section, and as corresponding with a similar square opening in the armature B in Fig. 5, and in Fig. 4 as tapered or chamfered to a curved form. The circular outline of the core from which it projects is indicated in Fig. 5 by the circular dotted line.

Fig. 6 is a dash-pot, which I prefer to employ to check the movements of the armature B and render them more gradual. The rod C, Figs. 1 and 6, is provided with a piston, P′, fitting more or less loosely in the tube P. The base H of the lamp-box has projections I I, allowing a slight play of the dash-pot body in a vertical direction, and a spring, S^2, may be provided to assist in holding the dash-pot in contact with the base H during normal operation. I find the slight play afforded to the dash-pot useful in assisting the quick closing of the clamp D immediately after the rod R has slid through it, or a feeding action has been exerted. An inverted tubular neck, O, is provided for preventing escape of fluid from the dash-pot when the lamp is inverted or laid upon its side, sufficient space being provided around the neck O to contain all the fluid when the lamp is in an inverted position.

Fig. 7 is a full-sized view of the safety-magnet, called into action to violently force the carbon-rod R downwardly when the contacts *t u* are opened by a failure to feed normally. The device by which this is accomplished is a spring, or any suitable actuating device, normally held out of action, but released when the carbon fails to feed and the arc abnormally lengthens. When the spring or other power acts on the upper-carbon carrier, a clamp-clutch, or any device that may grasp the upper-carbon carrier and pull it down forcibly, is arranged to be actuated by said spring at the proper time. Said clamp or clutch is also, by preference, provided with a suitable device for normally holding its jaw or other engaging surface away from the surface of the carrier, so that the latter may move freely upward as well as downward. The construction of these parts may be infinitely varied without departing from the invention, the gist of which consists in combining with a carbon-carrier a spring or other actuating power normally held out of action upon said carrier while the lamp is working properly, but automatically released and allowed to actuate the carrier by any suitable means when the arc becomes abnormally long or the carbon fails to feed for an extended period. When the spring acts upon the carrier through a clamp or clutch, as is usually the case when it is arranged to force the carbon that feeds toward the arc, said clamp or clutch may be constructed and arranged as follows: Surrounding the carbon-rod R is a collar, T, or sliding tube, provided at its upper part with a clamping-jaw, J, by which a firm hold upon the inclosed rod R may at times be effected. A spring, Z′, is attached to J at one end, and at the other to a piece, *f*, borne by the tube T. Projections K′, one or more, are placed upon the tube T, by which it may be upheld against the action of a spring, Q, tending to draw the tube T forcibly down. Engaging upon the projection K′ is a catch, *b*, supported or actuated by, or otherwise arranged so as to be under the control of the magnet S, and the catch *b* upholds the projection K′ and the tube T, in virtue of its position under the projection K′. A small projection, *k*, also holds the jaw J open, so as to leave the rod R free in the position of the parts, as shown in the figure. The magnet S is hung upon a lever, L, pivoted vertically under the piece K′ to the frame H. A spring, Z, supports the magnet S in position, leaving a small interval between its polar extremity and the iron case H, as shown. The position of the parts as here shown in Fig. 7 is given at the starting of the lamp, and is always maintained during normal operation, and it will be seen that the carbon-rod is free to descend, the jaw J being prevented from locking upon the rod R by the projection *k*.

Fig. 8 is a plan of the parts in the same position as in Fig. 7. R is a carbon-rod; J, the jaw; *k*, its stop or projection; S, the magnet-core; *b*, projection or catch borne by the magnet and engaging under the catches K′ of the tube T. The parts K′ and *b* may be duplicated on the other side of the rod R, as shown in dotted lines.

Fig. 9 is another view of the parts shown in Fig. 7 or end elevation, the tube T inclosing the rod R, and spring Q attached to the projection K′, the catch *b* under the part K′, the lever L upon which the magnet S is swung, as shown.

