(No Model.) 2 Sheets—Sheet 1.

E. THOMSON.

ELECTRIC ARC LAMP.

No. 493,739. Patented Mar. 21, 1893.

Fig. 1

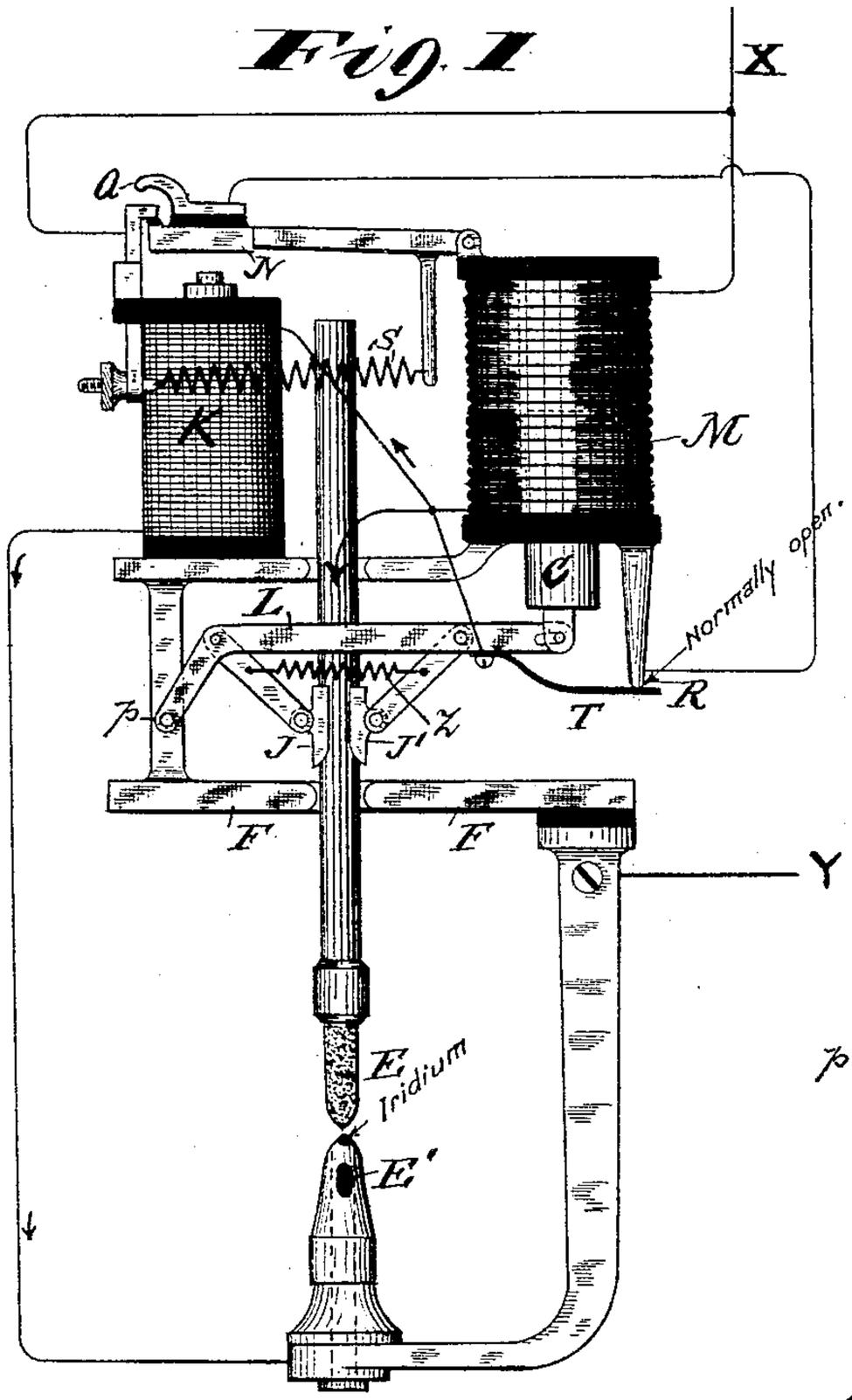


Fig. 2.

