(No Model.) 3 Sheets—Sheet 1.

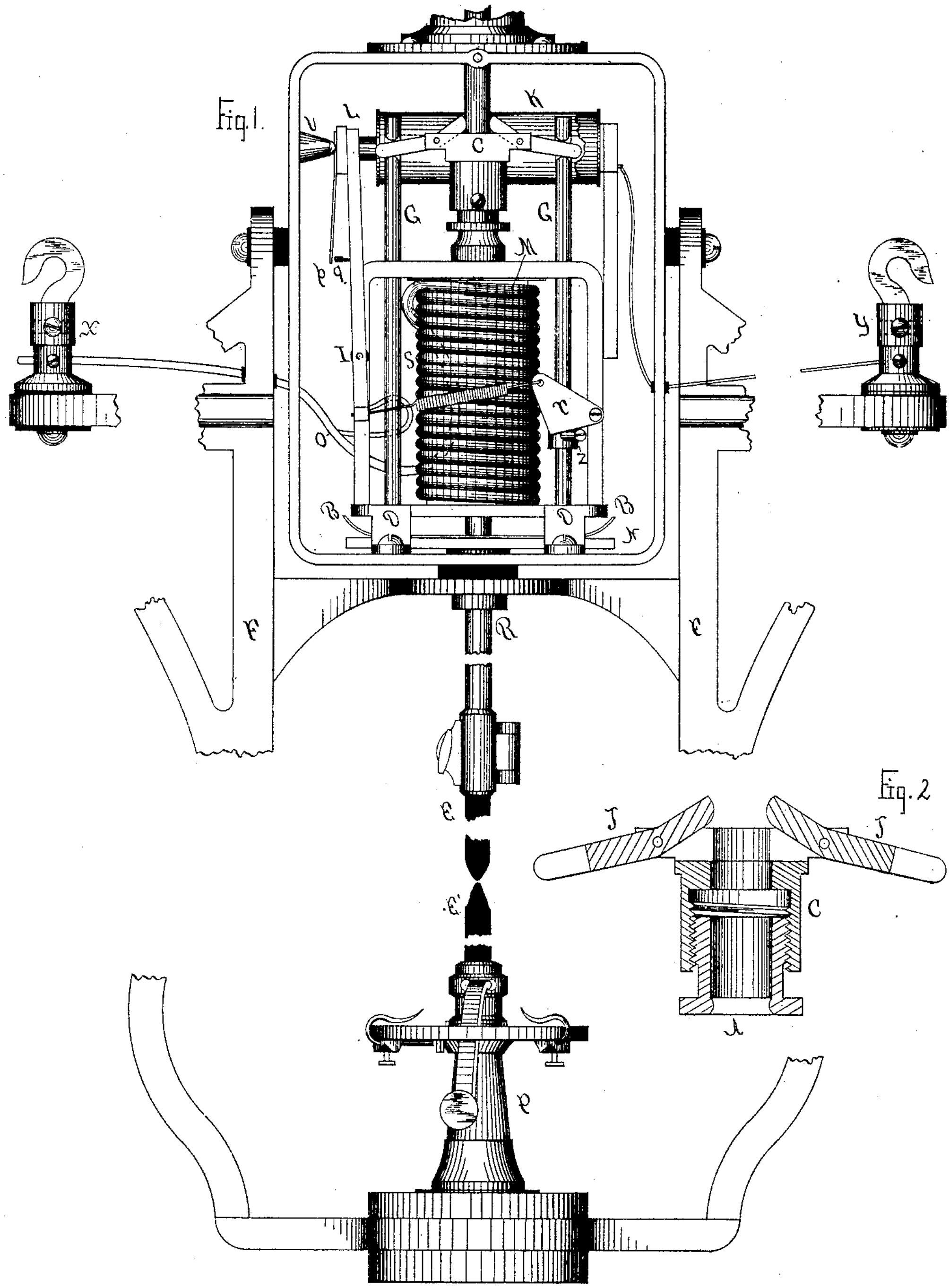
E. THOMSON.

ELECTRIC ARC LAMP.

No. 261,790. Patented July 25, 1882.

Fig. 1.

