(No Model.) 2 Sheets—Sheet 1.

E. THOMSON.

ELECTRIC ARC LAMP.

No. 297,195. Patented Apr. 22, 1884.

Fig. 1,

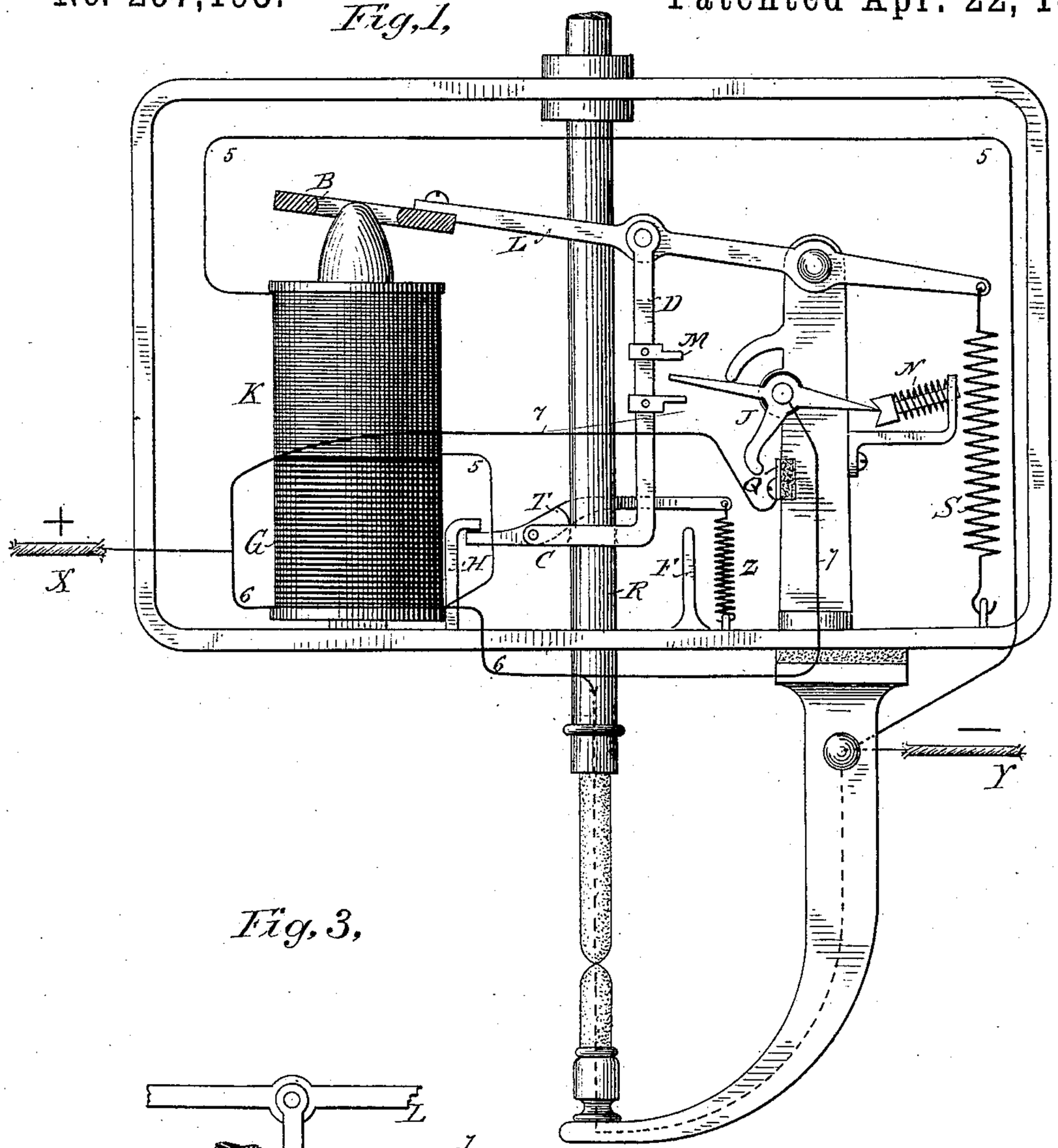


Fig. 3,

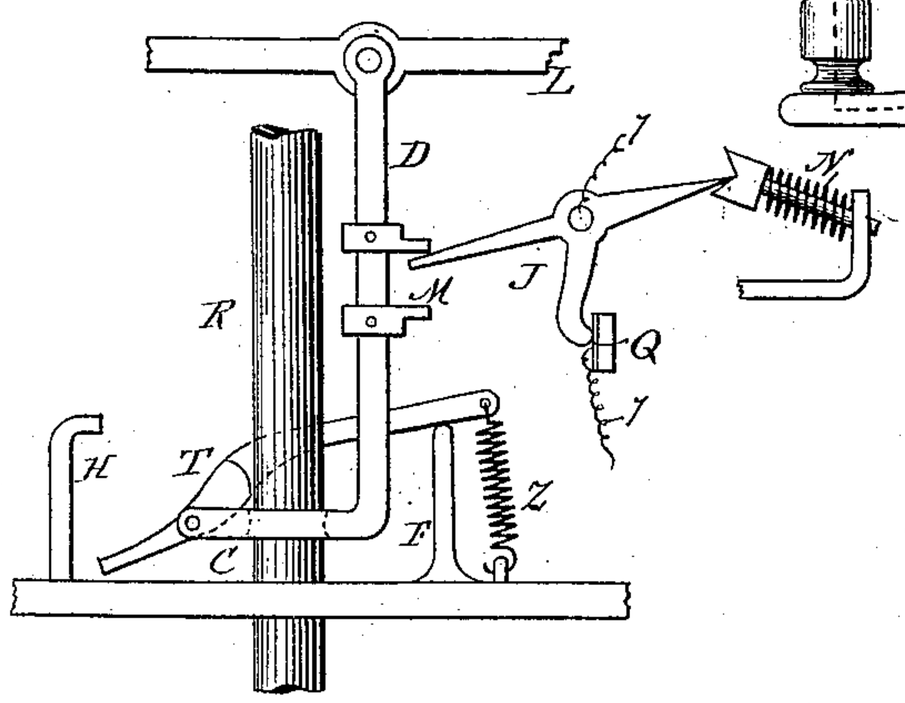
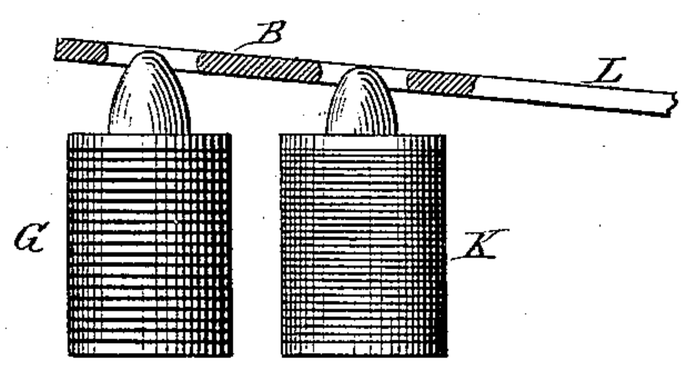


Fig. 2,



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Inventor:
Elihu Thomson
By his Attorney: H. G. Townsend

(No Model.) 2 Sheets—Sheet 2.