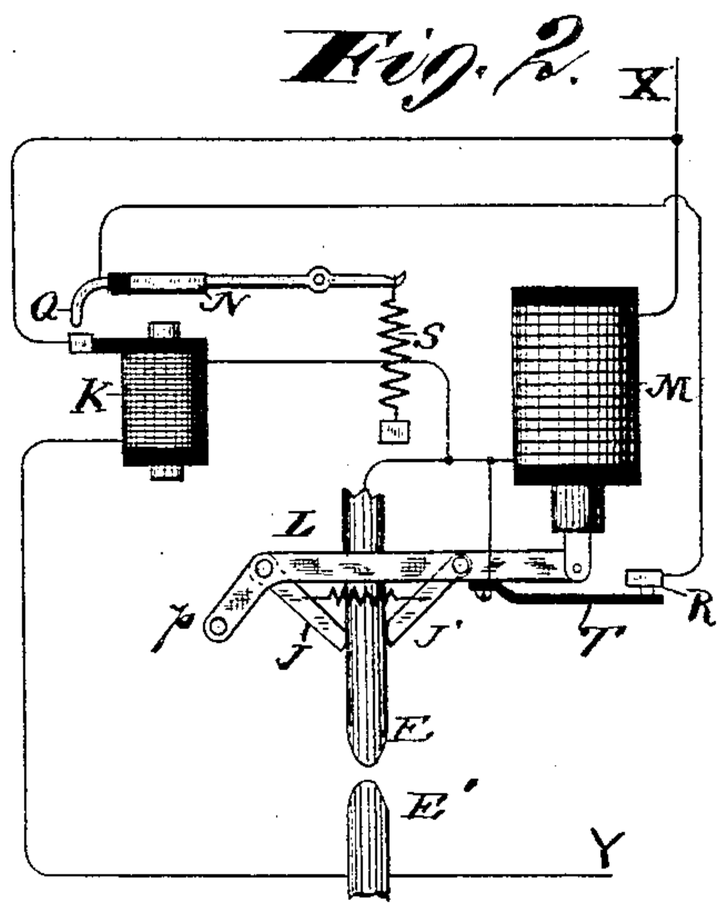


Fig. 5

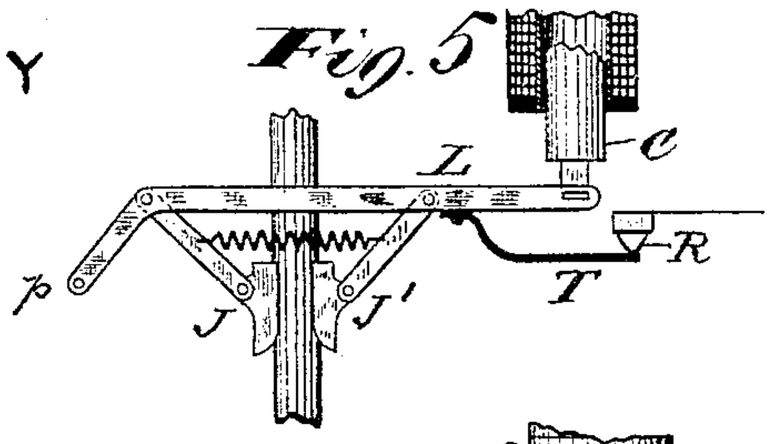


Fig. 6.

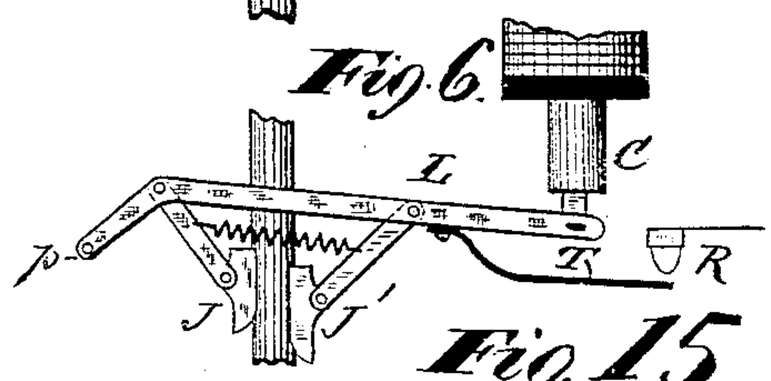


Fig. 3.

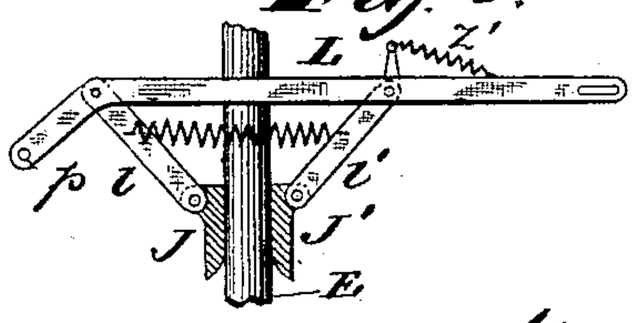


Fig. 15.