Fig. 2



Witnesses
W. B. Thomson
G. H. Churchill

Inventor
Elihu Thomson

(No Model.)

3 Sheets—Sheet 2.

E. THOMSON.

ELECTRIC ARC LAMP.

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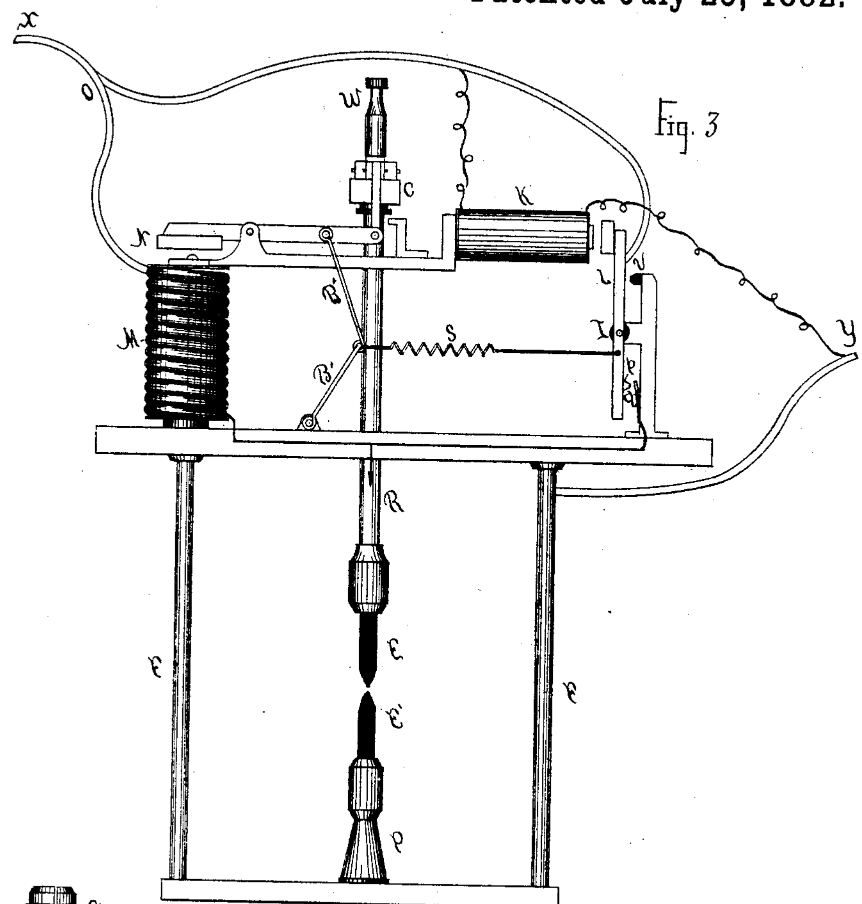

Fig. 3

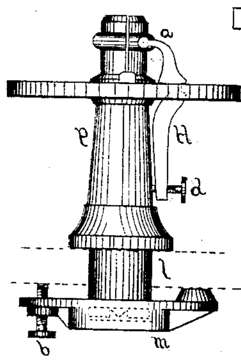

Fig. 4.

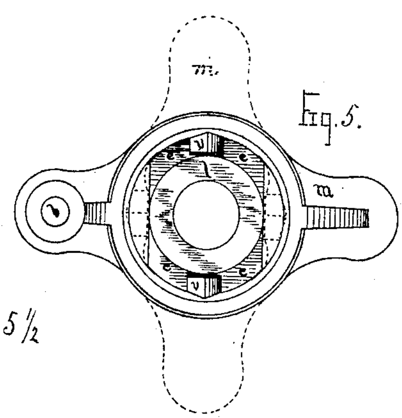

Fig. 5.

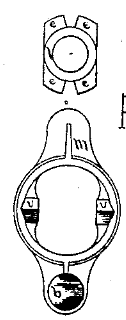

Fig. 5½

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(No Model.) 3 Sheets—Sheet 3.

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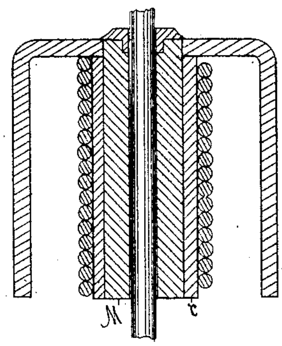

Fig. 6.

