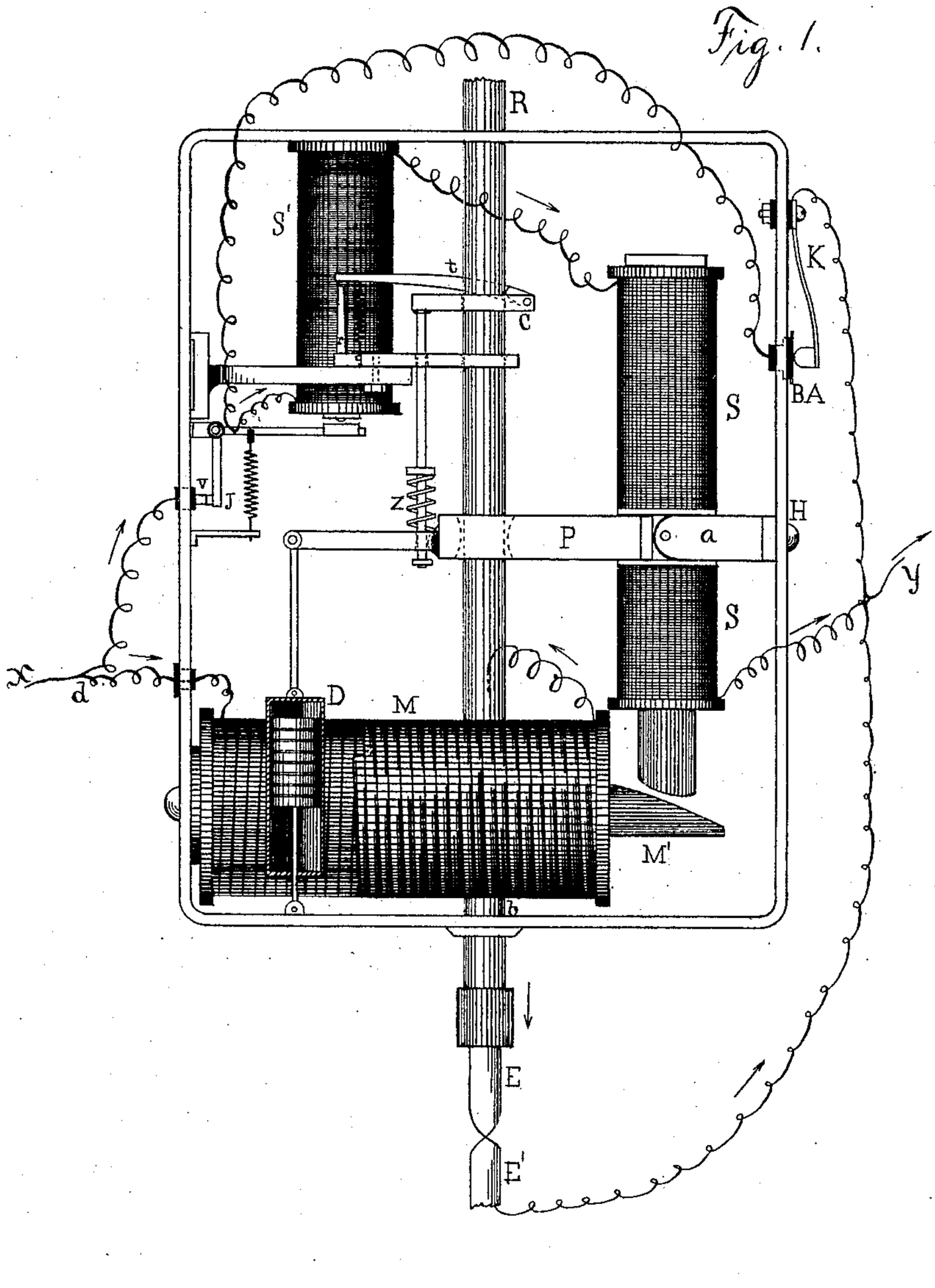
(No Model.) 2 Sheets—Sheet 1.