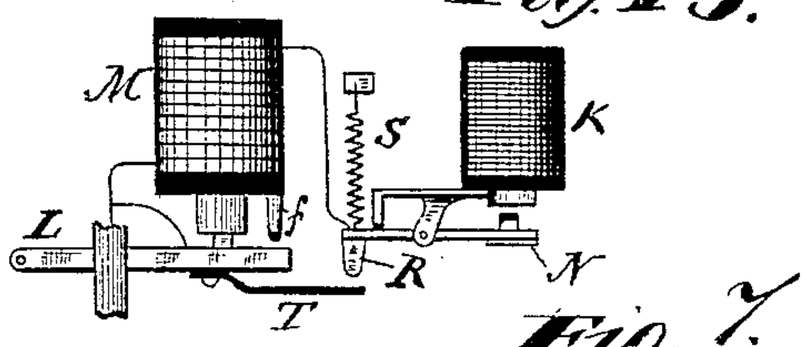


Fig. 4.

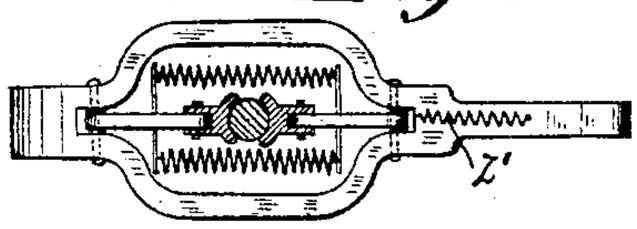
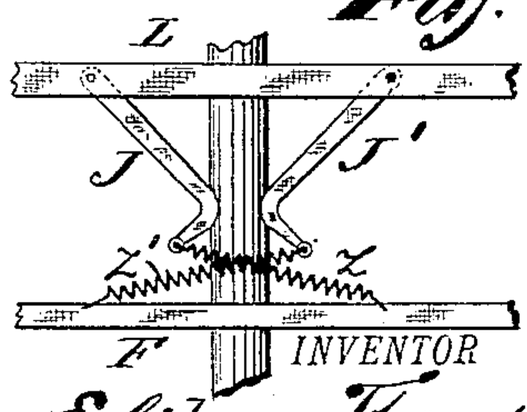


Fig. 7.



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Wm. H. Capel.

INVENTOR

Elihu Thomson.

BY

H. B. Townsend

ATTORNEY

(No Model.) 2 Sheets—Sheet 2.

E. THOMSON.

ELECTRIC ARC LAMP.

No. 493,739. Patented Mar. 21, 1893.

Fig. 8.

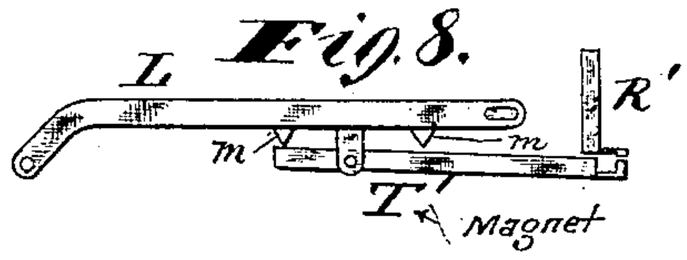


Fig. 9.

Fig. 10.

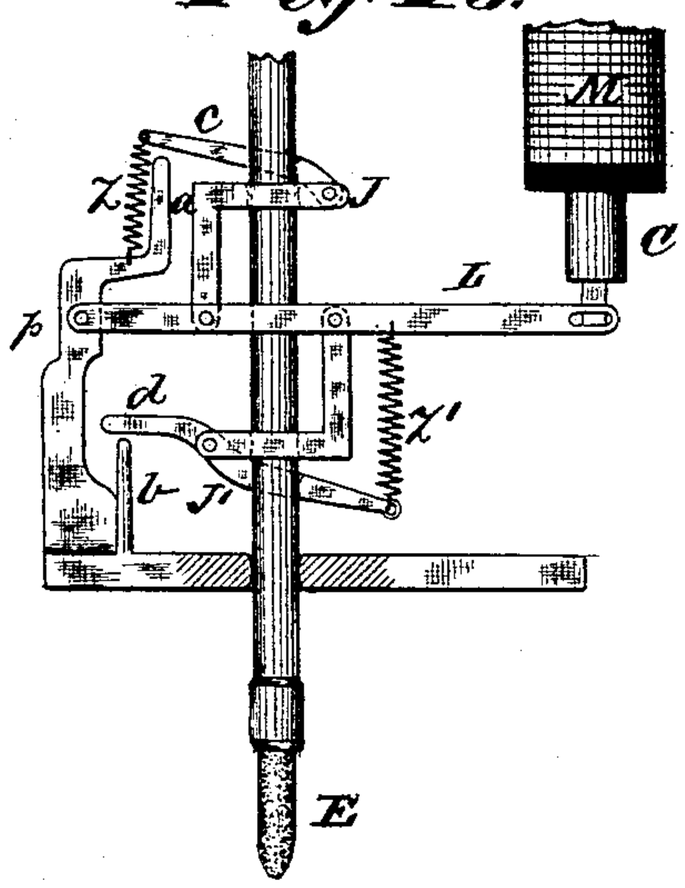


Fig. 11.