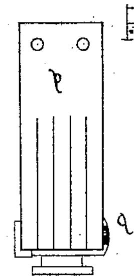

Fig. 7.

Fig. 8.

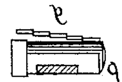

Fig. 9.

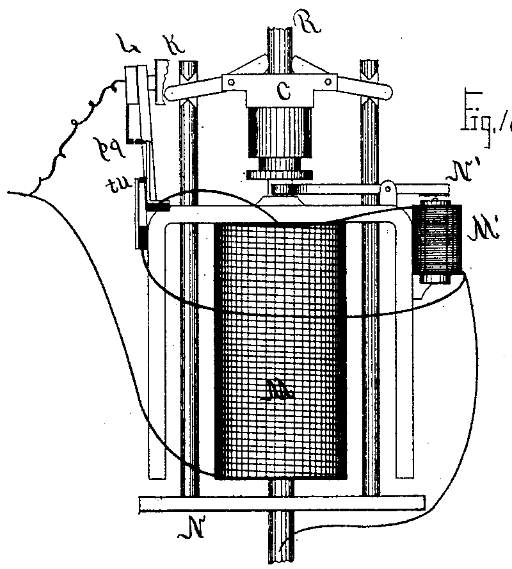

Fig. 10.

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N. PETERS. Photo-Lithographer. Washington. D. C.

UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF NEW BRITAIN, CONNECTICUT, ASSIGNOR TO THE AMERICAN ELECTRIC COMPANY, OF SAME PLACE.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 261,790, dated July 25, 1882.

Application filed December 17, 1880. (No model.)

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, residing at New Britain, county of Hartford, State of Connecticut, have invented certain Improvements in Electric-Arc Lamps, of which the following is a description.

My invention relates to that class of electric lamps which may be termed "drop and lift," in which a readjustment of the position of the carbon electrodes takes place at intervals during burning by a fall of the upper electrode and immediate lift of the same.

The object of my invention is to obtain in such lamps the greatest certainty of operation, especially when several of them are used upon a single circuit, also to simplify construction and to compensate for slight changes in the current strength operating them. For this purpose I employ chiefly an electro-magnet operating to lift the upper carbon electrode through the agency of a clutch mechanism, to be described, a shunt electro-magnet, or magnet placed in a derived circuit around the carbon electrodes, said shunt-magnet operating to cut out the lifting-magnet in accordance with patent to Thomson and Houston, No. 223,646, January 20, 1880; but the novel features embraced in the present invention relate to certain means of compensation applied to both the lifting-magnet armature and to the shunt-magnet armature, by means of which an automatic adaptation to varied current strength is secured, a safety magnetic attachment brought into action to cause the carbon electrodes to descend into contact in case of the failure of the ordinary operation of feeding, and minor improvement in the disposition of the parts.

Figure 1, Sheet I, shows a side elevation of the lamp with the working parts uncovered, as shown. Fig. 2, Sheet I, is a sectional view of the adjustable clutch used in the operation of lifting the upper carbon electrode. Fig. 3, Sheet II, is a side view, intended to show more distinctly the connections used in Fig. 1, and a minor modification in the arrangement of parts. Fig. 4, Sheet II, is a side elevation of the lower-carbon-electrode holder and clamping device. Fig. 5, Sheet II, is a view of the removable clamp for fastening the lower-carbon holder to the base of the lamp, also shown in Fig. 4. Fig. 5½ shows the removable clamp and the flange or plate upon which it locks detached. Fig. 6, Sheet III, is a sectional view of the lifting-magnet M, Fig. 1, showing the arrangement of its parts. Figs. 7, 8, and 9, Sheet III, show a form of contact mechanism for cutting out or short-circuiting the lifting-magnet M, Fig. 1, and corresponds to the contacts *p q*, as hereinafter described. Fig. 10 shows the application of what I term a "safety-magnet," which operates on the failure of the ordinary regulation to force down or jar the electrodes into contact, and thus prevent a break in the circuit caused by abnormal arc length.

I will now proceed to describe my invention in detail.