E. THOMSON.

ELECTRIC LAMP MECHANISM.

No. 305,413. Patented Sept. 16, 1884.

Fig. 1.



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(No Model.) 2 Sheets—Sheet 2.

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Fig. 2

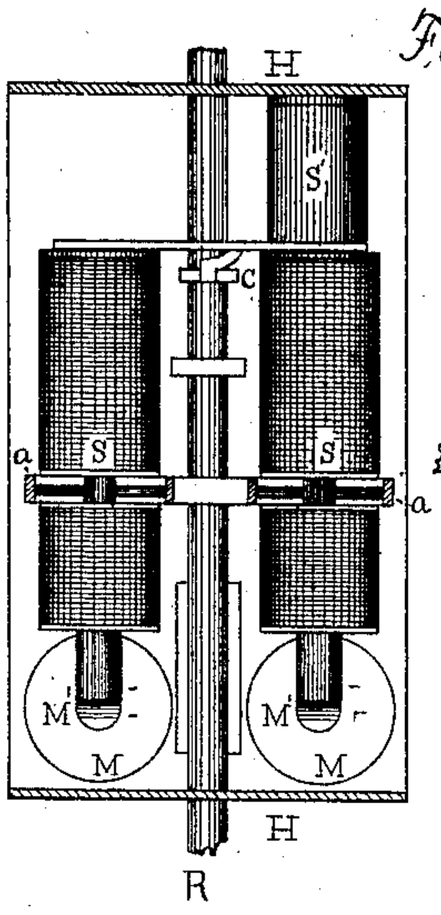


Fig. 3.

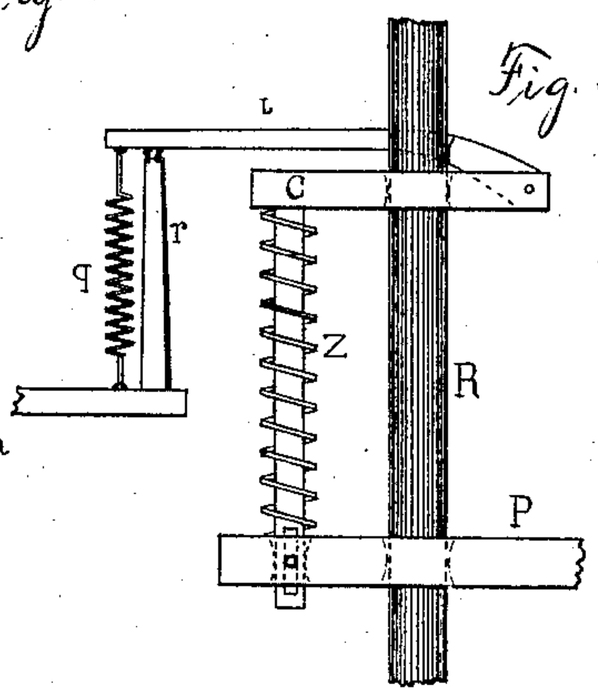


Fig 4.

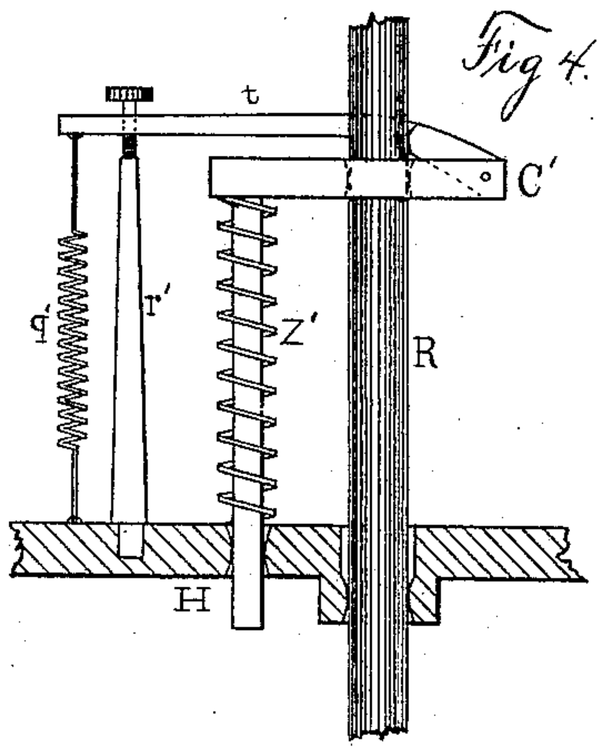


Fig. 5.