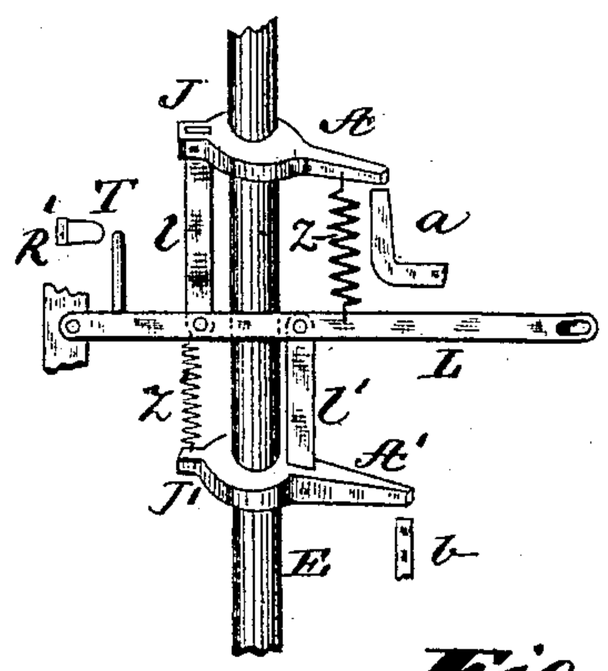


Fig. 12.

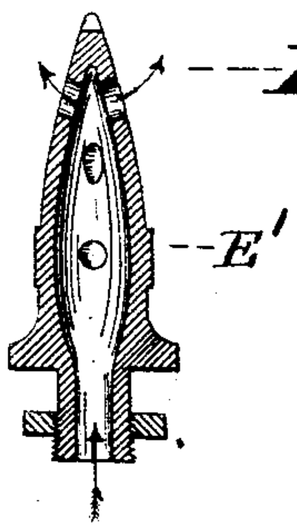


Fig. 13.

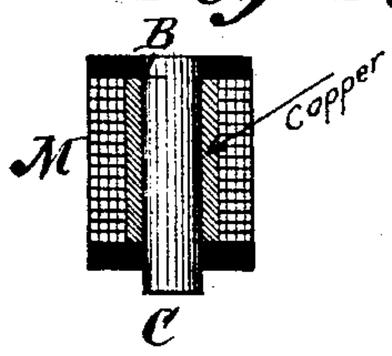
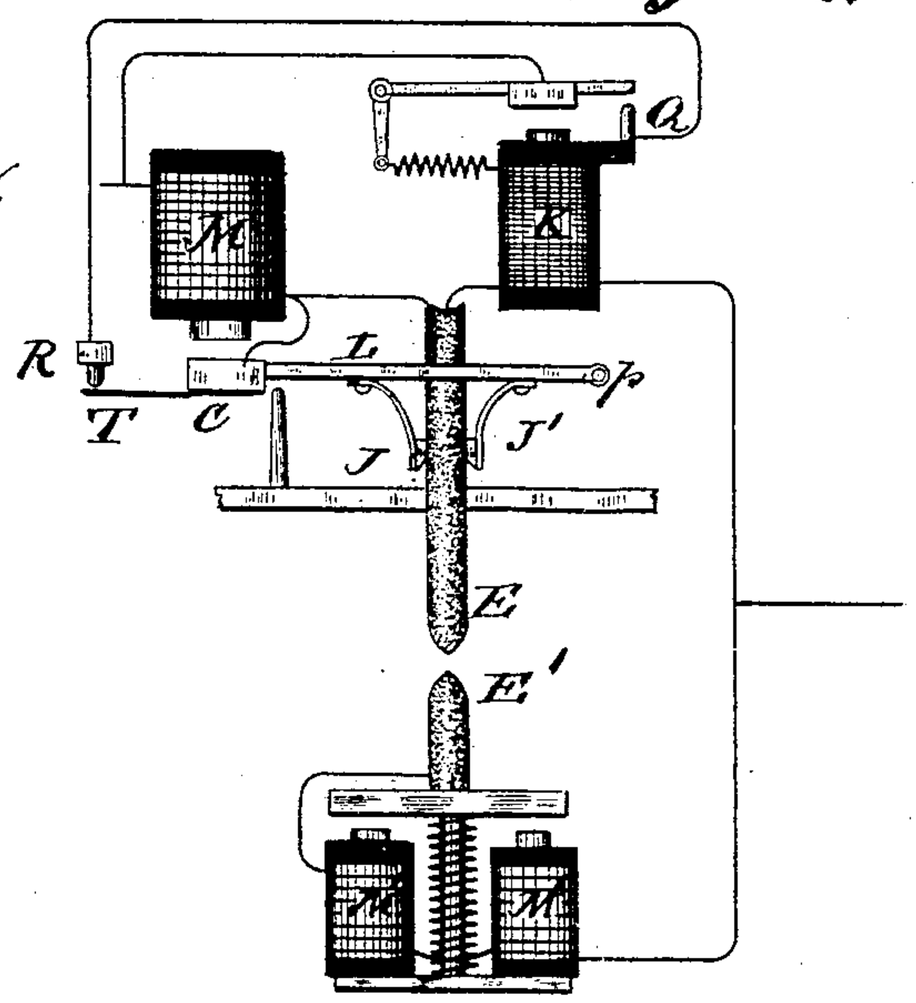


Fig. 14.