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Fig. 4,

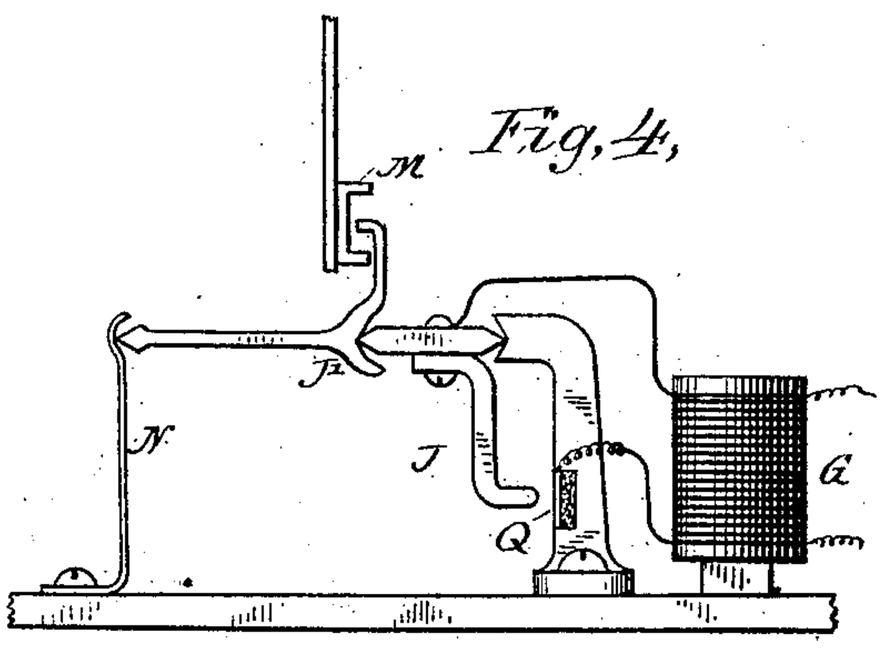


Fig. 5,

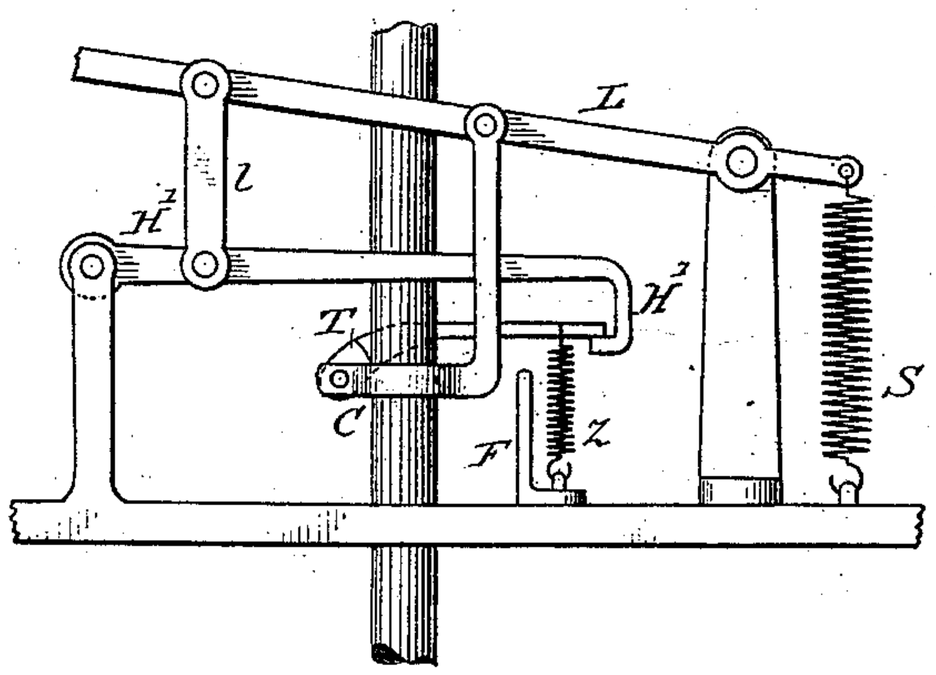


Fig. 6.