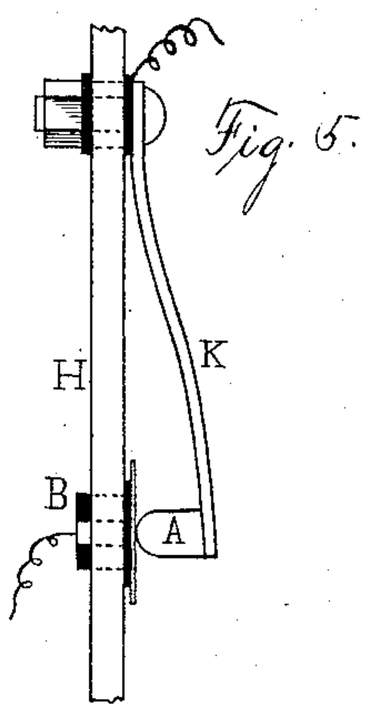


Fig. 6.

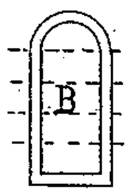
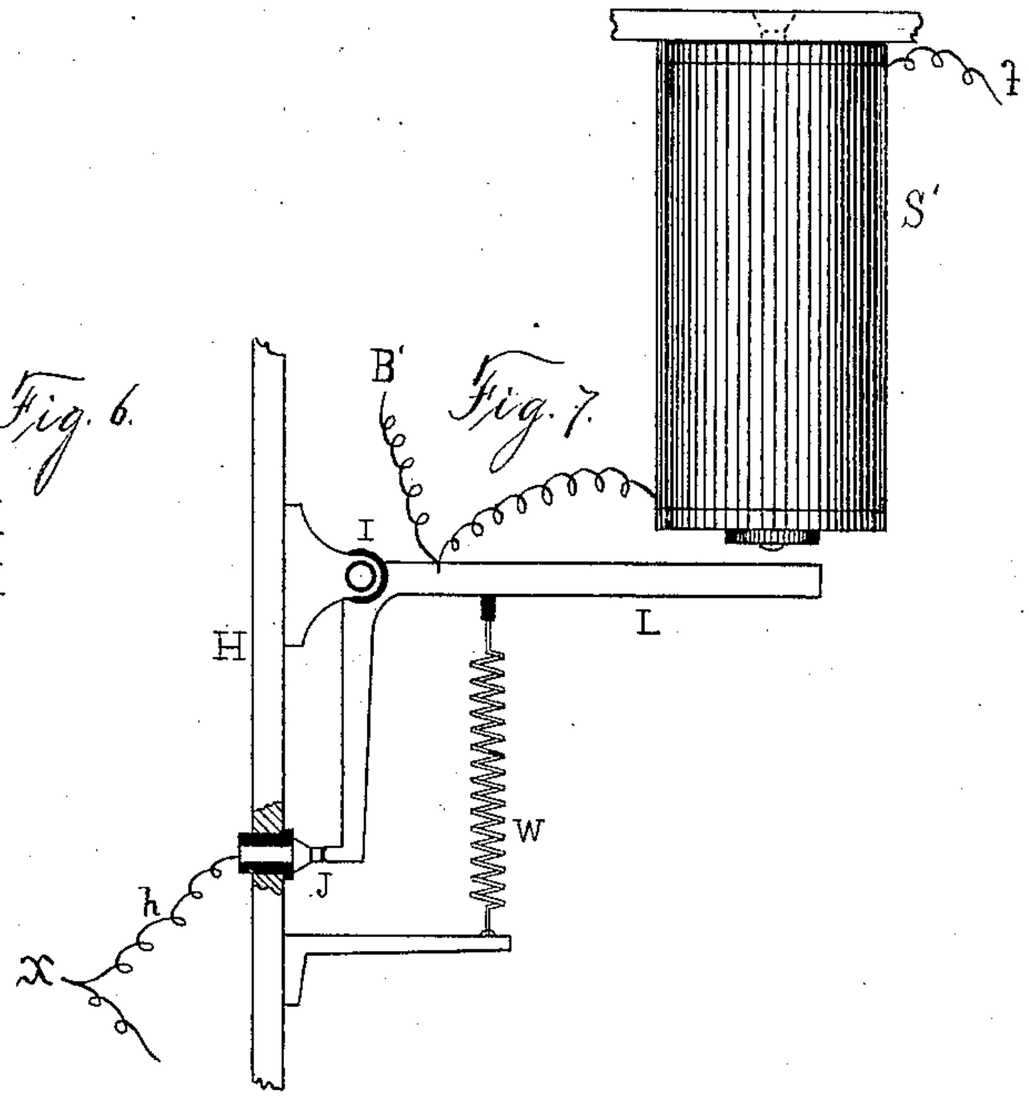