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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. 493,739, dated March 21, 1893.

Application filed June 30, 1886. Serial No. 206,676. (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 a certain new and useful Electric-Arc Lamp, of which the following is a specification.

My invention relates to certain improvements in electric arc lamp mechanism designed to render the lamp more efficient in action in feeding the carbons, cheaper to construct, and easier to adapt to varied conditions of working.

My invention relates more particularly to means for imparting a step by step feed movement to the carbon to compensate for consumption.

The invention consists also in a novel means for imparting first, a lifting movement to the carbons for the purpose of forming the arc and then by the same mechanism producing an intermittent step by step feed movement each of whose steps may be of any desired length.

In some of its features my invention may be regarded as an improvement upon that shown in United States Patent No. 256,605, dated April 18, 1882, inasmuch as it embodies feed clamps or clutches having a difference in their range of movement, which clamps or clutches are controlled by a lifting and feeding magnet placed in the main circuit and periodically cut out of circuit by means of a shunt or derived circuit to the arc, when a feed of the carbons is required to take place. The improved lamp however forming the subject of my present application contains an improved differential clamp movement and also involves the employment of a second switch contact in the branch of circuit by which the main circuit magnet is cut out or de-energized. Such second contact is designed to interrupt such cut out branch or de-energizing circuit intermittently, and is preferably operated by the main circuit magnet itself.

I will first proceed to describe a lamp constructed in accordance with the above principles and embodying in addition other features of advantage to the general operation of the lamp, but which are sometimes dispensed with, and will then in the claims more particularly recite the novel combinations and features constituting the invention.

In the accompanying drawings illustrating a lamp containing the invention herein claimed; Figure 1, is a side elevation of the lamp. Fig. 2, is a diagram of the circuit connections. Fig. 3, is a side elevation of differential feed clamps or clutches for the carbon rod or holder. Fig. 4, is a plan view of the same. Figs. 5 and 6, show the differential clamps or clutches in the two positions which they assume during action. Fig. 7, illustrates in side elevation a modified form of the clamps. Figs. 8 and 9, illustrate modified forms of contact devices. Fig. 10, illustrates in side elevation a modification in the feeding clamps, designed to secure additional advantages. Fig. 11, shows a modification similar in its operation to that of Fig. 10. Fig. 12, is a longitudinal section of a lower or negative electrode adapted for use with currents of small volume. Fig. 13, is a longitudinal section of the feed magnet connected to the feeding clutches. Fig. 14, illustrates a modification in which a separate magnet is used for forming the arc. Fig. 15, illustrates a modification in the manner of mounting and arranging the two contacts which control the shunt or de-energizing circuit of the feed magnet.

Referring to Fig. 1, E, indicates the positive or upper carbon or electrode, which may either be clamped to a carbon supporting rod as usual in the art, or may itself be fed directly through the clutches, the carbon holding rod being dispensed with.

J, J′, indicate clamp shoes or clutches of any desirable material pressing against the carbon rod or holder at opposite sides thereof in substantially the same transverse line. The shoes or clutches are connected to their operating lever L, by links as shown attached to the lever at different points from the fulcrum *p*, thereof, borne by the frame of the lamp. The clutches are pressed against the rod by the action of a spring *z*, uniting the links. By this construction the clamp shoes or clutches are given a different range of movement on the rise and fall of the lever produced through the action of an electro magnet M, which is provided with a movable

armature, or a core C, connected to the lever, so that, when the lever is raised by the action of coils of the magnet, the clutches will be raised and move the carbon rod upward.

The magnet M, has its coils in the circuit of the lamp as indicated from the point X, to the carbon holder and arc.

K, indicates a derived circuit magnet of any suitable construction placed in a branch or derived circuit around the arc and serving to control the position of a switch contact Q, which is carried by the armature N, of the electro magnet and is suitably arranged with reference to a contact stop so that, when the armature is moved by the power of the magnet, the contact will close circuit.

A retractor S, for the armature lever of the derived circuit magnet is suitably adjusted so that, unless the resistance of the arc slightly exceeds the normal, the contact will not be pulled down to close the circuit.