When the contacts *t u*, Fig. 1, are opened by the retirement of the armature B beyond its limits, during normal operation due to a failure of the clamp D to feed the carbon-rod, the magnet S is rendered active by the passage of the current and attracts itself to the sides of the frame H of iron. The position it then occupies is seen in Fig. 10. The spring Z is extended and the magnet S tipped over, so as to withdraw first the stop *k*, leaving the jaw J free to engage upon the rod R, and second, the projection *b* is withdrawn from the under side of the catch K′. In this position the tube T is left without any upholding-support, and is borne downward with considerable force by the spring Q or its own weight, if sufficient. However, the jaw J having locked upon the rod R by the aid of the spring Z′, the tube T cannot descend without bringing the rod R down with it, and as the spring Q may be of any desired strength, an approach of the carbon is thus secured and the circuit is kept from being broken by a failure of the lamp to feed. Moreover, the action of the

spring Q is continued through a considerable space, and thereby the carbons are held together until the defect in the feeding action is properly remedied. Should the tube T descend, as in Fig. 11, and bring the jaw J into contact with the stop *e*, the jaw is again opened and the rod R is again free to descend through the piece T. After the tube T has been released, the attendant, finding that it has been so released and has brought the carbons together, can restore it to its original position, Fig. 7, by simply raising it from below the frame H, attend to the lamp, examine into the causes of the safety-magnet having been called into action, and restore the lamp to its normal working condition. When the lamp is recarboned the magnet S is set, and is in the main circuit, owing to the fact that the contacts *t u* are opened by the armature. When the current begins to flow, however, the magnet M acts and closes the contacts *t u* before magnet S has time to act, the more prompt action of magnet M and armature B taking place because at this time the carbon-rod is not supported by the armature, and the retracting-force acting on magnet S is much stronger than that acting on armature B. Magnet S might be made more sluggish in action than M by means well known in the art—as, for instance, by making its core long or by making its wire of higher resistance than that of M. When the contacts *t u* are closed the current is diverted from S, which cannot then act until the armature falls back, so as to open the contacts for a comparatively prolonged interval.

Various changes in the relations of the parts of the safety device may be used to effect the same result—viz., to bring a stored force, as a stretched spring, into action consequent on an increased power of the shunt electro-magnet, when the arc of the lamp has attained an abnormal length.

I do not limit myself to any particular form or construction of device for imparting a positive movement to the carrier when it fails to feed properly, since the gist of my invention consists in employing a supplemental actuator that may, when called into action, give a positive thrust to the carbon or carrier, said actuator being normally prevented from operating during the usual feed movements of the carbon, and in automatically bringing the same into operation to force the carbons together, if from any cause the feed fail to take place and the arc become abnormally long.

I claim—

1. The combination, in an electric lamp, of a clamp or clutch applied so as to grasp the carbon carrier and impel it toward the opposite carbon, a spring or equivalent actuating device connected to the clamp, and a catch or detent for normally holding said clamp or clutch out of engagement with the carrier, as and for the purpose described.

2. The combination, with a spring-actuated impelling clutch or clamp for the carbon-carrier, of a catch or detent normally preventing the same from engaging with the carrier, and an electro-magnet that controls the catch.

3. The combination, with the carbon-carrier in an electric lamp, of an impelling clutch or clamp for forcing the carrier toward the opposite carbon, a suitable catch or detent for holding said clutch or clamp out of action, an electro-magnet controlling the detent, and a suitable circuit-controller, whereby the flow of an electric current through said magnet is controlled so as to cause a release of the detent by the electro-magnet whenever the arc becomes abnormally long.

4. The combination, with the carbon-carrier in an electric lamp, of a clamp or clutch applied in the manner described, so as to force the carrier toward the opposite carbon, a detent or catch for normally holding said clamp or clutch out of action during feed of the carbon, and releasing devices for releasing said clamp or clutch, controlled by an electro-magnet connected to the lamp-circuit in the manner described, so as to be affected by an abnormal increase in the length of arc.

5. The combination, in an electric lamp, of a carbon-carrier, a sleeve or guide for the carrier, a clamping toe or jaw mounted on the sleeve, and arranged to lock the carrier so as to impel the same toward the opposite carbon, an actuating-spring connected to the sleeve, and suitable catches or stops for holding the clamping-toe and the actuating-spring for the sleeve out of action.

6. The combination of the carbon-carrier, a spring-actuated sleeve or guide carrying a clamping toe or jaw, a stop for holding the clamping toe or jaw out of engagement with the carrier, a catch or stop engaging with the sleeve, and means for automatically and simultaneously withdrawing said stops, as and for the purpose described.