In Fig. 1 E E′ are two carbon electrodes in juxtaposition, the rod R being that by which the upper, E, is supported. Upon this rod is placed an adjustable self-locking clutch, C, the detailed construction of which is described in connection with Fig. 2. Two parallel rods, G G, connect the jaws of the clutch with a movable armature, N, placed under the base-plate D D, and arranged to be attracted by the electro-magnet M, through whose coils the direct current operating the lamp passes. Fig. 6 shows in section the form preferably given to this magnet, and which will be described. Springs of brass or steel, B B, attached to the armature N, and bent at the ends into a curve, concave upward, as shown, serve to give to the armature N an elastic seating against the magnet M when attracted by it.

K, Fig. 1, is one leg of an electro-magnet, placed in a derived circuit around the electrodes E E′, the other leg being removed to show the clutch C in position. The shunt-magnet K attracts its armature L whenever the arc resistance increases, thus closing the contact *p q*, which short-circuits the lifting-magnet M, and said magnet K operates as in patent to Thomson and Houston, above referred to. The contact-point *p* is upon a spring attached to the armature-lever, while the contact *q* is stationary, being attached in any suitable manner to the frame-work of the lamp.

The circuits through the magnet K, the lifting-magnets, and the shunt are substantially as indicated in Fig. 3, where the current entering at post x divides, one portion passing through the derived-circuit magnet K and out at post y, the other or principal portion going to the lifting electro-magnet M, and through the frame of the lamp to the upper carbon, where in passing to the lower carbon it forms the arc, thence to the insulated supports for the lower carbon and to the post y, where it joins the derived circuit passing through K. The shunt-circuit for electro-magnet M, which is closed by p q, passes to the armature-lever L, contact p to contact q, which is supported by the frame of the lamp where it rejoins the principal circuit and passes through the carbons, and so to the post y in the manner just described. The stop V limits the play of the armature L, which armature is supported upon a lever pivoted at I, and insulated from the other parts of the lamp. A coiled spring, S, is attached to the shunt-lever, and acts to hold the armature L away from the electro-magnet K. A small triangular piece of material, T, to which one extremity of the shunt-spring S is attached, as shown, is free to move around a pivot, as shown, and actuated by a small pin or lug, Z, moving with the clamp, placed upon one of the rods G, so that when the armature N rises the spring S is tightened, and, conversely, when the armature N falls the spring S is slackened.

Many other devices that shall cause an increase of tension in the retracting-spring S in accordance with the movements of the armature N may be used in place of that here described. One other device for accomplishing the same object is described farther on. In describing the operation of the lamp the action of these novel features will be explained.

F F is the frame of the lamp, and is made preferably of brass or cast-iron.

P is the pillar, supporting the lower electrode, E′.

The current enters at the binding-post X, insulated from the frame F, from thence to the coils of the magnet M, but branches at O to the shunt-lever and its contact p, and when p and n are closed it continues through n to the metal work of the lamp, to which n is attached, there rejoining the circuit through the lifting-magnet in the manner already described with relation to Fig. 3. Passing through the coils of the magnet M, it reaches the metal work of the upper part of the lamp, and thence passes down the rod R to the arc between E E to the pillar P, frame F, and out at the post Y. Insulation is interposed at all points where necessary to prevent the current from connecting the posts X and Y, except as described. The magnet K of high resistance—say three hundred ohms—is in a derived circuit around the arc, as before described. When the contacts p q are closed by the action of the magnet K the direct or lifting magnet M is cut out or short-circuited.

It will be convenient now to describe the operation of the lamp as shown in Fig. 1.