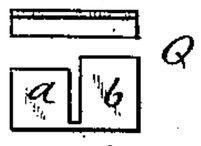


Fig. 7,

Fig. 8,

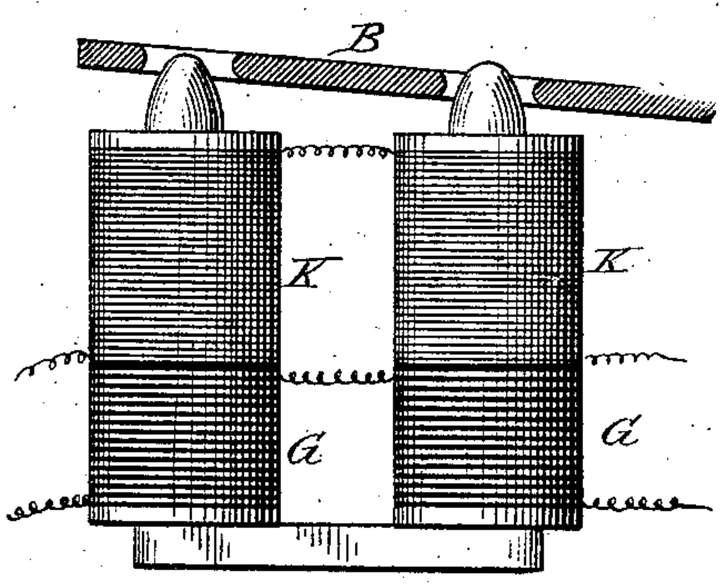


Fig. 9,

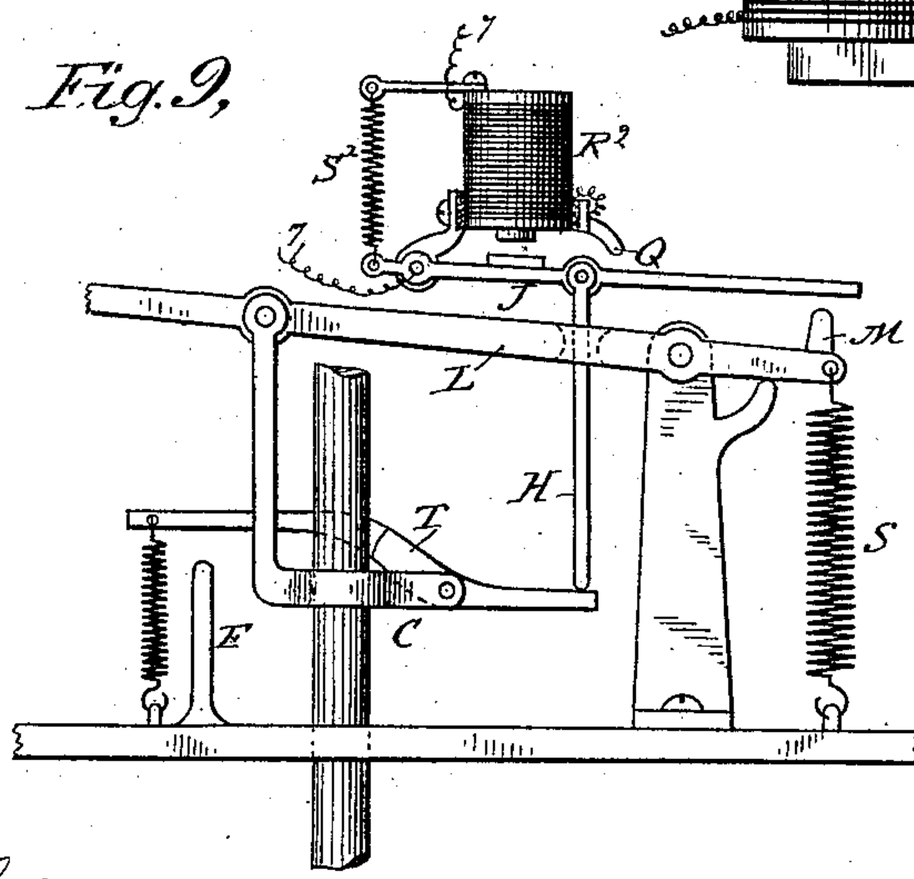
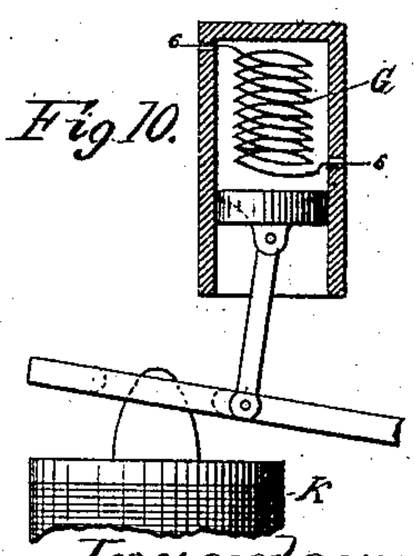


Fig. 10.



Witnesses:

Ernest Abshagen

Thos. Toomey.

Inventor;

Elihu Thomson

By his Attorney: H. L. Townsend

UNITED STATES PATENT OFFICE.

ELIHU THOMSON, OF LYNN, MASSACHUSETTS, ASSIGNOR TO THE THOMSON-HOUSTON ELECTRIC COMPANY, OF CONNECTICUT.

ELECTRIC-ARC LAMP.

SPECIFICATION forming part of Letters Patent No. 297,195, dated April 22, 1884.

Application filed January 4, 1884. (No model.)

To all whom it may concern:

Be it known that I, ELIHU THOMSON, a citizen of the United States, and a resident of Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Electric-Arc Lamps, of which the following is a specification.