Fig. 7.



Witnesses.
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UNITED STATES PATENT OFFICE.

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

ELECTRIC-LAMP MECHANISM.

SPECIFICATION forming part of Letters Patent No. 305,413, dated September 16, 1884.

Application filed February 25, 1882. (No model.) Patented in England July 6, 1882, No. 3,204; in Germany August 8, 1882, No. 24,452; in France August 19, 1882, No. 150,722, and in Belgium August 24, 1882, No. 58,849.

To all whom it may concern:

Be it known that I, ELIHU THOMSON, of New Britain, in the county of Hartford, State of Connecticut, have invented an Improvement in Electric-Lamp Mechanism, of which the following is a specification.

My invention relates to arc lamps; and it consists of a novel magnet system adapted to secure the greatest sensitiveness of reaction between a derived-circuit magnet or magnets around the arc and a direct or lifting magnet traversed by the lighting-current. I find by actual trial the results obtained exceed those of ordinary differential magnets, or those in which the main and derived circuit coils are combined upon a single magnet-core.

My invention consists in making one of the magnets, preferably the lifting or coarse-wire magnet, stationary, while the other, the shunt or fine-wire magnet, is arranged with relation to the first and made to rock upon a pivoted support, in the manner hereinafter described. This peculiar movable magnet carries an arm, which acts upon a clutch upon the carbon rod, or upon any equivalent regulating device, if desired. I, however, prefer to employ a peculiar slipping clutch, which has been made the subject of a prior application for Letters Patent, but which is herein used in a novel manner to effect a retarded feed of the carbon electrode.

Figure 1 is a front view of the mechanism of the lamp; Fig. 2, a side view of the same upon a smaller scale, where similar letters indicate similar parts. Fig. 3 shows the arrangement of a slipping clamp as used in my present invention. Fig. 4 shows a modified plan of using the same. Fig. 5 shows a simple automatic cut-off device for the purpose of preserving the circuit when too great a length of arc forms in one of the lamps of the series. Fig. 6 shows a portion of the same. Fig. 7 shows an automatic circuit-breaker for the derived circuit containing the "derived-circuit" magnets, so as to preserve them from destruction when the carbons are abnormally separated, and also to provoke a cut-out of the lamp by means of the devices, Fig. 5.