By the action of the current the magnet M attracts its armature N to a position more or less near to it, according the current strength, this variability being imparted by the curved springs B B, yielding more or less readily. The upward motion of the armature N and rods G G, attached thereto, locks the clutch C upon the rod R and lifts it, thus establishing the arc between the carbons. The carbons continue separated until by their consumption the resistance of the arc has increased sufficiently to bring the shunt-magnet into action, which, attracting its armature L, closes the contact p q, cuts out the lifting-magnet M, drops the clutch C and armature N, frees the rod R, (the clutch C striking the extension of M below it, its jaws being opened by a continued descent of the rods G G,) the carbons approach, lessen the arc resistance, render inactive the shunt K, the spring S opens the contact p q, and the current, again traversing the magnet M, relocks the clutch, and again holds the carbons apart. This readjustment of the arc length or feed takes place so quickly that but little effect is produced upon the steadiness of the light. The adjustment of the spring S requires to be such that it shall hold the armature L away from the magnet K with a force increasing as the current in the arc increases, and increasing in accordance with a change in the length of the arc produced by increased current independently of waste of carbon by consumption. Since the armature N, elastically held by the springs B B and oscillating with every change of current strength, controls the length of arc between the electrodes by the amount of lift imparted to the clutch C, it is easy to cause the elastic force of the spring S to increase or decrease in accordance with increase or decrease of current strength by connecting it indirectly to the armature N. This is accomplished by the piece T, which tightens the spring S when the armature N is lifted and releases said spring when the armature N is released or falls, the clamp serving to communicate motion to the piece T from the armature N and rod G. This feature enables me to adjust a lamp so that it will operate on any strength of current within practicable limits. This is due to the peculiar action of the springs B B in conjunction with the shunt-spring S, as described.

Fig. 2 shows in section the form of clutch which I have found to be more certain in its action, little subject to derangement from dirt, opening freely, and closing securely. There have been employed in drop and lift lamps many forms of clutch; but I have not found any possessing the advantages of the clutch, Fig. 2. The body of the clutch C is made of sufficient weight to cause the jaws J J to drop in against the carbon rod R, Fig. 1, when the outer extremities of said jaws are moved upward, as by the rods G G, Fig. 1. The release of said clutch is effected by its coming into contact with any support under it while the outer ends of the jaws J J are being depressed.

The body C is made extensible by a movable bushing, A, screwed into it or otherwise, and serves to adjust the position of release of the clutch when used in the position C, Fig. 1. By shortening the body of the clutch C the lift of the carbon E is increased. By lengthening it is diminished. It is essential to the operation of the clutch C that the jaws be pivoted to the body of the clutch between their inner and outer ends, and that their inner faces fit a portion of the carbon rod R at a position inclined, as in Fig. 2, above the body of the clutch, the points of contact with the rod being adjusted so that a secure hold is effected when the clutch is raised, and a free release occurs when it is dropped.

Fig. 3 shows a modified arrangement of parts serving the same ends as in Fig. 1. The clutch C is lifted by the armature N, attracted to the magnet M, which magnet is cut out at intervals by the shunt K and contacts p q, as before; but in this case one extremity of the spring S is attached to the shunt-lever L at a point below the pivot I, and at the other extremity to a toggle-joint, B′ B′, one end of which is fixed to the lifting mechanism of the clutch C, and the other to a fixed pivot, as shown. The action of the spring S is thus a double one. As before, it serves to hold the shunt-magnet armature away from said magnet K, and in addition, by the flexing it gives to the toggle B′ B′ or knee-joint, it serves to hold the armature N in proper relation to the magnet M during variations of current strength. Thus the springs B B, Fig. 1, are dispensed with, as also the piece T, Fig. 1, while the actions and relations of parts are still preserved.

The peculiar feature of the knee-joint B′ B′, Fig. 3, is that, as the attraction of the armature N toward the magnet M increases, the resistance of the spring S is made to increase likewise from the gradual straightening of the knee-joint as the armature N is drawn toward the magnet M. At the same time the straightening occurs the tension of the spring S upon the lever L is also increased. Thus the effects, as before described in connection with the springs B B and S, Fig. 1, are obtained likewise by the arrangement shown in Fig. 3.

At W, Fig. 3, is shown a narrowing of the rod R, so that when the carbon electrodes are nearly consumed the narrowed portion of the rod enters the clutch, which fails to grasp the the rod. Hence the electrodes fall together and the light is extinguished, thus showing that a renewal of the electrodes is needed. The same effect is produced by limiting the length of the rod R, so that it shall all have passed through the clutch C before the carbons are totally consumed. This arrangement only differs from that of patent to Thomson and Houston, No. 223,646, January 20, 1880, in that a self-acting clutch is employed instead of the roller-support of said patent.