My invention has for its object the production of a simple and effective arc-lamp, in which the proper feed movements of the carbons shall be controlled by the action of a derived-circuit coil or magnet of high resistance working in opposition to or combination with a spring or other suitable retractor.

My invention relates more especially to means for starting the lamp into action by the provision of a coil or magnet in the carbon-circuit, which shall supplement or assist the derived-circuit magnet in bringing the feed or governing mechanism of the lamp into proper operative position at the instant the current is turned on, and shall immediately thereafter be shunted or cut out of circuit and held out, so that the operation of adjusting and feeding the carbons may proceed under the joint control of the high-resistance magnet and its retractor without the assistance or intervention of said starting or auxiliary coil in the main circuit with the carbons.

My invention also consists in the combination, with the mechanism of an electric-arc lamp in which feed of the carbons is produced by the increase of magnet-power in a derived-circuit magnet, of auxiliary releasing devices which, in the retracted position of the magnet's armature, will permit the carbons to run together, means actuated by the first flow of current for adjusting or bringing the mechanism controlled by the derived-circuit magnet into proper feed-regulating position, and suitable cut-out or neutralizing devices, whereby, after such adjustment has been brought about, said means may be rendered inoperative and retained in such condition, so that the operation of the lamp may go on by the controlling action of the derived-circuit magnet only.

My invention consists, further, in certain combinations and details that will be hereinafter described, and then pointed out in the claims.

The auxiliary or starting coil or magnet may act directly upon the armature for the derived-circuit magnet, so as to assist the latter in drawing the armature from its extreme retracted position, and may be, as I have hereinafter shown, a separate magnet, or said coil may be wound upon the same core with the derived-circuit coil. The auxiliary coil, according to the arrangements herein described, is in a circuit closed by the contact of the carbons. It is automatically cut out by a suitable switch device or circuit-controller acted upon when the derived-circuit armature shall have moved the lamp mechanism into normal or feed-regulating position, and the cut-out devices are of such construction that said coil remains cut out despite the movements made by said armature in controlling the carbons, so that the usual operations may take place under the control of the derived-circuit magnet without the intervention of said auxiliary coil. Said cut-out devices may be worked or brought into action by the movement of the derived-circuit armature, or by any other devices whose movement is so timed or controlled as to cut out the coil or magnet or otherwise render it inoperative when, through the assisting action of said coil, the feed-controlling mechanism has been brought to such a point that the proper adjustment and feed of the carbon may be intrusted to the conjoint action of the derived-circuit magnet and its retractor. This point is ordinarily the point at which a feed of the carbons would be permitted if they were separated and free to move. The auxiliary coil may be kept out of circuit or inoperative by any suitable device, mechanical or magnetic. I have herein shown and claimed a mechanical trip device for this purpose; but other devices may be employed, and I have described and claimed in another application magnetic devices. The feed-regulating mechanism of the lamp herein shown is not only released when the derived-circuit magnet acquires a predetermined strength, owing to increase in the length of arc, and overcomes its retractor, but also when said armature is retracted to its extreme position. The release in the latter position permits the carbons to run together, and thus provides a circuit at starting whereby the auxiliary coil or other device may be energized. Such release may

be effected by any suitable device, but preferably by an auxiliary stop or detent. The mechanism or the stop as well as the mechanism may be moved in bringing the lamp into operative condition. I have shown both methods, but do not limit myself in this respect, the essence of the invention, so far as this head is concerned, consisting in arranging the parts or providing any suitable means whereby the feed mechanism may be released in the retracted position of the derived-circuit armature before starting of the lamp, bringing the mechanism into operative position when the current is turned on, and then leaving the lamp to the sole control of the derived-circuit magnet and its retractor.

Having explained the general principles of my invention, I will proceed to describe some of the devices that may be used and some of the forms that the apparatus may take in practice.

In the accompanying drawings, Figure 1 is an elevation of a lamp constructed in accordance with my invention. Fig. 2 illustrates a modification of the magnetic arrangements. Fig. 3 illustrates the position of the mechanism when the lamp is in operation. Fig. 4 is a modification of a switching or circuit-controlling device. Fig. 5 shows a modification of the releasing devices for the feed mechanism. Figs. 6 and 7 show in detail approved forms of switch-contacts. Fig. 8 shows a form of the lamp-magnet. Fig. 9 shows another arrangement and construction of the switching devices and of the detent or releasing devices. Fig. 10 illustrates a modification.