In Fig. 1, M is one leg of a horseshoe electro-magnet traversed by the direct current, and having curved sloping poles at M'. S is one leg of a shunt or derived circuit magnet, hung at its center of gravity in a suitable bracket, *a*, attached to the lamp-case H, and having secured to it a projecting piece, P, which communicates movement to a clamp, C, which lifts the carbon rod R. The connection between the clamp C and the piece P is an elastic one. To secure this a short spring, Z, is provided, interposed between prolonged portions, respectively, of the clamp C and piece P. In all other respects the clamp is the same as that described in a previous application for Letters Patent, filed by me in the United States Patent Office, on the 9th day of April, 1881, No. 30,406. Said clamp consists of a movable clamp-toe, *t*, pivoted to the body C, and having a spring, *q*, and stop *r* for releasing the clamp-toe *t*. (See Fig. 3.) S' is one leg of a horseshoe electro-magnet in a portion of the derived circuit around the arc, the action of which will be described farther on in connection with Fig. 7. K is a simple cut-off device, also to be hereinafter described in connection with Fig. 5. D is a dash-pot, of any ordinary or preferred construction, which is connected to the mechanism in any suitable manner. It is here shown connected to the arm P.

Fig. 2 is a view at the side of Fig. 1, and all the parts are therein designated by the same letters as before. M M are the two coils of the direct or lifting magnet; M' M', its two poles, (seen in end view;) S S, the two coils of the shunt or derived circuit magnet, hung centrally at *a a* to the lamp-case H H; and R, the carbon rod passing vertically through the clamp C, as shown; S', a portion of the derived-magnet circuit-coil, whose action will be fully described in connection with Fig. 7.

In Fig. 1 the current enters at X, passes through the lifting-coils of the magnet M M, and thence to the rod R, electrical connection therewith being made in any of the ordinary ways, to the arc at E E', and out at Y. A branch from the point *d* leads to the contacts at *v*, thence through magnet-coils of S', thence through

the coils of pivoted magnet S S, and out at Y. From a point between *v* and the coils of S′ a branch leads to a cut-out device, K, and through said device when the circuit is closed at that point to the junction Y. The direction of winding of the magnets M M and S S is such that the poles of said magnets that are opposed to one another are of like character when current circulates in both sets of coils. The poles M′ M′ are preferably sloped, curved, or tapered, for obtaining uniformity of action in all positions, as described in my previous applications for Letters Patent.

The general action of the parts during normal operation is as follows: The carbons being together, and the magnet-poles of S S and M M being separated, the clamp C is opened by its toe *t*, resting on the stop *r*, and therefore the rod R is free to descend. When the current passes through the magnet M M and carbons E E′, the magnet M M, being thus energized, attracts the poles of the shunt-magnet S S toward it, raising the piece P and relieving the toe *t* from the strap *r*, whereupon the spring *q* closes the clamping-toe upon the rod R, and by a further movement upward the rod R is lifted and an arc formed at E E′. This action of separation continues until the current flowing in the derived circuit S S is sufficient to prevent further opening of arc by energizing the iron cores of S S in a direction opposite to their induced magnetism from M M. Let now the arc-resistance increase by consumption of carbons, the current flowing through S S is proportionately increased, and a repulsion begins between the magnets M M and S S, due to like poles being in juxtaposition. The arc is thereby shortened by the descent of the piece P and clamp C. This action continues until the toe *t* is again in contact with the stop *r*, and now a slow descent of the rod R through the clamp C results, and a gradual feeding of the carbons is therefore effected during normal action of the lamp.

To render the action of the parts directly concerned in the automatic slip of the carbon rod more clear, reference is had to Fig. 3, where the parts are shown enlarged for clearness. They are shown in the position occupied during slipping. The clamp-toe *t* is just lightly closed upon the rod R, and the extension from said clamp is lightly resting upon the stop *r*. Let now the piece P be lowered very slightly. The sustaining force of the elastic spring connection Z, by which the part C is virtually supported, is thereby lessened, so that the part C, in which the clamping-toe *t* is pivoted, sinks, thereby slightly relieving the rod R from the clamp, the weight of which rod up to this moment has been upheld by the clamp C, and consequently has compressed the elastic support Z. Immediately the rod R begins to move down through the clamp, its downward pressure upon C is relieved, and the spring Z instantly forces the clamp C upward and relocks the toe *t* upon the rod R. The actions, as above described, are repeated with such extreme rapidity that there results only, to all appearances, a slow sliding of the rod R through the clamp C.