Fig. 4 represents the arrangement of the lower-carbon holder which I find advantageous. The pillar P has at its upper extremity a split-tube, one half being a part of said pillar and the other or movable portion being pivoted to the end of a lever, H, rocking in an opening in a horizontal plate or similar support, and having at its lower end a screw, d. Upon placing the lower carbon in the holder a simple movement of the screw d, imparting motion to the lever H, forces the portion a laterally against the carbon pencil. When a glass globe is used to surround the luminous point or arc it is not necessary to remove said globe to replenish the carbon in the lower holder; but the clamp is operated below the plate upon which said globe rests. This I find to be a very convenient device in the use of the lamp.

As it is desirable to make the pillar P movable sidewise, so as to adjust for exact juxtaposition of the electrodes, and also to make it easily removable from the lamp, I accomplish both ends by the removable lever-clamp shown in Figs. 4, 5, and 5½, and designated m. In Fig. 4 the pillar P is shown having a cylindrical extension, l, through the base of the lamp-frame, and which extension does not exactly fit the frame, and is so formed as to have locked to it a rocking lever having a bearing upon l on opposite sides, while its extremities bear upward firmly upon the base of the lamp-frame. The screw b is used to tighten and loosen the lever m and pillar P. By tightening the screw b the lever m draws the pillar P firmly against the part of the lamp-base upon which it rests, (indicated by dotted lines.) The lever m is constructed as shown in Fig. 5, so that a loosening of the screw b and change of position of m ninety degrees around the axis of the pillar P make the part m readily detachable from said pillar. To this end the extension l of the base of the pillar P is provided with lateral extensions e e e e, Fig. 5, between which exist two notches to receive angular projections v v from the lever m, which is formed, as shown, of a circular ring with diametrically-opposite lugs, one of which receives the fastening-screw b. The angular portions v v extend inward from the circular ring, and are large enough to be caught in the notches between e e, as shown, without slipping through said notches, at the same time that the lever m is free to rock upon them. By loosening the parts and turning the ring m through ninety degrees, as shown in dotted lines, Fig. 5, the projections v v come opposite open spaces on each side of the ears e e e e, and the ring m may now be freely detached from the pillar. The letter l represents the lower end of the pillar.

Fig. 6 is a section of the lifting-magnet M, Fig. 1, which is shown to consist of a U-shaped piece of iron, with an iron tube, M, extending downward from its center. Around this iron tube are wound the convolutions of insulated wire conveying the current. I prefer to surround the tube M, in addition to the wire, by a copper tube or other conducting-casing placed either outside or inside the wire, as shown at r. This casing acts to prevent spark at the contact p q, Fig. 1, by absorbing the extra current set up in the lifting-coil. I also modify the contacts p q to secure the same result at the same time that their action in short-circuiting the lifting-magnet is made gradual. This modification is shown in Figs. 7, 8, and 9. The spring p is divided into a comb or brush, the several teeth of which come successively into contact with the surface q, which consists of carbon or other equivalent conducting material, according to the varied strength of the current actuating the shunt-magnet which closes said contact. The contact p q, being a shunt around the lifting-magnet, is thus made to vary its resistance, and the lifting-magnet is gradually cut out thereby. This form of the contact p q has the property of less sudden action of the moving parts of the lamp, and is applicable where a gradual and quiet motion is desired. The spark at the contact p q is imperceptible.

Fig. 10 shows the application of what I designate as the "safety electro magnet," called into action to thrust the carbon electrodes together in any suitable manner when the regulation fails; and I do not limit myself to the employment of any particular device to effect such fall. In patent to Thomson and Houston, No. 223,646, January 20, 1880, the shunt electro-magnet serves this purpose; but I find it preferable to call into action an electro-magnet controlled by the shunt-magnet, so that when the arc resistance abnormally increases the shunt-magnet opens a contact, so as to divert a portion of the current of the lamp through the safety-magnet, whose action upon its armature jars loose the parts of the lamp, unlocks the clutch, or forces the approach of the electrodes, thus avoiding the danger of extinction of a series of lamps when one only is faulty, at the same time that the light is continued in the faulty lamp. When the action of the safety-magnet takes place it can also be made to occur so suddenly as to give an audible signal of the faulty action of the lamp, or its armature strike a sounding-surface for the same purpose. It may, if desired, be operated by a current other than the lamp-current; but such an arrangement affords no special advantage.