K indicates a coil of high resistance in a derived circuit around the carbons, and acting by means of a core and armature, B, upon a lever, L, in opposition to a retracting-spring, S, or other retractor. These parts are of any desired constructions, and are designed to control the position of the carbons in any usual way. The armature may be a perforated armature, and the pole end of the core conoidal, as shown, and as described in a patent already issued to me, for the purpose of giving a uniform magnetic pull in all positions of the armature for the same strength of current. The parts might be otherwise constructed or arranged to give the same result. The above is the preferred construction.

The lever L, through a link, D, or otherwise, gives motion to a feed-controlling mechanism of any desired kind—such, for instance, as a clamp or clutch properly arranged to raise the carbon when the retractor S prevails, and to permit a release of the carbon when, through an increase of arc length, the coil K receives an increased proportion of the current, and its magnetic effects consequently prevail over the retractor. I have herein shown the lever as acting on a clutch or clamp such as is contained in prior patents granted to me, and consisting, briefly, of a clamp or clutch body, C, through which the carbon or carbon-carrier R passes, and a clamping toe or jaw, T, pivoted on the body C, and normally held by a spring, Z, against the carrier or carbon, so as to prevent the same from moving downward through the body C.

F is the usual releasing-stop, arranged in the path of an arm extending from the toe T, so as to release the latter and permit the carbon to feed when the magnet or coil K is sufficiently energized, owing to increase in the length of arc.

H is an auxiliary stop arranged in the path of the clamp or clutch, to permit a release of the carbon when the armature B and lever L are drawn back or retracted to an abnormal extent in the opposite direction by the spring S. The stop H is placed at such a point that during ordinary or normal movements of L in adjusting the carbons the stop will not strike it; but when the current is turned off and the retractor pulls the lever to its extreme position the clamp is released by H, and remains released, so that at again starting the lamp the carbons will be in contact.

G indicates the auxiliary or starting coil, wound in the present case upon the same core with K, and preferably in the same direction, so as, when current flows in it, to assist the coil K in pulling the lever L down into proper position to start the lamp. The coil G might be on a separate core, as indicated in Fig. 2, and act upon the same armature or another armature connected to L, or other device controlling the feed mechanism.

The combination, with the derived-circuit coil, of an auxiliary or starting coil wound on the same core therewith is claimed in an application for patent filed by E. W. Rice and myself as joint inventors January 3, 1884, No. 116,300.

The magnet formed by the core of coils K and G might obviously be a horseshoe-magnet, as indicated in Fig. 8. The coil G is in a circuit, 6, with the carbons, as indicated, while the derived circuit of coil K is indicated by the numeral 5, which is a circuit around the carbons, as is obvious. The positive and negative conductors of the main circuit are indicated by X Y.

Coil G may be shunted by a switch or circuit controller, J, of any suitable construction, that, when in the position shown in Fig. 3, completes a shunt of low resistance, 7, around said coil. When the shunt is closed, the coil is ineffective, as is obvious. Its circuits may be controlled in any other desired manner to render it inoperative or ineffective. Many such ways will readily occur to electricians, and need not be set out in detail. Switch J is in Fig. 1 actuated or controlled by two lugs or projections, M, on the link D or other portion of the devices moving with L, the upper of which projections is suitably placed to throw J into the position shown in Fig. 3 when the link moves downward from its extreme retracted position under the influence of the auxiliary coil G. The lever J is held in such position by the action of the spring N bear-

ing endwise against an arm of J and in line with its fulcrum, so that it may act in angle upon the arm and hold J either in the position shown in Fig. 3 or in that shown in Fig. 1. The upper lug, M, is placed so as to cause the contacts Q to close and shunt coil G at or near the time when, in the downward movement of the clutch, the toe T impinges against the stop F and is released from the rod R. When this occurs the core of G and K decreases in magnetic strength, and the retractor S then acts and raises the clutch, so as to separate the carbons and form the arc, the amount of separation depending in the adjustment of the parts, and the upward movement continuing until there is a balance between the effects of coil K and of the spring or retractor S. The stop H is placed above the upward range of the clutch in the ordinary carbon adjusting and feeding movement, and, as already explained, only comes into play on an extreme movement of the lever L under the influence of its retractor. The lower lug or projection, M, is placed at such point that it will only act on the switch J to throw it to the position shown in Fig. 1 when the lever L is retracted to an extreme position. In moving to such position, which is the position shown in Fig. 1, the lower lug, M, strikes the lever or switch and carries it upward, the spring N acting to throw the contacts Q wide open when the arm against which the spring acts passes the horizontal, and to afterward hold them open until the coil G again acts. The spring N acts in the same manner to throw and hold the lever on downward movement of L at starting the lamp.