The contact Q, serves as one of the contacts controlling a branch or de-energizing circuit for the electro magnet M, so that when the contact is closed, the magnet M, will lose its power and its armature L, will fall back. This de-energizing circuit is here shown as consisting of a branch around the electro magnet M, which can only be completed when the lever L, is raised. In this branch or shunt path is interposed a second contact indicated at T, which is carried by the lever L, or is otherwise arranged so that, when the lever L, is lifted, the shunt branch or circuit may be completed if at the same time the contact Q, is closed, and when depressed by the falling back of the lever, the shunt or de-energizing branch shall be open. For the purpose of closing the branch the contact T, makes connection with a suitable stop R. One of the contacts, as for instance contact T, is so mounted as to be a yielding or movable contact capable of movement independently of the armature lever, the effect being to permit the armature to move a little distance after contact is established, and on its reverse movement to move slightly before contact is broken. The contact is preferably made as a spring. By this device the operating lever is permitted to have a range of movement beyond that necessary for merely opening and closing the contact.

Instead of providing a separate stop for each of the two contacts T, Q, as shown in Fig. 1, each contact may form a stop for the other with the same resultant effect, as illustrated in Fig. 15. In this instance the contact R is moved by the magnet K, through a very limited range, while the contact T, is moved upward toward the stop or contact Q, through a range limited by a stop *f*. When the armature N, of magnet K, is retracted by a spring S, the contact Q, is held in position where the contact T, cannot reach it so as to close the branch or de-energizing circuit, but when the magnet K, overcomes the retractor, the contact Q, is drawn down so as to close circuit on the contact T, until, through the action to be presently described, the feed has been sufficient to permit the retractor S, to again draw the contact Q, out of range of T, thus breaking the de-energizing circuit and permitting the magnet M, to hold the lever L, up.

The lower electrode E′, may be of carbon, or in some cases as where very small currents are used it may consist of a cone of copper tipped with an iridium point which does not waste during burning of the lamp.

The circuits of the lamp will be readily understood from the diagram. The connections are made by any desired devices.

Entering at X, the current divides, one portion passing through the coils of M, to the carbon rod or holder and through the arc to the point Y. A very small fraction of the current passes around the arc through the high resistance of the coils in magnet K. When the contacts T, Q, are closed a portion of the current flows in a branch around the coils of magnet M, re-uniting with the current which flows through the latter. When no current flows, the branch circuit is open at the contact T, because the lever L, is down. The clutches J, J′, are depressed and the carbons are in contact, the armature N, is retracted and the contact Q, is open. When current passes, the electro magnet M, is energized inasmuch as its de-energizing circuit is open and lifts the lever L, thus raising the clamps or clutches J, J′, but at different rates. The spring Z, holds the clamps against the carrier with sufficient friction to enable them to lift the carbon E, so as to form the arc. As the lever L, and the armature, or core C, continue to rise, the contact T, closes circuit at its stop with an elastic pressure, the spring T, bending slightly so as to allow the core and lever to rise somewhat beyond the point of closure. This action does not shunt the magnet M, inasmuch as the contact at Q, is still open. The arc now burns until its resistance is sufficient to cause the magnet K, to close the contact Q, by which action the magnet M, is shunted or weakened owing to the establishment of the de-energizing circuit through the contact Q, and the contact T. The core C, now falls away allowing the lever L, to move downward carrying with it the clutches J, J′, the clutch J′, moving downward faster than clutch J, owing to the fact that it is connected to the lever at a greater distance from its fulcrum. If now the clutch J, be suitably constructed to have a greater friction or bite on the carbon holder it will move the rod downward past J. In most cases the friction or bite of the two clutches may be equal if the weight of the carbon holder is considerable, but otherwise the clamp J′, should be given a greater bite which may be accomplished readily by making the spring pressure holding it against the rod greater, or constructing it so that it shall have a greater surface in contact with the rod. The same

result will be accomplished by making the surface of J′, from a material having greater friction on the rod, or by connecting it with the lever through a link applied in such way as to bear upon the clutch more nearly at a right angle. In any such case the rod will be fed downward, the adjustment being made such that a vibratory movement of the lever L, up and down, will feed the rod through the difference in range of movement of the two clamps in a similar manner to the devices described in United States Patent No. 256,605, before referred to. As soon as the lever L, drops back to a point where the contact T, opens the shunt or de-energizing circuit for the magnet M, the latter is again energized and raises the lever so as to again complete the shunt or de-energizing circuit through closure of contact at T. This action is repeated and continued, giving a vibratory movement to the lever L, as long as the contact Q, remains closed. But as the vibration is attended by a feed of the carbons the arc soon becomes shortened to its normal length and the armature N, is released thus opening contact at Q, so that the next time the lever is lifted to close contact T, the shunt or de-energizing circuit is not established, and the lever L, therefore remains lifted with the contact T, closed, ready for a repetition of the described operation.