Fig. 10 shows one of the ways in which the said safety-magnet may be applied. The action of the shunt-magnet K first closes the contact p q, as before described, cutting out the lifting-magnet M. If, however, the arc fails to be shortened thereby, the shunt increases in power, due to increased arc resistance, finally opening a contact at t u, which has up to this moment been closed. The safety-magnet M′ is thus called into action, as the contact u is a shunt around its coils, and said contact t u having been opened by the action of the shunt, due to abnormal arc resistance, the current passes through M′, which attracts its armature N′. The motion of the armature N′ then strikes the clutch C open and violently jars the working parts free.

I do not claim the application of clutches to the carbon rod of an electric lamp, as their use is very old. My invention relates to the described improvements designed to render the action of the drop and lift lamps more steady and certain, notwithstanding changes in current strength and neglect to keep all the parts clean and free.

I do not claim herein, broadly, the combination, with the derived-circuit electro-magnet, of an adjustable resistance automatically controlled thereby, and acting to divert the current in varying amounts from the feed-regulating electro-magnet, as this forms the subject of another application filed by me. The claims herein which apply to this portion of the lamp are limited to a special adjustable resistant device controlled by the derived-circuit magnet.

I claim as my invention—

1. In combination with an armature of an electro-magnet placed in a derived circuit around the electrodes, a retractile spring connected to devices moving automatically in accordance with changes in the direct current operating the lamp.

2. In an electric lamp, the combination of a shunt-controlling electro-magnet in a derived circuit around the electrodes, an armature, a retractile spring therefor, an armature and an electro-magnet in the direct circuit, and devices acting upon the retractile spring, whereby its tension is automatically varied in correspondence with the movements of the armature of the direct-circuit electro-magnet.

3. In an electric lamp, the combination of a lifting-armature, springs serving as an elastic seating for the same, a retractile spring connected to the armature which controls the feed according to the consumption of the electrodes, and intermediate devices whereby the lifting-armature automatically varies the tension of the retractile spring.

4. In an electric lamp, a clutch for lifting the carbon-carrier to form the arc, consisting of a movable body with adjustable portion A, in which are pivoted clamping-jaws J J, whose inner clamping ends rest upon the carrier at points above the line joining their pivots, whereby a movement of the outer ends of said jaws upward, imparting a downward movement to their inner ends, locks said clutch, while a downward movement of the outer ends reverses said action, substantially as described.

5. In an electric lamp, the combination, with the rectractile spring of an electro-magnet, of a compensating knee or toggle joint, B B′, substantially as and for the purpose described.

6. In an electric lamp, in combination with a pillar supporting the lower electrode, a detachable foot-clamp consisting of a lever, m, provided with projections v v, screw b, and plates e e upon said pillar, cut away at their sides, whereby said clamp-lever may be released by a partial rotation, substantially as described.

7. The combination, with the derived-circuit electro-magnet and the electro-magnet controlling the feed mechanism, of a derived

circuit to said feed-regulating electro-magnet, a carbon or other resistance-surface in said derived circuit, and a slit spring or comb whose teeth are arranged to successively make contact with the carbon, as or for the purpose described.

8. In an electric-light regulator, a supplemental tripping electro-magnet acting upon the clutch devices of the carbon-holder, and switch devices controlling the flow of current through said electro-magnet, operated by an electro-magnet in a derived circuit around the carbons, and adjusted to be called into action only by an abnormal increase of the current in said derived-circuit electro-magnet consequent upon an abnormal increase of resistance in the arc.

9. In an electric-light regulator, the combination of a supplemental safety electro-magnet acting upon the clutch devices of the carbon-feeding mechanism to trip the same, switch devices controlling the flow of current through said electro-magnet, and devices operating the switch and adjusted to be called into action only by an abnormal increase of the arc resistance, substantially as described.

10. In an electric-light regulator, a supplemental tripping electro-magnet whose terminals are connected to the main circuit, in combination with a normally-closed shunt-circuit, including contact-points under the control of an electro-magnet in a derived circuit around the carbons, substantially as described.

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