Fig. 1 shows the position of the parts when the lamp is out of action and no current is passing. The contacts Q are open, the clutch released by stop H, and the carbons in contact. When current is turned on, the coil G acts strongly upon the core and pulls down lever L until the clutch is brought to the ordinary or feed-regulating position or plane, and when the stop F is reached the circuit-controller J is operated and the coil G is cut out, remaining out until the lever is drawn back to its extreme position. The carbons are now left to the sole control of the coil K, and the adjustment and feed proceed in the well-known and ordinary manner.

In Fig. 4 is shown a modified construction of the shunting-switch or trip device J, made with knife-edge bearings, so as to give it increased sensitiveness to the action of the lugs M. The lugs M act on an intermediate piece, J′, held between a spring, N, and an arm projecting from J. The spring N acts, as in Fig. 1, to throw the lever J when its arm passes the horizontal line, and to hold it in either of its two positions, with the contacts Q open or closed. In the arrangement shown in Fig. 5 stationary stop H is replaced by a stop-lever, H′ H′, actuated by the lever L through a link, *l*, in such manner as to release the jaw T of the clutch upon a determinate upward movement of L. This is effected by giving to the releasing end of H′ a greater movement than that given to the clutch with a given traverse of L. The construction by which this is effected is obvious from an inspection of the figure.

The contacts Q are preferably rubbing contacts, and are best made double or treble. In Figs. 6 and 7 they are shown slit and made in two parts, *a b*, which do not make contact simultaneously. By such construction they are kept effective and always secure a good connection, since whatever spark is formed occurs at *b*, while *a* remains always in good order. *b* is the first to make and last to break.

Instead of a spring or mechanical device for keeping the circuit-controller or switch closed while the lamp is in action, I may employ a magnetic device such as shown in Fig. 9. This device and equivalent devices embodying an electro-magnet for acting on the switch to keep the starting-circuit through the coil in the carbon-circuit closed are described and specifically claimed in my application for patent filed January 4, 1884, No. 116,406. This figure also shows an arrangement whereby the stop H may be kept out of range of the clutch during the operations of the mechanism in feeding and adjusting the carbons. In this case I place an electro-magnet, R^2, of low resistance in the shunt closed by the switch J. This magnet acts on an armature carried by J, and holds the contacts Q together. The switch is primarily operated, as in Fig. 1, by the movement of the lever L, under the influence of coil G, from its extreme retracted position. A projection, M, on the lever L raises the lever J, and the magnet R^2 holds the lever, after contact is established at Q, until current is withdrawn from the lamp or ceases to flow through the carbons, whereupon the lever J drops back and opens the shunt, ready for the next operation. The lever J also controls the position of the stop H, and, by raising the same when the contacts Q are closed, removes said stop out of the ordinary range of the clutch in controlling the feed, so that said stop cannot release the clutch. After the lamp ceases to operate, the stop is lowered, and is in position to release the clutch on retraction of the armature.

Instead of employing the magnetic effects of the current in the starting-circuit, I may make use of other electromotor effects, and may therefore use the heat developed by the current in the starting-circuit through any thermostatic arrangement to move the lever L. Such an arrangement is illustrated in Fig. 10, where the coil G is a resistance-coil placed in a cylinder containing a gas or liquid expansible by heat, and acting through a piston to impart movement to the lever. The circuit of the coil may be the same and be controlled upon the same principle as those of coil G in other figures.

What I claim as my invention is—

1. The combination, in an electric-arc lamp, of a derived-circuit coil or magnet of high resistance, feed-regulating mechanism controlled

thereby, and released upon an extreme reverse movement of the magnet core or armature, as well as upon a forward movement thereof in the normal operation of the lamp, and means for assisting the derived-circuit magnet in bringing the feed mechanism into normal operating position, as and for the purpose described.