In a former application a similarly-acting clamp has been described; but my present device differs therefrom in the addition of the elastic support or connection Z, which should be rather stiff or not too easily compressed. I find, however, that the results obtained by this addition are superior, especially where the lifting-armatures and connections possess considerable mass or inertia, as in the present invention. The spring or elastic support Z is, it will be observed, independent of the retracting weight or spring for the lever or other device carrying the magnet, armature, or core for the lifting and feed-regulating magnet, and said spring-support is, moreover, applied in such way that its tendency, when relieved, is to carry the clutch in a direction the opposite of that in which the armature-lever or other device is carried by the usual retractor, and to thus cause an immediate re-engagement of the clutch after release of the rod independently of any movement that the magnet may impart to the lever supporting the parts. A much more delicate and sensitive action of the clutch in bringing the carbon to a stop during the feed-controlling operations is thus attained, and the sluggishness of action and danger of overfeed, due to inertia of levers, armatures, cores, &c., is largely avoided. The slightly-elastic connection Z allows the clamp C to act, as above described, as an automatic slip device, in a measure independently of the piece P and parts to which it is attached. The clamp C may therefore effect the rapid action, as set forth, without interference or disturbance from the effects produced by the inertia of the other parts, P; in fact, the parts, as described, may be applied, without reference to any lifting-armature, as an independently-acting device for slowing the descent of the carbon rod or similar portion of an electric lamp. In this case any well-known clamp may be used to grip the carbon rod and lift it or release it.

Fig. 4 shows the application of the clamp as a retarding device. C′ is the clamp-body, upheld, as before, by a spring, Z′, resting on a fixed support, H. The toe *t* is hinged to the clamp-body, as shown, and bears against the rod R, as before, and its elongated extremity rests upon a stop-surface at *r*′. The rod R, if now left free to the action of gravity, will descend with a motion more or less retarded, according to the relative strength of the two springs Z′ and *q*′ and the position occupied by the stop *r*′. The action of this device is precisely as before. The principle of its action may be stated in general to be as follows: When the carbon-rod is freed from the lifting-clamp, and begins to move downward under the action of gravity, the toe *t* is in engagement with said rod, so that said toe and clamping-body C′ are carried downward with the rod, thus compressing the spring Z′, the

strength of which is insufficient to counterbalance the weight of said clamping-body plus that of the carbon rod. The toe *t* is thus brought down against stop *r'*, thus disengaging the toe and clamp-body from the carbon rod. The spring *Z'* thereupon, being under compression due to the movement downward of the carbon rod, immediately raises the clamp-body and toe to a position where the toe will be removed from stop *r'*. The spring *q'* then immediately causes the toe to re-engage with the rod, and the action is repeated. This device may be substituted in many instances for dash-pots, wheel-work, fan-wheels, &c., with a minimum of complexity of parts.

I have described the spring as acting in combination with the particular clutch shown in a peculiar manner; but it is to be understood that said spring or elastic support has the other important and useful function of relieving the clamp or clutch from sudden movement by the action of the magnet, and thus preventing irregular and sudden movement of the carbon when the magnet increases in power. The use of the elastic connection or support for the clamp or clutch is therefore not limited to the peculiar form of clamp herein shown, and may be used with any form of lifting or separating clamp which acts to separate or move a carbon when the lamp-magnet increases in power, and serves in such case to produce a much more steady and uniform action. In any case, it is only necessary to support the clamp by the spring or other elastic device in such a way that the spring will take up sudden movement of the magnet system, and prevent such movement from being communicated suddenly to the clamp and carbon.