In Figs. 3 and 4, an additional spring Z′, is shown connected with the link applied to lever J′, so as to give the latter a greater friction or bite upon the carbon rod. The lower portions of the shoes or clutches J, J′, are preferably tapered outward to permit the carbons to be inserted from below. This construction is also preferably employed where the carbon is fed directly by direct engagement of the clutches or shoes with it.

In Figs. 5 and 6, the effects produced by moving the lever L, are illustrated.

In the modification shown in Fig. 7, the clutches or shoes J, J′, are directly pivoted to the lever L, and have independent springs Z, Z′, connecting them elastically to the frame F, the spring Z, being preferably a little stronger than Z′, especially where the carbon sticks or pencils are to be fed directly.

It is not essential that the contact T, should be a spring contact or that the lever L, may have a movement in excess of that required for simply opening and closing the circuit. Any devices may when found desirable be employed which will suffice to give the lever L, an additional movement beyond that which would ordinarily be attended by simply bringing the contact against its stop and away from the same. For instance a device such as shown in Fig. 8, may be employed for the same purpose. This device consists of a magnet T′, pivoted on lever L, and having a limited free movement at its contact end which movement is determined by suitable stops *m*, *m*, as indicated. The stop R′, forming in this case the contact stop consists of an armature or piece of soft iron that is attracted by the magnet T′. When the lever L, rises, the magnet T′, closes the circuit through the magnetic attraction a little before the lever L, has completed the upward movement allowed to it, and when the lever L, falls away, the magnet T′, hangs to R′, until the left hand stop *m*, takes up all play of the lever T′, and pulls it off of the stop R′. Another equivalent device adapted for employment in the same way is indicated in Fig. 9. In this case T, is a blade spring bearing a very small electro magnet *t*, which is put into circuit when it closes upon the stop R′, during upward movement of the lever L. The contact and its stop are thus held together, R′, being of magnetic material, and the spring T, upon the descent of the lever L, being held at its free end is bent until a stop V, carried by the lever bears upon it and forces the contact off of its stop.

In Fig. 10, I have shown clamps or clutches which are preferably employed where the clutches are required to work upon the carbon holding rod of metal. These clutches are so arranged that when lever L, is completely down, the carbon rod or holder shall be entirely free to descend by gravity. The clutches herein shown consist of a clutch body embracing the carbon rod and supported upon or pivoted to the lever L. Hinged to the clutch body is a clamping jaw or lever having an extended arm to which a spring is connected in such way as to tend to make the jaw bite upon the rod. A fixed stop arranged in the path of the arm releases the jaw from the rod when the clutch body is moved in the proper direction. These clutches are of the same general construction described in many prior patents granted to me. The upper clutch J, as shown, is connected to the lever L, near its pivot or fulcrum *p*, while the lower clutch J′, is connected to the lever at a greater distance from the fulcrum. The lower clutch J′, is however inverted in position as shown. A spring Z′ tends to close the pivot jaw or clutch upon the rod, while an extension *d*, from the clutch lever is arranged so as to engage with a stop *b*, and open the clutch when it is depressed. A similar stop *a*, serves to open the upper clutch J. When the lever L, is down in its lowest position the clutches are both opened by their respective stops *a* and *b*, but when the lever is raised the clutch levers are moved away from their stops and the springs Z, Z′, cause the clutch jaw to grip the carbon rod or carrier. It is plain that in this movement the clutch J, will have the advantage of grip due to the fact that the weight of the rod tends to pull its clamping jaw against the rod, while in the case of the clutch J′, whose clamping jaw is inverted, there is no such tendency. The range of the clutch J, will therefore determine the extent of lift, if the spring Z′, be so weak as not to give the clutch J′, a greater bite during such upward movement.

The clutches must be constructed to act by

friction only, and not to jam tightly. This is secured by constructing the clamping jaws so that they shall bear on the rod not too near the point where a horizontal line, drawn from the fulcrum of the jaw strikes the rod, that is to say, the line drawn from the pivot of the clutch to the point where the clutch bears on the rod must make a considerably less angle than a right angle with the axis of the rod. When the lever L, descends, the clutch J′, will move faster, and the spring Z, being made stronger than Z′, the rod will be pulled downward through the clutch J, by the action of the clutch J′, and will be fed as in Figs. 1 and 2, step by step, through the intermittent or vibratory up and down movement of the lever L.

In the modification shown in Fig. 11, the clutches are of the ring clamp type. They must be arranged and constructed so that they shall tilt to a greater extent than is usual in engaging with the rod thereby lessening their bite or grip and permitting the rod to move through one or the other according to the direction of movement required in the operation of raising the rod to form the arc, or of feeding it downward to compensate for combustion of the carbon. A suitable grip or bite of the clutches upon the rod is secured by the springs Z, Z′. The stops *a*, *b*, operate as in the arrangement shown in Fig. 10, to fully release the rod when the lever L, is depressed.