2. The combination, in an electric-arc lamp, of a feed mechanism and derived-circuit magnet controlling the same, a starting or assisting coil in the circuit with the carbons, and means for rendering said coil inactive and holding it out of action while the carbons are burning, as and for the purpose described.

3. The combination, in an electric-arc lamp, of a starting-coil in the circuit through the carbons, releasing devices to permit the carbon to descend freely when the lamp is out of action, and a switch or circuit-controller for rendering the starting-coil inactive as soon as the lamp begins to burn, as and for the purpose described.

4. In an electric-arc lamp, the combination, with the feed mechanism, of means for permitting a release of the carbon both when the feed-controlling armature is attracted and when it is retracted, as and for the purpose described.

5. In an electric-arc lamp, the combination of a derived-circuit magnet of high resistance around the carbons, a starting coil or magnet in circuit with the carbons when the lamp is out of action, and a switch or circuit-controller for shunting said coil when the lamp is started and holding it cut out so long as the lamp shall continue in operation.

6. In an electric lamp, the combination, with a derived-circuit magnet and feed-regulating mechanism released to produce a feed when the magnet's strength increases with an increase of arc, of auxiliary releasing devices which permit the carbon to feed when the magnet is de-energized, devices for bringing the feed mechanism at starting into normal or operating position to lift the carbon and form the arc, and means for throwing said devices out of operation, whereby the feed mechanism may be left to the control of the high-resistance derived-circuit magnet.

7. The combination, in an electric lamp whose carbons are normally or at the start in contact, of a derived-circuit magnet of high resistance in a branch around the carbons, feed mechanism controlled thereby, a starting coil or magnet in circuit with the carbons, to assist the derived-circuit magnet in starting the lamp, and a switch or circuit-controller for shunting said coil and holding it shunted, so that the lamp may operate under the control of the derived-circuit magnet independently of said coil.

8. The combination, substantially as described, of a derived-circuit magnet, a feed mechanism having an auxiliary stop or detent for permitting the carbons to come together when the magnet-armature is abnormally retracted, as well as when it is drawn forward by the increase of current in the derived-circuit magnet, a coil or magnet in circuit with the carbons for assisting the derived-circuit magnet, and means for shunting said coil when the feed mechanism has been moved to a predetermined point.

9. In an electric-arc lamp whose mechanism is controlled by a derived-circuit magnet only in the feed-controlling operation, the combination of a starting-circuit, a circuit closer or controller actuated by the magnet-armature in its movement to extreme position, and a spring bearing on said circuit-closer, so as to act upon it at an angle in either of its positions, and to thus hold the contacts open or closed independently of the lever when moving in a limited range.

10. The combination, in an electric lamp, of a derived-circuit magnet, a clamp or clutch controlled thereby, stops or detents for releasing the clutch at either extreme of movement, a coil or magnet for assisting the derived circuit-magnet at starting, and means for automatically preventing an operative flow of current in said coil when the derived-circuit-magnet armature has been moved to a predetermined point.

11. The combination, in an electric lamp, of a derived-circuit magnet whose coil is in a branch of high resistance around the carbons, a starting-coil wound on the same core with said derived-circuit coil and in circuit with the carbons, and a switch or circuit-controller for controlling or cutting off the flow of current in said latter coils, whereby, after the lamp is started, it may be left to burn under the sole control of the derived-circuit coil.

12. The combination, in an electric lamp, of a clamp or clutch and two releasing-stops for the latter, arranged in the manner described, to release the carbon or carbon-carrier in either of the extreme positions of the clutch.

13. The combination, in an electric lamp, of the clamp or clutch having the clamping toe or jaw T and two stops, arranged in the manner described, to release the toe on an upward or downward movement of the clutch to a determinate extent.

14. The combination, in an electric lamp, of a high-resistance derived-circuit feed-regulating magnet, an auxiliary coil in circuit with the carbons for moving the feed-regulating mechanism to a point from which, when retracted, it may raise the upper carbon, and means for automatically shunting said coil and holding it shunted, so that the operations of forming the arc and controlling the feed may progress under the control of the derived-circuit magnet only.

Signed at Lynn, in the county of Essex and State of Massachusetts, this 21st day of December, A. D. 1883.

ELIHU THOMSON.

Witnesses:
E. WILBUR RICE,
HARRY B. ROGERS.