Fig. 5 shows my simple cut-out device for shunting the current around the lamp when the arc has become too long. It consists of a spring, K, bearing a contact-button, A. This spring is insulated from the case H, and connected electrically to the exit-point of current, as Y, or one of the carbon points, as E'. The button or projection A rests upon a plate, B, connected to the other terminal, X, Fig. 1, through a contact, J, to be hereinafter described. Interposed between the contact-surfaces A and B is a layer of fine tissue-paper, preferably oiled, or a very thin film of any non-conductor. The plate B may be lacquered in the ordinary way to prevent contact between it and A. So long as this insulating-film remains intact the current passes through the arc at E E', Fig. 1; but if separation occurs in the lamp sufficient to break the circuit at that point or increase its resistance very greatly, the reaction of the circuit-current will cause the current to force its way through the thin tissue or lacquer film, and allow contact to be made at the point where the current has broken through the insulating-film, so as to short-circuit the arc or cut it out by shunting the current from it, preserving continuity for the rest of the circuit. If the tissue or other surface has been thus penetrated, the insulator may at any time be restored by shifting the contact of A or B, so as to include a new unimpaired portion of the insulating-film between them. The manner of so renewing the insulation is a matter of little importance, and the device may be constructed in any well-known way to allow of easy renewal. For this purpose I prefer to make the piece B removable, and attach the insulating-film firmly to its surface. The thickness of film required varies with the material used, and with the pressure of the button A upon it, and also with the length of circuit and intensity of current operating the lamp. With a few lamps in circuit—say six—and with a few ounces pressure of the spring K, thin tissue-paper is perforated by the breaking of the circuit at the arc.

In Fig. 7 a safety shunt-circuit breaker is shown for the purpose of preventing a destruction of the derived-circuit magnet S S, Fig. 1, under the following conditions: First, when by accident a very long arc is maintained for a lengthened period, the consequence of which is the diversion of too great a current to the shunt-magnet and the heating of its coils; second, it is sometimes the case that the want of good contact between the carbons of a particular lamp prevents the dynamo-machine starting or "building," as it is termed, but the residual magnetism of the machine gives enough current to traverse the shunt or fine wire of that particular lamp, and seriously heat said wire. It requires but ten minutes' running of a machine capable of sustaining thirty arcs in series to endanger the wire of a lamp under these conditions, although there is little perceptible current traversing the circuit and the machine is apparently not in operation. My device, Fig. 7, obviates the difficulty, and serves to provoke a penetration of an existing bad contact at the carbons, or to provoke a penetration of the insulating-film between A B, Fig. 5, so as to either start the lamp or cut out the defective lamp and complete the circuit. It acts also to assist the cutting out of the lamp when too long an arc forms. It consists of an electro-magnet, S', in the derived circuit around the arc, provided with an armature, L, pivoted to and insulated at I from a support, H. The armature L, when moved toward S' against a retractible spring, W, opens contact at J. The contact at J is in the derived circuit through S S and S', Fig. 1. When the derived-circuit magnet S' is too greatly energized from any cause, the contact at J is broken, the armature L being attracted to S and the derived circuit at once broken, to be again closed by the spring W through the loss of power of S', due to its circuit having been opened. The armature L continues its vibration, opening and closing the contact J. So long as the abnormal condition of the circuit of the lamp exists, the derived-circuit coils are prevented from remaining continuously in circuit for any length

of time, and are saved from injurious heating. Besides this advantage, the intermittent action so produced in the shunt or derived circuit is very beneficial in assisting in provoking a proper movement of the regulating mechanism should it have become stuck in any position, and in giving an audible signal of irregularity. Moreover, as the wire B′, Fig. 7, connects with the cut-out surface B, Fig. 5, when the contact J is opened by the armature L, the high-tension discharge or extra current from the derived-circuit coils S S S′ is thrown instantly upon the cut-out, so as to provoke penetration in obedience to well-known electrical laws, and the action of the armature L being repeated and intermittent, a perforation of the insulating-film at A B is greatly assisted. When this occurs, the current of the lamp-circuit, Fig. 1, enters at X, passes through the contact J, which is now closed, thence to L, and by the connecting-wire to B, to A, then to K, and out at Y, so that the lamp is cut out of the circuit, as are also the magnets S′ and S S.

What I claim as my invention is—

1. The combination, in an electric lamp, of a feed-controlling clamp or clutch, a releasing-stop, an actuating or controlling armature, and an interposed elastic connection between the connection and clamp, for causing quick re-engagement of the clamp after its release by the stop.