In Fig. 12, the preferred form of lower or negative electrode E′, is shown. This electrode is designed principally for use in cases where it is desired to make it unnecessary to replace the lower carbon where very small currents are employed, such for instance as currents ranging from three to five ampéres. The electrode consists of a hollow body of metal such for instance as copper made preferably conical near its top and terminating in a point of some refractory material, such as iridium. The hollow body has several openings to permit the circulation of cooling currents of air. Its width and external surface are made considerable in order to assist in keeping the electrode cool.

It is sometimes desirable especially where the devices shown in Figs. 8 and 9, are not used, and where the mass of the lever L, and that of the core or armature C, is small, so that they possess little inertia, to render the magnet M, somewhat sluggish in its action, which is done by surrounding its core with a copper band or tube forming a closed circuit conductor. Such closed circuit conductor might be formed of wire or constructed in any other way. The secondary currents developed in this conductor on opening and closing of the de-energizing or shunt branch around the magnet serve to retard the magnetic changes of the core and thus prevent oscillation of the carbon rod. A closed circuit conductor suitable for this purpose is indicated at B, Fig. 13.

The magnet M, may be employed for the purpose of producing the feed, the separation of the carbons to form the arc being effected by a separate magnet. Such an arrangement is illustrated in Fig. 14, where a separating magnet M′, M′, similar to that shown in United States Patent No. 220,508, granted to E. Thomson, and E. J. Houston, is shown as the one for effecting the separation of the carbons by lowering the negative electrode E′, and holding it down during the operation of the lamp. The upper carbon is fed downward by the magnet M, connected with and operating upon clutch devices in the manner already explained.

What I claim as my invention is—

1. The combination in an electric arc lamp, of an electro magnet, a positive-feed clutch mechanism actuated by said magnet and arranged to feed the carbon by positive action on a reverse movement of said magnet's parts due to decrease of power in the same, a circuit closer or controller connected to the circuit of said magnet, a derived circuit magnet for throwing the same into position to put the circuits of the feed magnet into operative condition when the arc increases in length, and a second circuit controller for the feed electro magnet actuated thereby and arranged in the manner described so as to cause the magnet to be de-energized when the armature of the same is raised by the magnet's power, as and for the purpose described.

2. The combination substantially as described of the main circuit magnet and a following or yielding contact which serves in closing and opening a circuit to throw the magnet into and out of action, an operating armature for the contact having a range of movement beyond that necessary to merely open and close the circuit of said magnet, a positive or step by step feed mechanism operated by said magnet, a circuit closer for closing the connections of the contact, and a derived circuit magnet for actuating the circuit closer when the arc lengthens, as and for the purpose described.

3. The combination in an electric arc lamp, of an electro magnet, a feed mechanism operated thereby, a switch contact governed by the magnet for throwing the same into and out of action so as to produce a reciprocating movement of the parts, and a consequent step by step feed, and a closed circuit conducting band or envelope for said magnet.

4. The combination in an electric arc lamp, of a main circuit magnet, differentially moving feed clutches supported thereby, a de-energizing circuit, a contact operated by said magnet and thrown, by the variation of the power of the magnet, into and out of position where the de-energizing circuit may be completed, a second contact, and a derived circuit magnet for moving the same into position for completing the de-energizing circuit when the arc increases in length.

5. The combination with a carbon rod or carrier, of the differentially positively acting

clamps bearing on the carbon rod or carrier at opposite sides thereof and moving positively in the same direction under the action of the magnet or its retractor, said clamps being arranged to engage the carbon rod in substantially the same transverse line.

6. The combination with the carbon rod or carrier, of the two clamping shoes J, J′, bearing against the carbon rod or carrier at opposite sides thereof and moving positively in the same direction under the action of the magnet or its retractor, said clamping shoes being supported at different distances from the fulcrum of the actuating lever, as and for the purpose described.

7. The combination with the carbon rod or carrier, of differentially moving clamps both applied to tend to move the carbon in the same direction at the same time, one of said clamps, to wit: that having the greater range of movement in a direction to feed the carbon having a greater bite or hold upon the carbon or carbon rods.

8. The combination in an electric arc lamp, of a main circuit magnet, a positive-feed mechanism engaging with the carbon carrier and supported by said magnet, a de-energizing circuit, a contact operated by said magnet and thrown, by the variations of the power of the magnet, into and out of position where the de-energizing circuit may be completed, a second contact, and a derived circuit magnet for moving the same into position for completing the de-energizing circuit when the arc increases in length.

Signed at Lynn, in the county of Essex and State of Massachusetts, this 26th day of June, A. D. 1886.

ELIHU THOMSON.

Witnesses:
M. L. THOMSON,
GEORGE J. CARR.