7. In a safety device for an electric lamp, an electro-magnet, S, shunting contacts for the same closed during normal feed of the carbons, and a clutch or clamp and actuating-spring therefor, normally detained by said magnet during feed of the carbon, and arranged in the manner described to grip the carbon-rod and force the carbons together when the carbons fail to feed properly.

8. A safety device in an electric lamp, consisting of a clamp or clutch arranged to act upon the carbon-holder, a powerful spring upon said clamp or clutch, a catch or stop adapted to be removed from said clutch device by an electro-magnet, and a set of contacts forming a shunt around said magnet, substantially as described.

9. The combination, with the carbon-carrier, of an actuating clamp or clutch applied so as to force the carrier toward the opposite carbon, a disengaging-stop normally holding the same out of engagement, means for withdrawing the same when the arc becomes ab-

normally long, and a supplemental disengaging-stop for disengaging the clamp when it has completed its throw.

10. The combination of the electro-magnet S, arranged as described, catches *b k*, clamp-sleeve T, springs *q*, for the purpose of effecting an approach of the carbon electrodes when said magnet is energized by suitable devices brought into action by the formation of an arc of abnormal length.

11. The combination, with the feed-controlling devices in an electric lamp, of a dash-pot both members of which are movable for a slight distance in the same direction with the part of the feed-controlling devices from which they are actuated.

12. The combination, with a feed clamp or clutch for an electric lamp, of an actuating lever or support, and a dash-pot one member of which is connected to said lever, while the other member is movable longitudinally for a slight distance with the first when the lever or support moves in a direction to cause the clamp to close and engage with the carbon-carrier.

13. The combination, with the feed-controlling clamp or clutch in an electric lamp, of a dash-pot one member of which is connected with the feed-clamp, so as to retard its movement, while the other member is free, so as to be capable of following the retarding movement of the first, so as not to oppose its movement, and suitable stops for limiting the movement of the free member.

14. The combination, with a feed-controlling clamp or clutch in an electric lamp, of a dash-pot whose piston is connected with said clamp, and a dash-pot cylinder resting loosely on the floor of the lamp or other support, and provided with stops set to allow a slight movement of said cylinder with the piston.

15. The combination, with the regulating magnet or armature, of a dash-pot movable longitudinally with its piston, as and for the purpose described.

16. In an electric lamp, the combination of a regulating-magnet helix, and a double shunt consisting of a permanently-closed circuit around said helix, containing an adjustable resistance, and an automatically-variable resistance acting in accordance with variations in the arc length.

17. The combination with a carbon-carrier in an electric lamp, of a supplemental actuating device for forcing an approach of the carbons normally out of engagement with the carrier while the feed of the carbons is taking place in the proper manner, and means for bringing said actuating device into operation whenever from any cause the carbon-carrier sticks and produces an arc of abnormal length, so as to force the carbons together and preserve the circuit.

18. The combination, substantially as described, with a carbon-carrier for an electric lamp, of carbon separating and feeding mechanism, a supplemental actuating-spring for forcing the carbons together through any suitable supplemental device, means for holding said spring out of action during normal feed of the carbons, and a releasing device for automatically releasing the spring, so that it may force the carbons together if from any cause the carbon or carbon-carrier fail to feed properly.

19. The combination, with the carbon-carrier for an electric lamp, of carbon separating and feeding mechanism, and a supplemental actuating device for grasping the carbon or carrier and forcing the carbons positively together whenever the feed fails to take place in the normal way.

20. The combination, with a carbon or carbon-carrier, of a supplemental actuating device, a catch or detent normally engaged therewith, to hold said actuating device out of action, and means for disengaging said catch or detent upon an abnormal increase in the length of arc, so as to permit said actuating device to force the carbon into contact with the opposite carbon.

21. The combination, with the carbon separating and feeding mechanism in an electric lamp, of a supplemental device for grasping the carbon or carbon-carrier and carrying it toward the opposite carbon and held out of action during separation and feed of the carbon, and means for bringing said supplemental device into action whenever, from any reason, the carbon or carbon-carrier fails to feed so as to produce an arc of abnormal length.

ELIHU THOMSON.

Witnesses:
W. B. THOMSON,
E. WILBUR RICE.