2. The combination, with the carbon-carrier in an electric lamp, of a clamping device normally tending to engage with the carrier, means for disengaging the clamp when said clamp is moved with the carrier, and an elastic support for the clamp, whereby said clamp may be returned to a point where it will automatically re-engage with the carrier.

3. The combination, substantially as described, in an electric lamp, of a clutch, a spring for forcing said clutch into engagement with the carbon rod, and an elastic spring-support for the clutch.

4. The combination, substantially as described, in an electric lamp, of a lifting and releasing clamp, an operating armature or electro-magnet for said clamp, and an elastic connection between the clamp and armature.

5. The combination, substantially as described, of the pivoted clamping-toe having the elongated arm, the disengaging-stop beneath the arm, the spring or elastically supported clamp-body in which the clamping-toe is pivoted, and the lifting armature or electro-magnet.

6. The combination, substantially as described, of the hinged toe *t*, stop *r*, spring *q*, clamp-body C, and elastic support Z.

7. The combination, with a carbon or carbon-carrier constantly tending to feed, of a feed controlling or releasing clamp or clutch normally engaged with the carbon or carrier, and a spring connected to the clutch and normally influenced by the carbon or carrier when thus engaged, so that when the latter is released from the clutch the spring will tend to cause immediate re-engagement of the clutch with the carbon or carrier.

8. The combination, with the carbon or carbon-carrier in an electric lamp, of a releasing clamp or clutch normally holding said carrier or carbon at a regulated distance from the opposite electrode, and an elastic connection between said clamp and its actuating-lever or support, said connection being under a stress tending to cause a quick re-engagement of the clutch as soon as the release of the carbon from its clutch relieves the elastic connection from the influence of the carbon or carbon-carrier.

9. The combination, with a feed clamp or clutch and its supported carbon or carbon-carrier, of an elastic sustaining or actuating device independent of the retractor for the magnet, and tending to move the clutch in a direction to cause a re-engagement when the clutch is relieved in part or in whole from the influence of the carbon or its rod in the act of feeding.

10. The combination, with an electric translating device, of two conducting-electrodes, normally separated by an insulator, but arranged in close proximity to one another, and connected, respectively, with the positive and negative sides of the device, so that on an abnormal resistance in the main or principal circuit through said device the current shall force its way from one of said electrodes to the other, as and for the purpose described.

11. The combination, substantially as described, in an electric lamp, of two contact points or surfaces, an interposed insulating-film, and electrical connections from said contact points or surfaces to the circuit of the lamp on either side of the arc, the whole constituting an automatic cut-out for the lamp.

12. The combination, substantially as described, in an electric lamp, of a conducting plate or surface connected to the general circuit on one side of the lamp, an insulating-film upon said plate, and a spring-actuated contact-piece connected to the general circuit upon the other side of the lamp.

13. The combination, substantially as described, with an electric lamp, of a derived circuit to said lamp and an automatic circuit-breaker in the derived circuit, said circuit-breaker being adjusted to act only upon a flow of current in the derived circuit greater than that required in said derived circuit for actuating the regulating devices.

14. The combination, substantially as described, with the derived-circuit regulating electro-magnet in an electric lamp, of an independent electro-magnet in said derived circuit, and a circuit-breaker operated by the latter for automatically opening and closing said circuit at rapid intervals during the existence of an abnormal resistance between the carbons.

15. The combination, substantially as described, of the derived-circuit electro-magnet

S S, for the regulating mechanism, the derived-circuit electro-magnet S′, and the derived-circuit breaker J.

16. The combination, in an electric lamp, of two contact surfaces or points normally separated by an insulating-film, and arranged, as described, to form, when in contact, a shunt or cut-out circuit, and an automatic circuit-breaker in a derived circuit around the carbon, substantially as and for the purpose described.

17. The combination, substantially as described, of the electro-magnet S′ in a derived circuit, a contact-breaker, also in said derived circuit, and the contact points or surfaces separated by an insulating-film and connected to the general circuit in the manner described, so that when they are in contact they form a portion of a cut-out or safety circuit.

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